Comprehensive Energy Audit
For

Lime Village Washeteria

Prepared For

Lime Village Traditional Council

August 5, 2016

Prepared By:

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PREFACE

This energy audit was conducted using funds from the United States Department of Agriculture and Rural Utilities Service as well as the State of Alaska and Department of Environmental Conservation. Coordination with the Lime Village Traditional Council has been undertaken to provide maximum accuracy within this audit and to coordinate potential follow up retrofit activities.

The Rural Energy Initiative at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Lime Village Traditional Council, Alaska. The authors of this report are Kevin Ulrich, Energy Manager-in-Training (EMIT); and Collette Kawagley, Engineering Intern.

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted over one site visit in July 2016 by the Rural Energy Initiative of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy conservation measures. Discussions of site-specific concerns, non-recommended measures, and an energy conservation action plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Rural Energy Initiative gratefully acknowledges the assistance of Lime Village Traditional Council President Jennifer John, Lime Village Water Plant Operator Fred Bobby, and Lime Village Traditional Council Bookkeeper Lisa Gusty.

1. EXECUTIVE SUMMARY

This report was prepared for the Lime Village Traditional Council. The scope of the audit focused on the Lime Village Washeteria. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, heating and ventilation systems, and plug loads.

In the near future, a representative of ANTHC will be contacting the Lime Village Traditional Council to follow up on the recommendations made in this report. Funding has been provided by to ANTHC through a Rural Alaska Village Grant to provide the community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2016 calendar year.

Based on electricity and fuel oil prices in effect at the time of the audit, the total predicted energy costs are $17,206 per year; annual predicted energy costs are $10,517 for electricity and $6,689 for #1 Oil. The price per kWh is $1.20 and the price per gallon is $6.40. These predictions are based on the electricity and fuel prices at the time of the audit.

The Lime Village Washeteria is predicted to spend $10,517 for electricity. This includes $3,505 paid by the Traditional Council and $7,012 paid by the Power Cost Equalization (PCE) program through the State of Alaska.

The State of Alaska PCE program provides a subsidy to rural communities across the state to lower the cost of electricity and make energy in rural Alaska more affordable. In Lime Village, the cost of electricity without PCE is $1.20/kWh, and the cost of electricity with PCE is $0.40 /kWh.

Table 1.1: Predicted Annual Fuel Use for the Lime Village Washeteria

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	8,786 kWh	4,772 kWh
#1 Oil	1,045 gallons	978 gallons

Benchmark figures facilitate comparing energy use between different buildings. The table 1.2 below lists several benchmarks for the audited building. More details can be found in section 3.2.2.

Table 1.2: Building Benchmarks for the Lime Village Washeteria

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	110.0	8.25	$11.27
With Proposed Retrofits	95.2	7.13	$7.84
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

Table 1.3 below summarizes the energy efficiency measures analyzed for the Lime Village Washeteria. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.3: Summary of Recommended Energy Efficiency Measures

Priority List – Energy Efficiency Measures							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
1	Other Electrical - Copier	Turn off when not in use.	$887	$50	203.45	0.1	1,605.5
2	Other Electrical - Computer	Turn off when not in use.	$1,169	$200	67.00	0.2	2,109.4
3	Lighting - Artic Entry	Replace with new energy-efficient LED lighting.	$103	$80	14.67	0.8	178.9
4	Lighting - Laundry Room, larger fixtures	Replace with new energy-efficient LED lighting.	$516	$400	14.67	0.8	894.3
5	Other Electrical - Boiler 1 Circulation Pump	Turn off pump during the summer months.	$631	$500	14.58	0.8	1,181.5
6	Other Electrical - Microwave	Unplug microwave when not in use.	$40	$50	9.25	1.2	72.1
7	Lighting - Watering Point	Replace with new energy-efficient LED lighting.	$36	$80	5.17	2.2	64.6
8	Lighting - Exterior	Replace with new energy-efficient LED lighting.	$334	$900	4.36	2.7	669.5
9	Air Tightening	Add weatherization around exterior doors.	$205	$500	3.74	2.4	629.3
10	Other Electrical - Well Pump	Repair pump controls and safety alarm, run pump only when needed. Well pump has been replaced three times in ten years due to faulty controls.	$0 + $1,500 Maint. Savings	$6,000	3.72	4.0	0.0
11	Lighting - Laundry Room, smaller fixtures	Replace with new energy-efficient LED lighting.	$13	$40	3.57	3.2	21.7
12	Lighting - Office Supply Room	Replace with new energy-efficient LED lighting.	$22	$80	3.20	3.6	39.9
13	Lighting - Water Process/Office	Replace with new energy-efficient LED lighting.	$178	$640	3.19	3.6	317.6
14	Lighting - Dryer Plenum	Replace with new energy-efficient LED lighting.	$11	$80	1.59	7.2	19.8

Priority List – Energy Efficiency Measures							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
15	Lighting - Mechanical Room	Replace with new energy-efficient LED lighting.	$22	$160	1.59	7.2	39.5
16	Lighting - Big Bathroom	Replace with new energy-efficient LED lighting.	$8	$80	1.14	10.0	14.2
17	Setback Thermostat: Process Rooms	Install a programmable thermostat and implement a Heating Temperature Unoccupied Setback to 60° F for the Process space.	$79	$1,000	1.04	12.7	241.8
18	Heating Ventilation and Domestic Hot Water	Train operator on boiler cleaning, repair timer on bathroom sinks, rewire Tekmar boiler controller, clean boiler, repair boiler pump injection, repair faulty gauges, replace hydronic automatic air reliefs, install fuel meters, and replace fuel filters.	$517	$13,500	0.67	26.1	1,711.1
19	Setback Thermostat: Washeteria	Install a programmable thermostat and implement a Heating Temperature Unoccupied Setback to 60° F for the Washeteria space.	$48	$1,000	0.63	20.9	146.4
20	Lighting - Small Bathroom	Replace with new energy-efficient LED lighting.	$3	$80	0.45	25.6	5.7
21	Window – Office Supply Room Window North Wall	Remove existing glass and install triple glass.	$35	$1,326	0.45	37.7	108.0
22	Window - Artic Entry Window South Wall	Remove existing glass and install triple glass.	$35	$1,326	0.45	37.7	108.0
23	Window - Laundry Room Window East Wall	Remove existing glass and install triple glass.	$78	$2,653	0.50	33.9	239.8
24	Window - Water Treatment Room Window West Wall	Remove existing glass and install triple glass.	$70	$2,653	0.45	37.6	216.1

Priority List – Energy Efficiency Measures							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
25	Window - Laundry Room Window South Wall	Remove existing glass and install triple glass.	$51	$2,523	0.35	49.0	157.9
26	Other Electrical - Washers	Replace with new energy efficient washers.	$87	$4,000	0.31	46.1	157.7
27	Lighting - Janitor Room	Replace with new energy-efficient LED lighting.	$1	$40	0.24	48.8	1.5
28	Other Electrical - Fan	Install programmable controller to be able to shut off fan when the area is unoccupied.	$58	$3,000	0.22	51.7	110.3
29	Other - Clothes Drying	Valve off pipes to dryers.	$0	$50	0.00	999.9	0.0
30	Lighting - Crawl Space	Replace with new energy-efficient LED lighting.	$0	$200	0.00	999.9	-0.1
	TOTAL, all measures		**$5,238 + $1,500 Maint. Savings**	**$43,191**	**2.01**	**6.4**	**11,062.0**

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 $5,238 per year, or 30.4% of the buildings' total energy costs. These measures are estimated to cost $43,191, for an overall simple payback period of 6.4 years.

Table 1.4 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 1.4: Detailed Breakdown of Energy Costs in the Building

Annual Energy Cost Estimate						
Description	**Space Heating**	**Water Heating**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Total Cost**
Existing Building	$7,802	$1,170	$9	$2,539	$5,687	**$17,206**
With Proposed Retrofits	$7,439	$1,120	$9	$1,071	$2,330	**$11,969**
Savings	$362	$50	$0	$1,468	$3,357	**$5,238**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Lime Village Washeteria. The scope of this project included evaluating building shell, lighting and other electrical systems, and heating and ventilation 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 and ventilation equipment
- Lighting systems and controls
- Building-specific equipment
- Water consumption, treatment (optional) & disposal

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 the Lime Village Washeteria 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.

Lime Village Washeteria consists of the following activity areas:

1) Washeteria: 657 square feet
2) Water Treatment Plant and Office Space: 870 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; heating and ventilation systems; 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. LIME VILLAGE WASHETERIA

3.1. Building Description

The 1,527 square foot washeteria was constructed in 2005, with a normal occupancy of two people. The number of hours of operation for this building average 14 hours per day, considering all seven days of the week. The washeteria is always open but most of the community use occurs during the day. The operator and office workers use the building for around 6 hours per week.

The Lime Village Washeteria serves as the water gathering point for the residents of the community and as a location for Laundromat and shower services. There is one watering point

with a ¾" pipe that provides treated water for the community pickup. There are 2 washers and 3 dryers in the washeteria, though due to the high cost of electricity the residents do not use the dryers in the washeteria.

Water is pumped into the water treatment plant from an underground well located under the washeteria building. Due to the clean nature of the water there is no need for filters and chlorine injection. The water is stored in 4 pressure tanks inside the washeteria building. The rest of the water is used in the washing machines and bathrooms. There is no pump to keep the pressure up for the washeteria, instead the well pump provides sufficient pressure.

Description of Building Shell

The exterior walls are single stud 2x10 frame type and has 9.25 inches of R-38 Batt insulation. The insulation appears to be slightly damaged and the wall space of the building is approximately 1,278 square feet.

The roof of the building is mostly cathedral ceiling with a standard framing with 24" spacing. This ceiling has approximately 1,358 square feet of space with 12 inches of R-50 Batt insulation. The ceiling in the arctic entry, bathrooms, janitor closet, and office supply room have a roof with a small attic space, also with standard framing with 24" spacing, 12 inches of R-50 Batt insulation. The space of the ceiling with an attic is about 238 square feet.

The floor of the building is constructed on top of a crawlspace that is about 3 feet tall and is framed with standard lumber. It is insulated by 2 inches of slightly damaged XPS foam and has approximately 1,527 square feet of floor space.

There is a total of 5 exterior windows in the building, two of which are in the laundry room and are both 6'x4' double glass with an area of 24 square feet, one window faces east while the other faces south. In the office room there is a 3'x4' double glass window with an area of 12 square feet facing north. In the water treatment room there is a 6'x4' double glass window with an area of 24 square feet facing west. Lastly there is a double glass window in the artic entry facing south that is 3'x4' with an area of 12 square feet.

There are 4 exterior doors in the Lime Village Washeteria, one in the artic entry, two in the water treatment room, and one giving access to the watering point. All four doors are metal with an EPS core and an area of around 21 square feet. The arctic entry and watering point doors are half-lite while the water treatment room doors contain no glass. The arctic entry and water treatment plant doors are not closing properly due to the foundation settling.

Figure 1: Door in Artic Entry, needs to be weatherized

Figure 2: Door in Water Treatment Plant, needs to be weatherized

Description of Heating Plants

The heating plants used in the building are:

Boiler 1

Fuel Type:	#1 Oil
Input Rating:	420,000 BTU/hr
Steady State Efficiency:	75 %

Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	Oct - Apr

Boiler 2

Fuel Type:	#1 Oil
Input Rating:	420,000 BTU/hr
Steady State Efficiency:	75 %
Idle Loss:	0 %
Heat Distribution Type:	Glycol
Boiler Operation:	Oct - Apr

Figure 3: Boilers used in the Lime Village Washeteria

Space Heating Distribution Systems

There are three cabinet unit heaters and four unit heaters that provide space heat to the washeteria. The heaters are listed below with information on heat output, and location.

Cabinet Unit Heater 1: 5 MBH Rating, Larger Bathroom

Cabinet Unit Heater 2: 48.8 MBH Rating, Laundry Room

Cabinet Unit Heater 3: 9.9 MBH Rating, Arctic Entry

Unit Heater 1: 161.7 MBH Rating, Dryer Plenum

Unit Heater 2: 12.6 MBH Rating, Mechanical Room

Unit Heater 3: 21.7 MBH Rating, Water Treatment Room

Unit Heater 4: 12.6 MBH Rating, Watering Point Room

The unit heater in the mechanical room is rarely used due to the boilers heating the space, and the unit heater in the dryer plenum is rarely used due to the dryers being rarely used.

Domestic Hot Water System

There is one indirect-fired hot water heater with 80 gallons of storage for the washeteria that provides hot water to the building for the bathrooms, showers, and washers.

Description of Building Ventilation System

There is a ventilation fan in the boiler room, it is a Greenheck Model SS1-20-428-C6 and is rated for 1600 CFM and 1/6 HP. There are exhaust fans in both bathrooms, they are Greenheck SP-A70 and each have a rating of 75 CFM and 20 Watts. In the janitor room there is an exhaust fan which is a Greenheck SP –A90 with a rating of 50 CMF and 40 Watts.

Lighting

The artic entry has 1 fixture with four T8 4 ft. fluorescent light bulbs per fixture.

The larger bathroom has 1 fixture with three T8 4ft. fluorescent light bulbs per fixture.

The smaller bathroom has 1 fixture with two T8 4ft fluorescent light bulbs per fixture.

The laundry room has 5 fixtures with four T8 4ft. fluorescent light bulbs per fixture. There is also 1 fixture with one T8 4ft. fluorescent light bulb.

The janitor room has 1 fixture with one T8 4ft. fluorescent light bulb.

The water treatment room has 8 fixtures with four T8 4ft. fluorescent light bulbs per fixture.

The office room has 1 fixture with four T8 4ft. fluorescent light bulbs per fixture.

The mechanical room has 2 fixtures with four T8 4ft. fluorescent light bulbs per fixture.

The dryer plenum has 1 fixture with four T8 4ft. fluorescent light bulbs per fixture.

The crawl space has 4 fixtures with one CFL, spiral, 15 W bulb per fixture.

The watering point has 1 fixture with three T8 4ft. fluorescent light bulbs per fixture.

On the exterior of the building there are 3 fixtures with one 50 W high pressure sodium bulb per fixture.

Plug Loads

The Lime Village Washeteria has a variety of power tools, a telephone, and some other miscellaneous loads that require a plug into an electrical outlet. The use of these items is infrequent and consumes a small portion of the total energy demand of the building.

Major Equipment

Table 3.1 lists equipment used in the Lime Village Washeteria related to the water intake and heating processes.

Table 3.1: Water Intake and Heating Equipment Information

Equipment	Rating (Watts)	Annual Consumption (kWh)
Well Pump	373	137
Boiler 1 Circulation Pump	161	1,412
Boiler 2 Circulation Pump	245	0
Glycol Makeup Tank	84	107
Building Circulation Pumps (2)	245	806

The well pump draws water from an underground well. The pump operates on demand with an estimated time of an hour per day.

The boiler 1 circulation pump circulates glycol from the main glycol circulation loop through the boiler. This pump is operating constantly because of a manual override switch. It is rated for 245 Watts but was measured to consume 161 Watts.

Boiler 2 circulation pump is not used due to boiler 2 not functioning properly.

The glycol makeup tank provides glycol to the main circulation loop when necessary.

The building circulation pumps circulate glycol throughout the building to all the unit heaters and to the radiant heaters in the crawlspace.

There are heat tapes for the raw water intake and septic line that are used for emergency thaw purposes. They are each rated for approximately 500 watts. The heat tapes have rarely been used in the last few years, with the sewer line heat tape was only used once in the past two years in order to pump put their septic tank last spring.

Table 3.1 lists equipment used in the Lime Village Washeteria not related to the water intake and heating processes.

Table 3.2: Non Water Intake or Heating Equipment Information

Equipment	Rating (Watts)	Annual Consumption (kWh)
Washeteria Desktop Computer and Monitor	150	1,315
Office Computer	150	47
Washeteria TV	200	5
Office Copier	115	1,008

Office Phone	5	44
Microwave	1,300	81
Laundry Room Ceiling Fan	44	162

The computer and TV ratings are based on an estimated average for similar equipment.

The microwave uses 1,300 watts when actively heating food. When the microwave is idle the power draw is minimal.

The ceiling fan operates during the summer months to cool the laundry room.

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 Lime Village Traditional Council owns and operates the Lime Village Electric Utility, who manages a power plant that provides electricity to all the residential and public utilities in the village.

The average cost for each type of fuel used in this building is shown below in Table 3.3. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.3: Energy Rates for Each Fuel Source

Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 1.20/kWh
#1 Oil	$ 6.40/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Lime Village Traditional Council pays approximately $17,206 annually for electricity and other fuel costs for the Washeteria.

Figure 4 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.

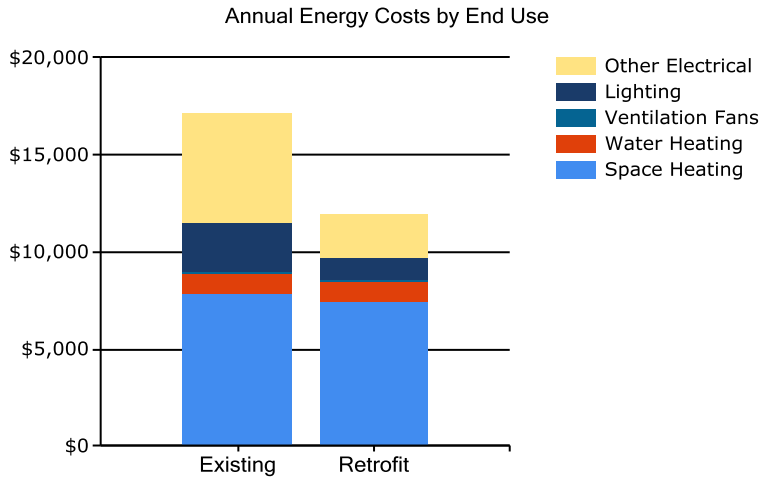

Figure 4: Annual Energy Costs by End Use

Figure 5 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 5: Annual Energy Costs by Fuel Type

Figure 6 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.

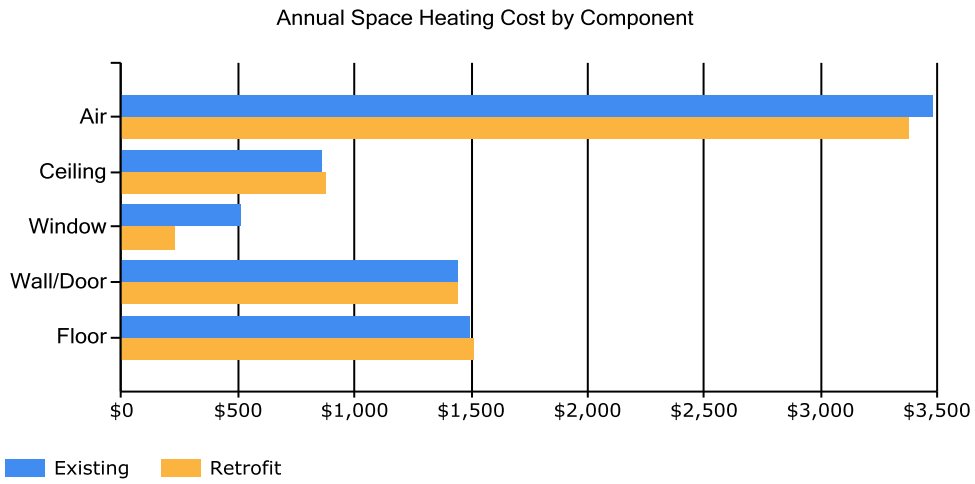

Figure 6: Annual Space Heating Cost by Component

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.

Table 3.4: Electrical Consumption by Category

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	218	171	143	75	12	1	1	1	17	91	154	217
DHW	69	62	69	66	69	66	69	69	66	69	66	69
Ventilation Fans	1	1	1	1	1	1	1	1	1	1	1	1
Lighting	264	241	264	256	112	49	50	50	49	264	256	264
Other Electrical	396	361	396	383	413	400	413	413	400	396	383	396

Table 3.5: Fuel Oil Consumption by Category

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	202	158	133	67	10	0	0	0	14	86	144	200
DHW	3	3	3	2	2	2	2	2	2	4	3	3

3.2.2 Energy Use Index (EUI)

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

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and

distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.
The site and source EUIs for this building are calculated as follows. (See Table 3.4 for details):

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

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

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

Table 3.6: Lime Village Washeteria 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	8,786 kWh	29,988	3.340	100,160
#1 Oil	1,045 gallons	137,959	1.010	139,339
Total		**167,947**		**239,499**
BUILDING AREA		1,527	Square Feet	
BUILDING SITE EUI		110	kBTU/Ft^2/Yr	
BUILDING SOURCE EUI		157	**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.				

Table 3.7: Lime Village Washeteria Building Benchmarks

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	**110.0**	**8.25**	**$11.27**
With Proposed Retrofits	**95.2**	**7.13**	**$7.84**
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. **EUI/HDD: Energy Use Intensity per Heating Degree Day.** **ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.**			

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 heating and ventilation 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 Lime Village Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Lime Village 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.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Lime Village. 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 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 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. This is the same as Table 1.1. It is located here for easy reference when reviewing the details of the recommendations.

Table 4.1: Recommended Energy Efficiency Measures Ranked by Economic Benefit

Lime Village Washeteria, Lime Village, Alaska Priority List – Energy Efficiency Measures							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
1	Other Electrical - Copier	Turn off when not in use.	$887	$50	203.45	0.1	1,605.5
2	Other Electrical - Computer	Turn off when not in use.	$1,169	$200	67.00	0.2	2,109.4
3	Lighting - Artic Entry	Replace with new energy-efficient LED lighting.	$103	$80	14.67	0.8	178.9

Lime Village Washeteria, Lime Village, Alaska
Priority List – Energy Efficiency Measures

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
4	Lighting - Laundry Room, larger fixtures	Replace with new energy-efficient LED lighting.	$516	$400	14.67	0.8	894.3
5	Other Electrical - Boiler 1 Circulation Pump	Turn off pump during the summer months.	$631	$500	14.58	0.8	1,181.5
6	Other Electrical - Microwave	Unplug microwave when not in use.	$40	$50	9.25	1.2	72.1
7	Lighting - Watering Point	Replace with new energy-efficient LED lighting.	$36	$80	5.17	2.2	64.6
8	Lighting - Exterior	Replace with new energy-efficient LED lighting.	$334	$900	4.36	2.7	669.5
9	Air Tightening	Add weatherization around exterior doors.	$205	$500	3.74	2.4	629.3
10	Other Electrical - Well Pump	Repair pump controls and safety alarm, run pump only when needed. Well pump has been replaced three times in ten years due to faulty controls.	$0 + $1,500 Maint. Savings	$6,000	3.72	4.0	0.0
11	Lighting - Laundry Room, smaller fixtures	Replace with new energy-efficient LED lighting.	$13	$40	3.57	3.2	21.7
12	Lighting - Office Supply Room	Replace with new energy-efficient LED lighting.	$22	$80	3.20	3.6	39.9
13	Lighting - Water Process/Office	Replace with new energy-efficient LED lighting.	$178	$640	3.19	3.6	317.6
14	Lighting - Dryer Plenum	Replace with new energy-efficient LED lighting.	$11	$80	1.59	7.2	19.8
15	Lighting - Mechanical Room	Replace with new energy-efficient LED lighting.	$22	$160	1.59	7.2	39.5
16	Lighting - Big Bathroom	Replace with new energy-efficient LED lighting.	$8	$80	1.14	10.0	14.2
17	Setback Thermostat: Process Rooms	Install a programmable thermostat and implement a Heating Temperature Unoccupied Setback to 60° F for the Process space.	$79	$1,000	1.04	12.7	241.8

Lime Village Washeteria, Lime Village, Alaska Priority List – Energy Efficiency Measures							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
18	Heating Ventilation and Domestic Hot Water	Train operator on boiler cleaning, repair timer on bathroom sinks, rewire Tekmar boiler controller, clean boiler, repair boiler pump injection, repair faulty gauges, replace hydronic automatic air reliefs, install fuel meters, and replace fuel filters.	$517	$13,500	0.67	26.1	1,711.1
19	Setback Thermostat: Washeteria	Install a programmable thermostat and implement a Heating Temperature Unoccupied Setback to 60° F for the Washeteria space.	$48	$1,000	0.63	20.9	146.4
20	Lighting - Small Bathroom	Replace with new energy-efficient LED lighting.	$3	$80	0.45	25.6	5.7
21	Window – Office Supply Room Window North Wall	Remove existing glass and install triple glass.	$35	$1,326	0.45	37.7	108.0
22	Window - Artic Entry Window South Wall	Remove existing glass and install triple glass.	$35	$1,326	0.45	37.7	108.0
23	Window - Laundry Room Window East Wall	Remove existing glass and install triple glass.	$78	$2,653	0.50	33.9	239.8
24	Window - Water Treatment Room Window West Wall	Remove existing glass and install triple glass.	$70	$2,653	0.45	37.6	216.1
25	Window - Laundry Room Window South Wall	Remove existing glass and install triple glass.	$51	$2,523	0.35	49.0	157.9
26	Other Electrical - Washers	Replace with new energy efficient washers.	$87	$4,000	0.31	46.1	157.7
27	Lighting - Janitor Room	Replace with new energy-efficient LED lighting.	$1	$40	0.24	48.8	1.5

Lime Village Washeteria, Lime Village, Alaska Priority List – Energy Efficiency Measures							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
28	Other Electrical - Fan	Install programmable controller to be able to shut off fan when the area is unoccupied.	$58	$3,000	0.22	51.7	110.3
29	Other - Clothes Drying	Valve off pipes to dryers.	$0	$50	0.00	999.9	0.0
30	Lighting - Crawl Space	Replace with new energy-efficient LED lighting.	$0	$200	0.00	999.9	-0.1
	TOTAL, all measures		**$5,238 + $1,500 Maint. Savings**	**$43,191**	**2.01**	**6.4**	**11,062.0**

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. Lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1 Window Measures

Rank	Location	Size/Type, Condition	Recommendation
21	Window/Skylight: Office Supply Room Window North Wall	Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46	Remove existing glass and install triple glass.

Installation Cost	$1,326	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$35
Breakeven Cost	$595	**Savings-to-Investment Ratio**	0.4	**Simple Payback yrs**	38

Auditors Notes: The window design is 3’ x 4’.

Rank	Location	Size/Type, Condition	Recommendation
22	Window/Skylight: Artic Entry Window South Wall	Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46	Remove existing glass and install triple glass.

Installation Cost	$1,326	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$35
Breakeven Cost	$595	**Savings-to-Investment Ratio**	0.4	**Simple Payback yrs**	38

Auditors Notes: The window design is 3’ x 4’.

Rank	Location	Size/Type, Condition	Recommendation
23	Window/Skylight: Laundry Room Window East Wall	Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46	Remove existing glass and install triple glass.

Installation Cost	$2,653	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$78
Breakeven Cost	$1,323	**Savings-to-Investment Ratio**	0.5	**Simple Payback yrs**	34

Auditors Notes: The window design is 6’ x 4’.

Rank	Location	Size/Type, Condition	Recommendation
24	Window/Skylight: Water Treatment Room Window West Wall	Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46	Remove existing glass and install triple glass.

Installation Cost	$2,653	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$70
Breakeven Cost	$1,192	**Savings-to-Investment Ratio**	0.4	**Simple Payback yrs**	38

Auditors Notes: The window design is 6' x 4'.

Rank	Location	Size/Type, Condition	Recommendation
25	Window/Skylight: Laundry Room Window South Wall	Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46	Remove existing glass and install triple glass.

Installation Cost	$2,523	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$51
Breakeven Cost	$871	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	49

Auditors Notes: The window design is 6' x 4'.

4.3.2 Air Sealing Measures

Rank	Location	Existing Air Leakage Level (cfm@50/75 Pa)	Recommended Air Leakage Reduction (cfm@50/75 Pa)
9		Air Tightness estimated as: 2500 cfm at 50 Pascals	Add weatherization around exterior doors.

Installation Cost	$500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$205
Breakeven Cost	$1,871	**Savings-to-Investment Ratio**	3.7	**Simple Payback yrs**	2

Auditors Notes: The building foundation has settled and as such the door frames have been warped out of shape. As a result the exterior doors do not fit properly into the door frames and large cracks are around the frames. Add weather stripping and insulation to prevent air leakage into the building.

4.4 Mechanical Equipment Measures

4.4.1 Heating Domestic Hot Water Measure

Rank	Recommendation
18	Train operator on boiler cleaning, repair timer on bathroom sinks, rewire Tekmar boiler controller, clean boiler, repair boiler pump injection, repair faulty gauges, replace hydronic automatic air reliefs, install fuel meters, and replace fuel filters.

Installation Cost	$13,500	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$517
Breakeven Cost	$9,012	**Savings-to-Investment Ratio**	0.7	**Simple Payback yrs**	26

Auditors Notes: The boilers have not been cleaned since their installation and the operator stated that he did not know how to properly do this task. Training for the operator on boiler cleaning will allow for proper boiler maintenance and improved performance.

The bathroom sinks run on a timer system that automatically controls the length of time that the faucet is turned on. The large bathroom sink operation time was measured at 60-65 seconds and the small bathroom sink was measured at 40-45 seconds. This is much longer than necessary and should be adjusted to 25-30 seconds to minimize water waste.

The existing Tekmar boiler controller does not sequence the boiler operation properly. This unit was installed after a previous unit burned out and there was no corresponding replacement of the same model. The Tekmar is improperly programmed and is not wired correctly for effective boiler operation. This unit needs to be rewired and reprogrammed for a primary – secondary boiler operation system.

The boiler heat is not being effectively distributed to the main glycol circulation loop. The boiler temperature set points are at 185 ° F but the main glycol loop temperatures were between 105-115 ° F. Discussions after the site visit with an operations engineer revealed that the highest temperature that the loop will reach is around 140-145 ° F. The heat is not being distributed properly and likely causes include faulty boiler circulation pumps, broken check valves, or congestion within the pipe. Repairs to this will allow the boiler to operate much more efficiently and reduce boiler run time in the winter.

The temperature and pressure gauges in the mechanical room were all damaged with the needles either bent or detached from the base pins. This was the result of a single incident where violent pressure spikes caused the heating system to give a loud pounding and banging sound. Replacing these gauges will allow for more secure operation of the facility.

Figure 7: Broken Gauges within the Mechanical Room

Operator Training on Boiler Cleaning: $2,000
Bathroom Sink Timer Repair: $1,500
Rewire Tekmar: $2,120
Clean Boilers: $1,850
Replace Boiler Pump Injection: $2,060
Repair Faulty Gauges: $390
Replace Hydronic Automatic Air Reliefs: $420
Install Fuel Meters: $1,760
Replace Fuel Filters: $190
Miscellaneous: $1,210

Total Cost: $13,500

4.4.2 Night Setback Thermostat Measures

Rank	Building Space		Recommendation		
17	Process		Implement a Heating Temperature Unoccupied Setback to 60° F for the Process space.		
Installation Cost	$1,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$79
Breakeven Cost	$1,042	**Savings-to-Investment Ratio**	1.0	**Simple Payback yrs**	13
Auditors Notes: Install a programmable setback thermostat to control the temperature of the building. When not in use, set temperature inside of washeteria to 60° F, such as at nights and on weekends; anytime the process rooms are not in used by the general public.					

Rank	Building Space		Recommendation		
19	Washeteria		Implement a Heating Temperature Unoccupied Setback to 60° F for the Washeteria space.		
Installation Cost	$1,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$48
Breakeven Cost	$632	**Savings-to-Investment Ratio**	0.6	**Simple Payback yrs**	21
Auditors Notes: Install a programmable setback thermostat to control the temperature of the building. When not in use, set temperature inside of washeteria to 60° F, such as at nights and on weekends; anytime the washeteria is not in used by the general public.					

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 loads. The building 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	
3	Artic Entry	FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$103
Breakeven Cost	$1,174	**Savings-to-Investment Ratio**	14.7	**Simple Payback yrs**	1
Auditors Notes: The room has one fixture with four light bulbs to be replaced with two new light bulbs.					

Rank	Location	Existing Condition	Recommendation
4	Washeteria Big Fixtures	5 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$400	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$516
Breakeven Cost	$5,867	**Savings-to-Investment Ratio**	14.7	**Simple Payback yrs**	1

Auditors Notes: The room has five fixtures with four light bulbs to be replaced with two new light bulbs in each fixture for a total of ten light bulbs to replace.

Rank	Location	Existing Condition	Recommendation
7	Watering Point	FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$36
Breakeven Cost	$414	**Savings-to-Investment Ratio**	5.2	**Simple Payback yrs**	2

Auditors Notes: The room has one fixture with three light bulbs to be replaced with two new light bulbs.

Rank	Location	Existing Condition	Recommendation
8	Exterior	3 HPS 50 Watt StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$900	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$334
Breakeven Cost	$3,922	**Savings-to-Investment Ratio**	4.4	**Simple Payback yrs**	3

Auditors Notes: There are three fixtures with one light bulb to be replaced with one new light bulb each.

Rank	Location	Existing Condition	Recommendation
11	Washeteria Small Fixture	FLUOR T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$40	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$13
Breakeven Cost	$143	**Savings-to-Investment Ratio**	3.6	**Simple Payback yrs**	3

Auditors Notes: The room has one fixture with one light bulb to be replaced by one new light bulb.

Rank	Location	Existing Condition	Recommendation
12	Office Supply Room	FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$22
Breakeven Cost	$256	**Savings-to-Investment Ratio**	3.2	**Simple Payback yrs**	4

Auditors Notes: The room has one fixture with four light bulbs to be replaced by two new light bulbs.

Rank	Location	Existing Condition	Recommendation
13	Water Process/Office Room	8 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$640	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$178
Breakeven Cost	$2,039	**Savings-to-Investment Ratio**	3.2	**Simple Payback yrs**	4

Auditors Notes: The room has eight fixtures with four light bulbs to be replaced by two new light bulbs in each fixture for a total of 16 light bulbs to replace.

Rank	Location	Existing Condition	Recommendation
14	Dryer Plenum	FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$11
Breakeven Cost	$127	**Savings-to-Investment Ratio**	1.6	**Simple Payback yrs**	7

Auditors Notes: The room has one fixture with four light bulbs to be replaced by two new light bulbs.

Rank	Location	Existing Condition	Recommendation
15	Mechanical Room	2 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$22
Breakeven Cost	$254	**Savings-to-Investment Ratio**	1.6	**Simple Payback yrs**	7

Auditors Notes: The room has two fixtures with four light bulbs to be replaced by two new light bulbs in each fixture for a total of four light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
16	Big Bathroom	FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$8
Breakeven Cost	$91	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	10

Auditors Notes: The room has one fixture with three light bulbs to be replaced by two new light bulbs.

Rank	Location	Existing Condition	Recommendation
20	Small Bathroom	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$3
Breakeven Cost	$36	**Savings-to-Investment Ratio**	0.4	**Simple Payback yrs**	26

Auditors Notes: The room has one fixture with two light bulbs to be replaced by two new light bulbs.

Rank	Location	Existing Condition	Recommendation
27	Janitor Room	FLUOR T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$40	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1
Breakeven Cost	$9	**Savings-to-Investment Ratio**	0.2	**Simple Payback yrs**	49

Auditors Notes: The room has one fixture with one light bulb to be replaced by one new light bulb.

Rank	Location	Existing Condition	Recommendation
30	Crawl Space	4 FLUOR CFL, Spiral 15 W	Replace with new energy-efficient LED lighting.

Installation Cost	$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$
Breakeven Cost	-$1	**Savings-to-Investment Ratio**	0.0	**Simple Payback yrs**	1000

Auditors Notes: The room has four fixtures with one light bulb to be replaced by one new light bulb per fixture.

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation
1	Copier	Office Copier	Unplug when not in use.

Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$887
Breakeven Cost	$10,173	**Savings-to-Investment Ratio**	203.5	**Simple Payback yrs**	0

Auditors Notes:

Rank	Location	Description of Existing	Efficiency Recommendation
2	Computer	Washeteria Desktop Computer	Turn off when not in use.

Installation Cost	$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,169
Breakeven Cost	$13,399	**Savings-to-Investment Ratio**	67.0	**Simple Payback yrs**	0

Auditors Notes:

Rank	Location	Description of Existing	Efficiency Recommendation
5	Pump	Boiler 1 Circ. Pump	Turn off pump during the summer months when the boiler does not need to be running.

Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$631
Breakeven Cost	$7,290	**Savings-to-Investment Ratio**	14.6	**Simple Payback yrs**	1

Auditors Notes:

Rank	Location	Description of Existing	Efficiency Recommendation
6	Microwave	Microwave	Unplug microwave when not in use.

Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$40
Breakeven Cost	$462	**Savings-to-Investment Ratio**	9.2	**Simple Payback yrs**	1

Auditors Notes:

Rank	Location	Description of Existing	Efficiency Recommendation
10	Pump	Well Pump	Repair pump controls and safety alarm, run pump only when needed.

Installation Cost	$6,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$
				Maintenance Savings (/yr)	$1,500
Breakeven Cost	$22,316	**Savings-to-Investment Ratio**	3.7	**Simple Payback yrs**	4

Auditors Notes: Train the operator to run pump only when needed to draw water, and to prevent it running in hand mode. Repair the safety alarm. Well pump has been replaced three times in ten years due to faulty controls. Further investigation is needed to identify how to repair their well for the long term.

Rank	Location	Description of Existing	Efficiency Recommendation
26	Washers	Washers	Replace with new energy efficient washers.

Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$87
Breakeven Cost	$1,233	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	46

Auditors Notes: Replace with new washers, expect new washers to be 20% more efficient.

Rank	Location	Description of Existing	Efficiency Recommendation
28	Fan	Laundry Room Ceiling Fan	Install programmable controller to be able to shut off fan when the area is unoccupied.

Installation Cost	$3,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$58
Breakeven Cost	$674	**Savings-to-Investment Ratio**	0.2	**Simple Payback yrs**	52

Auditors Notes: The plastic cover for the switch is physically broken and makes it difficult to operate. This should be addressed when the controller is installed.

4.5.3 Other Measures

Rank	Location	Description of Existing	Efficiency Recommendation
29		Clothes Drying	Valve off dryers.

Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$
Breakeven Cost	$	**Savings-to-Investment Ratio**	0.0	**Simple Payback yrs**	1000

Auditors Notes: Valve off glycol loop to the dryers, also turn off breaker for the dryers.

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.

In the near future, a representative of ANTHC will be contacting the Lime Village Traditional Council to follow up on the recommendations made in this report. Funding has been provided by to ANTHC through a Rural Alaska Village Grant to provide the community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2016 calendar year.

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	**AUDITOR INFORMATION**
Building: Washeteria	**Auditor Company:** ANTHC
Address: Lime Village	**Auditor Name:** Kevin Ulrich and Collette Kawagley
City: Lime Village	**Auditor Address:** 4500 Diplomacy Drive
Client Name: Fred Bobby	
Client Address:	**Auditor Phone:** (907) 729-3237
	Auditor FAX:
Client Phone: (907) 526-5954	**Auditor Comment:**
Client FAX:	
Design Data	
Building Area: 1,527 square feet	**Design Space Heating Load:** Design Loss at Space: 41,212 Btu/hour with Distribution Losses: 41,212 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 62,823 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 2 people	**Design Indoor Temperature:** 70 ° F (building average)
Actual City: Lime Village	**Design Outdoor Temperature:** -40.1 ° F
Weather/Fuel City: Lime Village	**Heating Degree Days:** 13,339 ° F-days
Utility Information	
Electric Utility: Lime Village Traditional Council	**Average Annual Cost/kWh:** $1.197/kWh

Annual Energy Cost Estimate						
Description	**Space Heating**	**Water Heating**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Total Cost**
Existing Building	$7,802	$1,170	$9	$2,539	$5,687	**$17,206**
With Proposed Retrofits	$7,439	$1,120	$9	$1,071	$2,330	**$11,969**
Savings	$362	$50	$0	$1,468	$3,357	**$5,238**

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	110.0	8.25	$11.27
With Proposed Retrofits	95.2	7.13	$7.84

EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area.
EUI/HDD: Energy Use Intensity per Heating Degree Day.
ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.

Appendix B – Actual Fuel Use versus Modeled Fuel Use

The graphs below were generated from the AkWarm energy model software program.
The orange bars show actual fuel use, and the blue bars are AkWarm's prediction of fuel use.

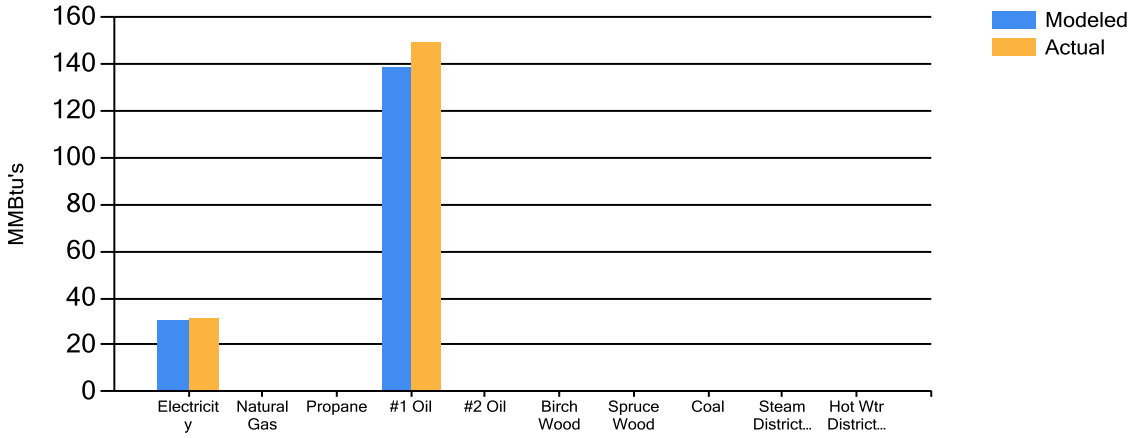

Figure 8: Annual Fuel Use

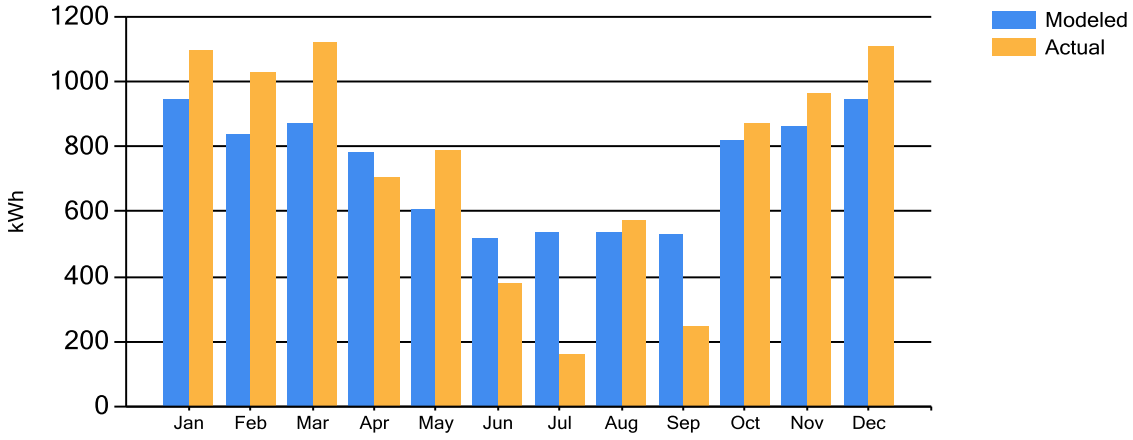

Figure 9: Electricity Fuel Use

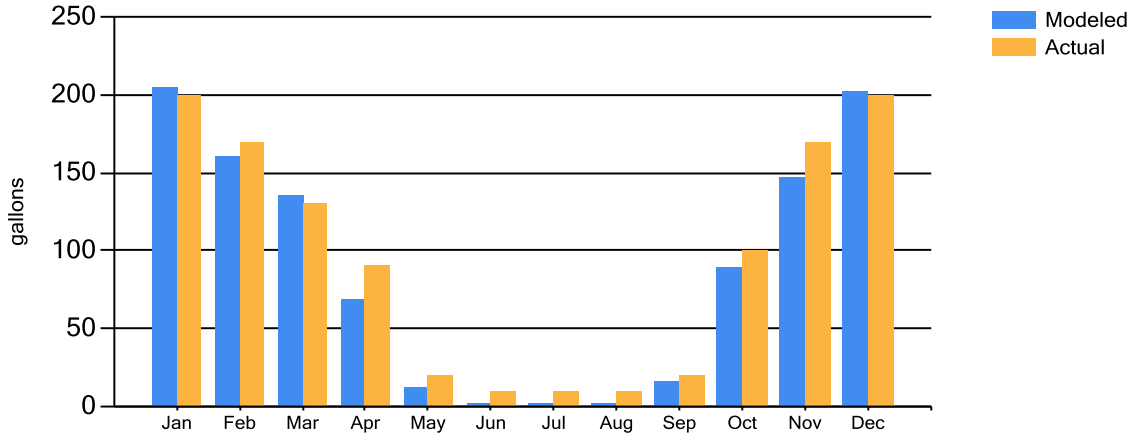

Figure 10: #1 Fuel Oil Fuel Use

Appendix C - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	3.7	3.6	3.6	3.4	3.1	2.9	2.9	2.9	2.9	3.5	3.6	3.7
As Proposed	2.4	2.3	2.2	2.1	1.7	1.6	1.6	1.6	1.7	2.1	2.3	2.4

AkWarmCalc Ver 2.5.3.0, Energy Lib 3/7/2016