Comprehensive Energy Audit
For
Tuluksak Water Treatment Plant and Washeteria

Prepared For
Tuluksak Native Community

February 8, 2012

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Tuluksak Native Community. The authors of this report are Chris Mercer, Certified Energy Auditor (CEA) and Gavin Dixon.

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

ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of Treatment Plant Operator Carl Napoka Sr., and Joey Allain, Tuluksak Utility Manager.

1. EXECUTIVE SUMMARY

This report was prepared for the Tuluksak Native Community. The scope of the audit focused on Tuluksak Water Treatment Plant and Washeteria. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, HVAC systems, and plug loads.

Based on electricity and fuel oil prices in effect at the time of the audit, the annual predicted energy costs for the buildings analyzed are $5,200 for Electricity, $40,655 for #1 Oil and total energy costs are $45,854 per year.

It should be noted that this facility received the power cost equalization subsidy from the state of Alaska last year. If it had not received PCE, electric costs would have been $20,790 instead of $5,188.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Tuluksak Water Treatment Plant and Washeteria. 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	Cooking and Clothes Drying - Clothes Dryer	The hydronic dryer should be shut off in the summer time, so that the boiler can be shut off and reduce fuel use.	$1,208	$100	175.66	0.1
2	Other Electrical: Heat Tape	Add new Clock Timer or Other Scheduling Control	$744	$250	18.43	0.3
3	Other Electrical: Heat Tape	Improve Manual Switching	$199	$100	12.31	0.5
4	HVAC And DHW	Boiler maintenance is critical to proper operation, and fuel efficiency. The boilers should be thoroughly cleaned at least annually. During summer the lone hydronic dryer accounts for a substantial portion of hydronic load, and should be shut down due to boiler cycling inefficiencies. The hot water heater has faulty controls and is not efficiently transferring heat to the water. Additionally, insulation of all hydronic piping will reduce boiler demands.	$9,124	$12,000	12.31	1.3

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]
5	Setback Thermostat: Water Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Plant space.	$1,405	$200	95.33	0.1
6	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	$825	$500	22.38	0.6
7	Water Distribution and Treatment	Raw water heat-add should be reduced to and control to 40oF. Currently an elevated set point is producing and unnecessary load on the hydronic system. School water service circulation loop is above the required temperature; controls should be repaired and adjusted. This system should be shut down in summer.	$1,479	$7,500	2.66	5.1
	TOTAL, all measures		**$14,985**	**$20,650**	**10.72**	**1.4**

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 $14,985 per year, or 32.7% of the buildings' total energy costs. These measures are estimated to cost $20,650, for an overall simple payback period of 1.4 years.

Table 1.2 below is a breakdown of the annual energy cost across various energy end use types, such as Space Heating and Water Heating. The first row in the table shows the breakdown for the building as it is now. The second row shows the expected breakdown of energy cost for the building assuming all of the retrofits in this report are implemented. Finally, the last row shows the annual energy savings that will be achieved from the retrofits.

Table 1.2 Annual Energy Cost Estimate											
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Lighting**	**Refrigeration**	**Other Electrical**	**Cooking**	**Clothes Drying**	**Ventilation Fans**	**Service Fees**	**Total Cost**
Existing Building	$20,312	$0	$6,046	$268	$0	$2,738	$5,200	$11,290	$0	$0	**$45,854**
With All Proposed Retrofits	$9,059	$0	$6,261	$268	$0	$1,795	$3,405	$10,082	$0	$0	**$30,869**
SAVINGS	$11,253	$0	-$215	$0	$0	$943	$1,795	$1,208	$0	$0	**$14,985**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Tuluksak Water Treatment Plant and Washeteria. 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 Tuluksak Water Treatment Plant and 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.

Tuluksak Water Treatment Plant and Washeteria is classified as being made up of the following activity areas:

1) Water Plant: 1,200 square feet
2) Washeteria: 600 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. Tuluksak Water Treatment Plant and Washeteria

3.1. Building Description

The 1,800 square foot Tuluksak Water Treatment Plant and Washeteria was constructed in 1980, with a normal occupancy of 5 people. The number of hours of operation for this building average 6.6 hours per day, considering all seven days of the week.

Description of Building Shell

The exterior walls are 2x6 construction with 5.5 inches of batt insulation.

The Roof of the building is a warm roof with 6 inches of insulation.

The floor of the building is built on pilings with 6 inches of batt insulation. The floor is rotten and decaying from leaks in many areas, especially near the washers in the Washeteria. The condition is intensified by the humid dryer exhaust venting below the facility.

Typical windows throughout the building are insulated vinyl and fiberglass

Doors are metal urethane with no thermal break; the utility door for the water plant is no longer in use and is blocked by shelving and tools.

Description of Heating Plants

The Heating Plants used in the building are:

Boiler #1

Fuel Type:	#1 Oil
Input Rating:	363,000 BTU/hr
Steady State Efficiency:	58 %
Idle Loss:	1.5 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

Boiler #2

Fuel Type:	#1 Oil
Input Rating:	389,400 BTU/hr
Steady State Efficiency:	58 %
Idle Loss:	1.5 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

Space Heating Distribution Systems

Heat is distributed in the water plant through two unit heaters, one of which is near failure. Much of the heat in the facility comes from jacket losses off the boilers which primarily serve the water treatment process, school distribution and hydronic dryer in the washeteria. The Washeteria is heated by an unregulated baseboard heating unit and dryer byproduct heat.

Domestic Hot Water System

The domestic hot water heating in the building is used primarily in the washers. Currently an aged hydronic water heater is served by the primary boilers. The heat exchange capacity of this unit has been severely limited by scale and buildup. The controls for the hot water heater are similarly fouled and no longer functioning. The effect is that the hot water heater slowly heats up to 170 degrees at night when no hot water is being used. As that water is used over the course of the day, the hot water heater is not able to maintain hot water temperatures and ends the day closer to 80 degrees. This subjects the hydronic system to a small cycled load and decreases system efficiency through cycle losses.

Lighting

The building is lit by six, four foot T8 fluorescent lighting fixtures, with four 25 watt bulbs each.

Plug Loads

Primarily plug loads in the building are the General Electric washing Machines and Dryers.

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: Tuluksak Traditional Power - 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	$ 0.15/kWh
#1 Oil	$ 6.50/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Tuluksak Native Community pays approximately $45,854 annually for electricity and other fuel costs for the Tuluksak Water Treatment Plant and Washeteria.

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

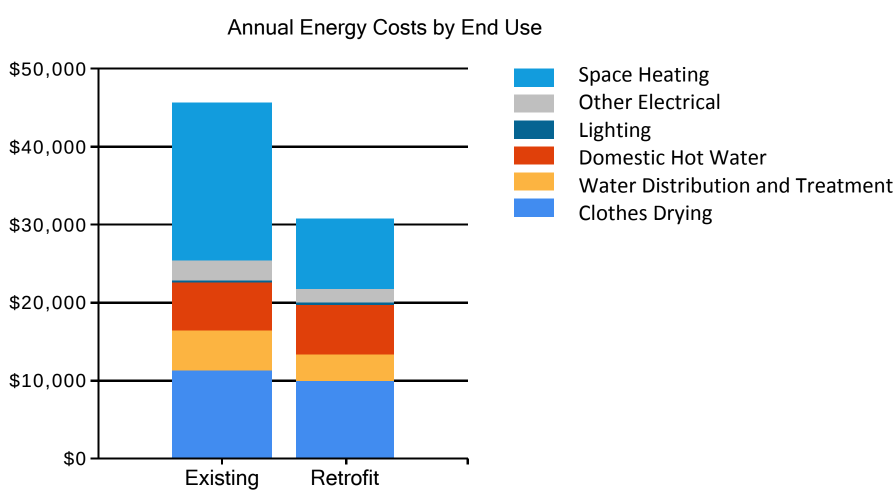


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

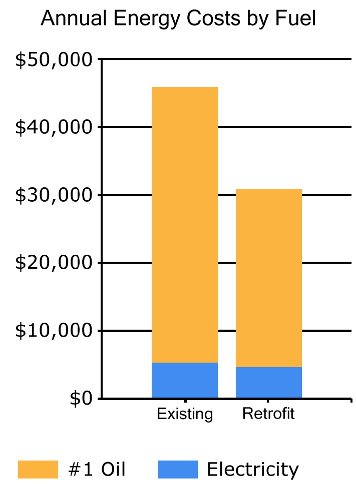
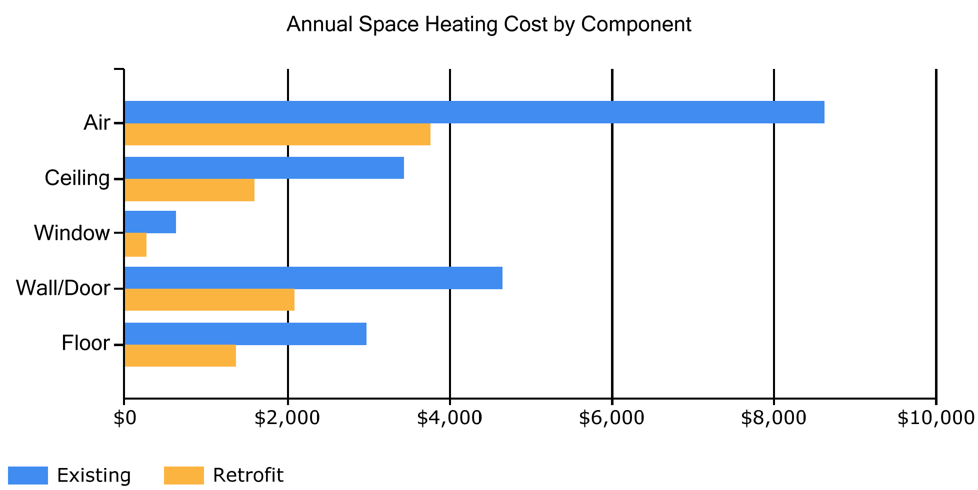


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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
Other_Electrical	1549	1412	1549	1499	1549	1499	1549	1549	1499	1549	1499	1549
Lighting	152	138	152	147	152	147	152	152	147	152	147	152
Cooking	200	182	200	194	200	194	200	200	194	200	194	200
Clothes_Drying	1009	920	1009	977	1009	977	1009	1009	977	1009	977	1009
DHW	4	3	4	4	4	4	4	4	4	4	4	4
Space_Heating	29	26	29	28	29	28	28	29	28	29	28	29

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Cooking	80	73	80	78	80	12	13	13	78	80	78	80
Clothes_Drying	124	113	124	120	124	120	124	124	120	124	120	124
DHW	79	72	79	76	79	76	79	79	76	79	76	79
Space_Heating	265	242	265	256	264	255	263	263	256	265	257	266

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
Tuluksak Water Treatment Plant and 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	34,664 kWh	118,307	3.340	395,146
#1 Oil	6,255 gallons	825,604	1.010	833,860
Total		**943,911**		**1,229,006**
BUILDING AREA		1,800	Square Feet	
BUILDING SITE EUI		524	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		683	**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 Tuluksak Water Treatment Plant and Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Tuluksak 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 Tuluksak. 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
Tuluksak Water Treatment Plant and Washeteria, Tuluksak, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Cooking and Clothes Drying - Clothes Dryer	The hydronic dryer should be shut off in the summer time, so that the boiler can be shut off and reduce fuel use.	$1,208	$100	175.66	0.1
2	Other Electrical: Heat Tape	Add new Clock Timer or Other Scheduling Control	$744	$250	18.43	0.3
3	Other Electrical: Heat Tape	Improve Manual Switching	$199	$100	12.31	0.5
4	HVAC And DHW	Boiler maintenance is critical to proper operation, and fuel efficiency. The boilers should be thoroughly cleaned at least annually. During summer the lone hydronic dryer accounts for a substantial portion of hydronic load, and should be shut down due to boiler cycling inefficiencies. The hot water heater has faulty controls and is not efficiently transferring heat to the water. Additionally, insulation of all hydronic piping will reduce boiler demands. Cost also includes 3 days of outside Utility Support to assist with repairs and configuration.	$9,124	$12,000	12.31	1.3

Table 4.1 Tuluksak Water Treatment Plant and Washeteria, Tuluksak, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**
5	Setback Thermostat: Water Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Plant space.	$1,405	$200	95.33	0.1
6	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	$825	$500	22.38	0.6
7	Water Distribution and Treatment	Raw water heat-add should be reduced to and control to 40oF. Currently an elevated set point is producing and unnecessary load on the hydronic system. School water service circulation loop is above the required temperature; controls should be repaired and adjusted. This system should be shut down in summer.	$1,479	$7,500	2.66	5.1
	TOTAL, all measures		**$14,985**	**$20,650**	**10.72**	**1.4**

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 Mechanical Equipment Measures

4.3.1 Heating/Cooling/Domestic Hot Water Measure

Rank	Recommendation				
4	Boiler maintenance is critical to proper operation, and fuel efficiency. The boilers should be thoroughly cleaned at least annually. During summer the lone hydronic dryer accounts for a substantial portion of hydronic load, and should be shut down due to boiler cycling inefficiencies. The hot water heater has faulty controls and is not efficiently transferring heat to the water. Additionally, insulation of all hydronic piping will reduce boiler demands. Many heated pipes in the building are uninsulated and should be insulated to reduce losses and increase efficiency. Retrofit cost includes 3 days of Tribal Utility Support, replacement parts and insulation.				
Installation Cost	$12,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$9,124
Breakeven Cost	$147,680	**Savings-to-Investment Ratio**	12.3	**Simple Payback yrs**	1
Auditors Notes:					

4.3.2 Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
6	Washeteria			Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$825
Breakeven Cost	$11,188	**Savings-to-Investment Ratio**	22.4	**Simple Payback yrs**	1
Auditors Notes: Installing a setback thermostat in the washeteria and fixing the control valve supplying heat to the baseboard heating would produce a significant savings. Currently heating to the washeteria is uncontrolled and the baseboard heating is supplying heat all the time regardless of the temperature in the washeteria. Additionally the washeteria should be heated to only 60 degrees when the facility is not being used.					

Rank	Building Space			Recommendation	
5	Water Plant			Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Plant space.	
Installation Cost	$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,405
Breakeven Cost	$19,066	**Savings-to-Investment Ratio**	95.3	**Simple Payback yrs**	0
Auditors Notes: The water plant is currently set to 75 degrees. The water plant does not need to be heated to that level even when occupied. Keeping the water plant heated to only 60 degrees would provide comfort, prevent freeze ups, and reduce pipe sweating.					

4.5 Electrical & Appliance Measures

4.5.1 Other Electrical Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
3	Heat Tape	Well Line Heat Tape with Manual Switching		Improve Manual Switching	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$199
Breakeven Cost	$1,231	**Savings-to-Investment Ratio**	12.3	**Simple Payback yrs**	1
Auditors Notes: The heat tape to the well should be turned off when the raw pump is being used. The line will not freeze during pumping operations. Ideally the heat tape would be configured to be selectable only when the pump is not running.					

Rank	Location	Description of Existing		Efficiency Recommendation	
2	Heat Tape	Bunk House Heat Tape with Manual Switching		Add new Clock Timer or Other Scheduling Control	
Installation Cost	$250	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$744
Breakeven Cost	$4,607	**Savings-to-Investment Ratio**	18.4	**Simple Payback yrs**	0

Auditors Notes: The work camp heat tape should be used only as thaw recovery for when the work camp is in use and its service lines frozen. Otherwise the tape can be turned off. Additionally the heat tape should be controlled from the work camp and not hard wired at the treatment plant. When the work camp is not in operation for extended periods the line should be drained and isolated.

4.5.4 Water Treatment and Distribution

Rank	Location		Description of Existing		Efficiency Recommendation
7					The controls should be reconfigured to control the temperature of the loop based on a return temperature of 40 degrees. The Raw Water heat add is also too high. The current heat add controls are trying to heat the incoming raw water to 80 degrees, with a heat exchanger limitation of 46 degrees. The water for treatment purposes only needs to be 40 degrees. By making the set point 40 degrees, there would be significant energy savings. All heat add controls for the raw water were currently functional.
Installation Cost	$7,500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,479
Breakeven Cost	$19,940	**Savings-to-Investment Ratio**	2.7	**Simple Payback yrs**	5
Auditors Notes: Addition ally the school water circulation pump can be shut off in the summer time, as there is no risk of freezing in the summer months.					

4.5.5 Clothes Drying Measures

Rank	Location		Description of Existing		Efficiency Recommendation
1					The hydronic dryer should be shut off in the summer time, so that the boiler can be shut off. While the costs of the electric dryers in the summer will go up slightly due to higher use the boiler savings are more significant.
Installation Cost	$100	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,208
Breakeven Cost	$17,566	**Savings-to-Investment Ratio**	175.7	**Simple Payback yrs**	0
Auditors Notes:					

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