Comprehensive Energy Audit
For
Akiak Water Plant

Prepared For
City of Akiak

June 27, 2011

Prepared By:

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Native Village of Akiak. The authors of this report are Carl H. Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM) and Gavin Dixon.

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

ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of the City, Tribal, and operations staff for the Native Village of Akiak.

1. EXECUTIVE SUMMARY

This report was prepared for the City of Akiak. The scope of the audit focused on Akiak Water Plant. 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 as follows, $62,076 for Electricity, $2,695 for recovered heat, and $3,557 for #1 Oil. For recovered heat, a value of $7.50 per one million btus of heat was used; this is the standard AVEC recovered heat charge. Currently in Akiak, the utility does not charge the water plant for use of recovered heat. The total energy costs are $68,327 per year.

It should be noted that these facilities did not receive the power cost equalization subsidy from the state of Alaska last year. These facilities are most likely eligible for PCE, and the community should apply for PCE. With PCE these facilities would have annual electrical costs around $21,000 per year, a savings of $41,000 per year.

If there were no recovered heat available for the water plant it would take 2,669 gallons additional gallons of fuel oil to replace the heating load of the building and its process loads. Fuel records were not available for these facilities, so all numbers are estimated based on the findings of the audit. It is highly recommended that fuel and electric data is restored on a monthly basis for use in all public facilities, especially the water plant.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Akiak Water Plant. 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	HVAC And DHW	(x)	$809	$1,500	10.19	1.9
2	Other Electrical: Lift Station Electric Heat	Improve Manual Switching	$2,576	$2,000	8.23	0.8
3	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Treatment Plant space.	$208	$600	5.11	2.9
4	Lighting: WTP Lighting	Replace with 21 LED Replacement Bulbs	$1,932	$3,780	4.44	2.0
5	Circulation Loops	Reduce Circulation Loop Heating to 40 degrees based on return temperature, and replace circulation pump motors with premium efficiency motors.	$1,462	$4,500	4.01	3.1

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6	Other Electrical: Lift Station Submersible Pumps	Improve Manual Switching	$1,236	$2,500	3.16	2.0
7	Water Storage Tank	Reduce tank storage temperature to 40 degrees. Repair Heat Add controller to control temperature accurately.	$74	$500	1.99	6.8
8	Other Electrical: Pressure Pumps	Replace with 2 Burks Crane 1-1/4 impeller	$362	$2,600	1.41	7.2
	TOTAL, cost-effective measures		**$8,658**	**$17,980**	**4.57**	**2.1**
	The following measures were *not* found to be cost-effective:					
9	Air Tightening	Perform air sealing to reduce air leakage by 5%.	$23	$500	0.47	21.7
	TOTAL, all measures		**$8,681**	**$18,480**	**4.46**	**2.1**

Table Notes:

1 Savings to Investment Ratio (SIR) is a life-cycle cost measure calculated by dividing the total savings over the life of a project (expressed in today's dollars) by its investment costs. The SIR is an indication of the profitability of a measure; the higher the SIR, the more profitable the project. An SIR greater than 1.0 indicates a cost-effective project (i.e. more savings than cost). Remember that this profitability is based on the position of that Energy Efficiency Measure (EEM) in the overall list and assumes that the measures above it are implemented first.

2 Simple Payback (SP) is a measure of the length of time required for the savings from an EEM to payback the investment cost, not counting interest on the investment and any future changes in energy prices. It is calculated by dividing the investment cost by the expected first-year savings of the EEM.

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $8,681 per year, or 12.7% of the buildings' total energy costs. These measures are estimated to cost $18,480, for an overall simple payback period of 2.1 years. If only the cost-effective measures are implemented, the annual utility cost can be reduced by $8,658 per year, or 12.7% of the buildings' total energy costs. These measures are estimated to cost $17,980, for an overall simple payback period of 2.1 years.

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

Table 1.2 Annual Energy Cost Estimate										
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Lighting**	**Other Electrical**	**Circulation Loops**	**Water Storage Tank**	**Ventilation Fans**	**Service Fees**	**Total Cost**
Existing Building	$10,238	$0	$993	$3,307	$31,263	$21,790	$738	$0	$0	**$68,327**
With All Proposed Retrofits	$9,281	$0	$993	$1,305	$27,075	$20,328	$664	$0	$0	**$59,646**
SAVINGS	$957	$0	$0	$2,002	$4,187	$1,462	$74	$0	$0	**$8,681**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

Akiak Water Plant is classified as being made up of the following activity areas:

1) Water Treatment Plant: 1,280 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. Akiak Water Plant

3.1. Building Description

The 1,280 square foot Akiak Water Plant was constructed in 1986, with a normal occupancy of 1 person. The number of hours of operation for this building average 4 hours per day, considering all seven days of the week.

Description of Building Shell

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

The roof of the building is a warm roof with a bottom insulation layer of six inches, a top insulation layer of six inches, and over an inch of insulated sheathing.

The floor is a concrete slab foundation.

Typical windows throughout the building are double paned glass with wood vinyl frames.

Doors are metal with fiberglass insulation.

Description of Heating and Cooling Plants

The Heating Plants used in the building are:

Waste Heat from Power Plant

Fuel Type:	Recovered Heat
Input Rating:	420,000 BTU/hr
Steady State Efficiency:	97 %
Idle Loss:	0 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

Boiler

Fuel Type:	#1 Oil
Input Rating:	420,000 BTU/hr
Steady State Efficiency:	68 %
Idle Loss:	1.5 %
Heat Distribution Type:	Water
Boiler Operation:	Sep - Jun

Space Heating and Cooling Distribution Systems

The building is heated by a series of unit heaters supplied off the boilers and waste heat.

Domestic Hot Water System

Domestic hot for the Akiak WTP is delivered via an on demand oil burning hot water heater. The service is provided primarily for mixing chemicals during the water treatment process.

Waste Heat Recovery Information

Waste heat is provided to the Akiak WTP from the community's electric power plant, approximately 200 feet and across the street. Hydronic heat is delivered by insulated steel pipe to the WTP heat exchanger. A Goldline differential temperature sensor regulates the delivery of waste heat to the WTP by actuation of a three-way valve.

Lighting

The building is lit by 21 T12 magnetic fluorescent fixtures with four 40 watt bulbs in each.

Major Equipment

Major equipment in the plant includes two Burks Crane pressure pumps, running continuously. This is the single largest electrical load in the facility. There are two sets of circulation pumps for the circulation loops which are similarly large loads.

A heat tape to the well line is a significantly large load, as is the well pumps themselves. Various treatment pumps, the clear well transfer pump in the treatment tank, and various controls and displays throughout the plant make up the rest of the significant equipment and electrical loads in the building.

Lift Station

The main lift station has two submersible pumps, at the time of the visit the lift station was unmonitored, and not being properly maintained. Minor operational issues inside the lift-station are accounting for significant energy losses. The lift station has one pump which is not properly seated in the wet well, this accounts for significant run times with no transfer of waste water. Additionally the excessive electric heater temperature set points of 70+ degrees Fahrenheit inside the lift station facility are needless.

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: Akiak, City of - 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	$ 0.63/kWh

Recovered	$ 7.50/million Btu
#1 Oil	$ 5.00/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Akiak pays approximately $68,327 annually for electricity and other fuel costs for the Akiak Water Plant.

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

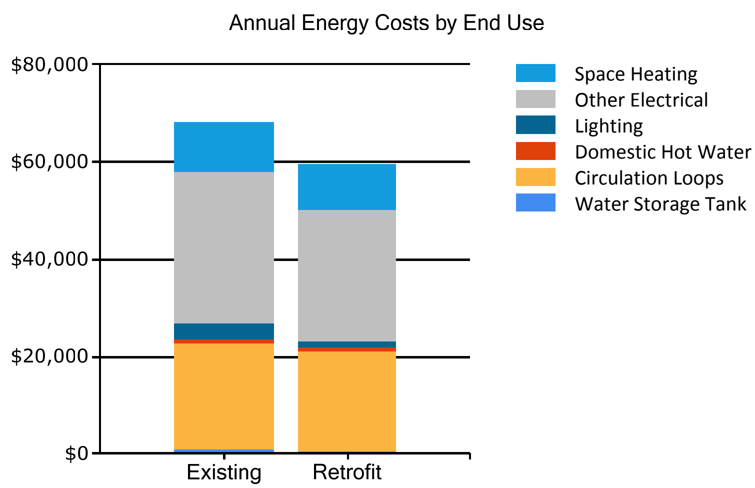


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

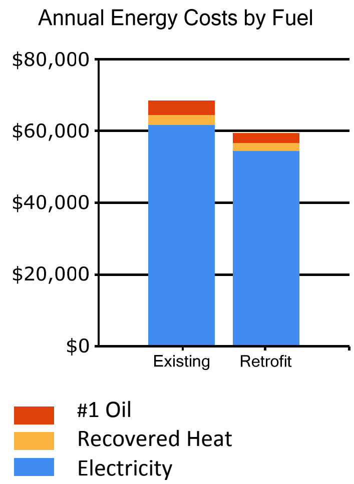
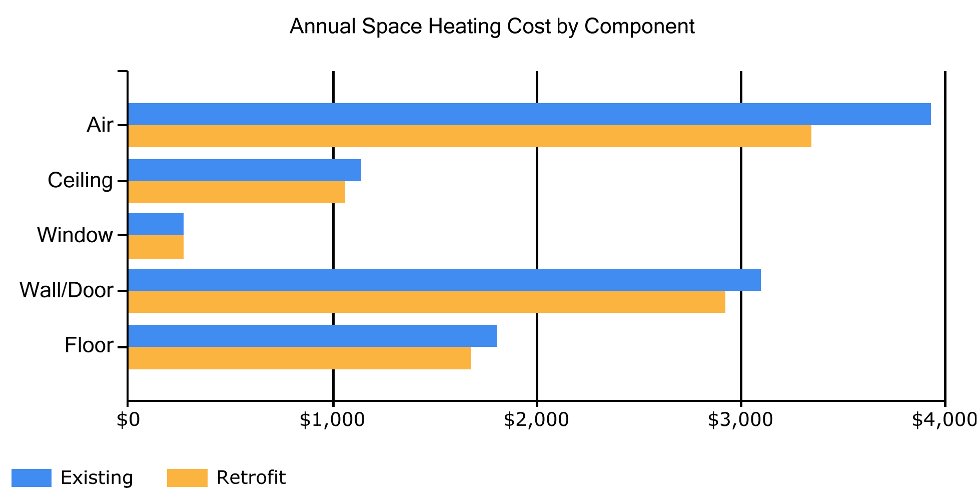


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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	4721	4302	4721	4569	3245	3093	3196	3196	4569	4721	4569	4721
Lighting	445	406	445	431	445	431	445	445	431	445	431	445
Circulation Loops	3668	3343	3668	3550	3668	0	0	0	3550	3668	3550	3668
Water Storage Tank	0	0	0	0	0	0	0	0	0	0	0	0
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	124	113	124	120	124	120	124	124	120	124	120	124
Space_Heating	839	764	838	811	838	808	834	834	811	838	811	839

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	82	73	65	61	63	32	34	34	61	63	61	82

Hot Water District Ht Consumption (Million Btu)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Circulation Loops	21	20	21	21	21	0	0	0	21	21	21	21
Water Storage Tank	11	10	11	11	11	0	0	0	11	11	11	11
DHW	1	1	1	1	1	1	1	1	1	1	1	1
Space_Heating	7	6	5	5	5	5	5	5	5	5	5	7

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):

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

Building Source EUI = (Electric Usage in kBtu X SS Ratio + Fuel Oil Usage in kBtu X SS Ratio + similar for other fuels)
Building Square Footage
where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.4
Akiak Water Plant 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	98,533 kWh	336,292	3.340	1,123,216
Recovered Heat	359.36 million Btu	359,356	1.280	459,976
#1 Oil	711 gallons	93,893	1.010	94,832
Total		**789,542**		**1,678,024**
BUILDING AREA		1,280	Square Feet	
BUILDING SITE EUI		617	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		1,311	**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 Akiak Water Plant was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Akiak 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 Akiak. 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
Akiak Water Plant, Akiak, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

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	TOTAL, cost-effective measures		**$8,658**	**$17,980**	**4.57**	**2.1**
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Table 4.1 Akiak Water Plant, Akiak, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
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	TOTAL, all measures		$8,681	$18,480	4.46	2.1

4.2 Interactive Effects of Projects

The savings for a particular measure are calculated assuming all recommended EEMs coming before that measure in the list are implemented. If some EEMs are not implemented, savings for the remaining EEMs will be affected. For example, if ceiling insulation is not added, then savings from a project to replace the heating system will be increased, because the heating system for the building supplies a larger load.

In general, all projects are evaluated sequentially so energy savings associated with one EEM would not also be attributed to another EEM. By modeling the recommended project sequentially, the analysis accounts for interactive affects among the EEMs and does not “double count” savings.

Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. When the building is in cooling mode, these items contribute to the overall cooling demands of the building; therefore, lighting efficiency improvements will reduce cooling requirements in air-conditioned buildings. Conversely, lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties and cooling benefits were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1 Air Sealing Measures

Rank	Location	Existing Air Leakage Level (cfm@50/75 Pa)		Recommended Air Leakage Reduction (cfm@50/75 Pa)	
9		Air Tightness from Blower Door Test: 1700 cfm at 50 Pascals		Perform air sealing to reduce air leakage by 5%.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$23
Breakeven Cost	$234	**Savings-to-Investment Ratio**	0.5	**Simple Payback yrs**	22
Auditors Notes: This recommendation does not necessarily have a good payback, but being aware of leaks and taking small measures to reduce air leakages, such as closing the door all the way, adding weather stripping to the front door and using caulk to seal air leakages on the windows could also further reduce heat losses. Given the nature of WTP operations the ventilation requirements are generally greater than the noted air leakage. Increasing facility tightness might require additional mechanical ventilation at times.					

4.4 Mechanical Equipment Measures

4.4.1 Heating/Cooling/Domestic Hot Water Measure

Rank	Recommendation				
1	Humidity Control Controls				
Installation Cost	$1,500	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$809
Breakeven Cost	$15,285	**Savings-to-Investment Ratio**	10.2	**Simple Payback yrs**	2
Auditors Notes: Current ventilation is controlled by a thermostat rather than humidistat. Additionally in the current configuration the heat actuating thermostat is installed directly in the path of outside ventilation air. This causes two opposing thermostat to continuously heat and ventilate the same space.					

4.4.3 Night Setback Thermostat Measures

Rank	Building Space	Recommendation			
3	Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Treatment Plant space.			
Installation Cost	$600	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$208
Breakeven Cost	$3,065	**Savings-to-Investment Ratio**	5.1	**Simple Payback yrs**	3
Auditors Notes: Implementing a setback thermostat for the building to control the temperature could significantly reduce the heating load in the building. By setting the temperature the building is heated to at night and when there is no one in the facility to 55 degrees, the heating demand of the system would be reduced, saving fuel oil. AN additional benefit is reduced humidity, which can be a problem in the water plant.					

4.5 Electrical & Appliance Measures

4.5.1 Lighting Measures

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

Rank	Location	Existing Condition	Recommendation		
4	WTP Lighting	21 FLUOR (4) T12 4' F40T12 34W Energy-Saver Efficient Magnetic with Manual Switching	Replace with 21 LED Replacement Bulbs		
Installation Cost	$3,780	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$1,932
Breakeven Cost	$16,790	**Savings-to-Investment Ratio**	4.4	**Simple Payback yrs**	2
Auditors Notes: Replacing the current T12 40 watt fixtures in the building with LED 18 watt bulbs and removing the ballast of the old fixtures, significant energy savings can be realized. This can be coupled with removing one bulb per fixture, as LED's often produce more light. LED's are appropriate for an industrial setting, and function well in the cold.					

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
8	Pressure Pumps	2 Burks Crane 1-1/4 impeller with Manual Switching	Replace with 2 Burks Crane 1-1/4 impeller		
Installation Cost	$2,600	**Estimated Life of Measure (yrs)**	12	**Energy Savings (/yr)**	$362
Breakeven Cost	$3,675	**Savings-to-Investment Ratio**	1.4	**Simple Payback yrs**	7
Auditors Notes: Replace current motors with premium efficiency motors.					

Rank	Location	Description of Existing	Efficiency Recommendation
6	Lift Station Submersible Pumps	2 Submersible Pumps with Manual Switching	Improve Manual Switching

Installation Cost	$2,500	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$1,236
Breakeven Cost	$7,895	**Savings-to-Investment Ratio**	3.2	**Simple Payback yrs**	2

Auditors Notes: A reevaluation of the controls and some maintenance on the submersible pumps should be done in a single day trip by Tribal Utility Support. Controls were set such that the lead pump would only shut down as the lag pump brought the liquid level below the lag shut-off, this was due to the lack of pump alternation, and the lead pump not properly seated in the wet well. At the time of the visit the lead pump was effectively a sewage 'fountain' and not transferring waste water as designed.

Rank	Location	Description of Existing	Efficiency Recommendation
2	Lift Station Electric Heat	2 Electric Heaters in Lift Station with Manual Switching	Improve Manual Switching

Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$2,576
Breakeven Cost	$16,452	**Savings-to-Investment Ratio**	8.2	**Simple Payback yrs**	1

Auditors Notes: Turning down the heat to 50 degrees, and installing a thermostat to more accurately control the heat would reduce the electrical demand while maintaining an appropriate buffer to keep the station from freezing.

4.5.3 Circulation Loop Measures

Rank	Location	Description of Existing	Efficiency Recommendation
5			Reduce Circulation Loop Heating to 40 degrees based on return temperature, and replace circulation pump motors with premium efficiency motors.

Installation Cost	$4,500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,462
Breakeven Cost	$18,065	**Savings-to-Investment Ratio**	4.0	**Simple Payback yrs**	3

Auditors Notes: Installing controls to control the temperature of the circulation loops by the returning temperature, and then keeping the return temperature at 40 degrees, as opposed to the current 46, will yield significant energy savings. Additionally the circulation pumps should have premium efficiency motors installed during the next pump change.

4.5.5 Water Store Tank Measures

Rank	Location	Description of Existing	Efficiency Recommendation
7			Reduce tank storage temperature to 40 degrees. Repair Heat Add controller to control temperature accurately.

Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$74
Breakeven Cost	$994	**Savings-to-Investment Ratio**	2.0	**Simple Payback yrs**	7

Auditors Notes: Fixing the heat add controller for the water storage tank, and controlling the temperature to be set at 40 degrees would yield significant fuel savings. Additionally this could prevent freezing in the storage tank and could realize additional maintenance savings.

5. ENERGY EFFICIENCY ACTION PLAN

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

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

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