Comprehensive Energy Audit
For
Sleetmute Water Treatment Plant

Prepared For

Sleetmute Traditional Council

August 1, 2011

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Table of Contents

PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Sleetmute Traditional Council. The authors of this report are Carl H. Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM), Chris Mercer, PE and 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 Kenneth Mellick, Sleetmute Water Plant Operator.

1. EXECUTIVE SUMMARY

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

Based on electricity and fuel oil prices in effect at the time of the audit, the annual energy cost for the building analyzed was $5,584 for electricity and $13,500 for #1 fuel oil. This results in a annual energy cost of $19,084 per year.

It should be noted that this facility received a power cost equalization (PCE) subsidy last year. If it did not receive the PCE, the annual electricity cost would have been $11,896 and the total annual energy cost would have been $25,396.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Sleetmute Water Treatment 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	Standby generator heating	Shut off generator heat since the generator has not been used in years.	$406	$0	>100	0.0
2	Other Electrical: Circulation Pumps	Shut off the circulation pumps an additional 30 days per year in the summer	$470	$0	>100	0.0
3	Other Electrical: Tank Heat Circulation Pumps	Shut off the circulation pumps an additional 30 days per year in the summer	$52	$0	>100	0.0
4	Heating and Domestic Hot Water	Convert the boiler from a always hot to a run on demand by any of the three zones, the potable water tank, or the circulation loop only. This can be accomplished with a fairly simple boiler controller. Also, shut off the boiler and Toyotomi Laser 73 an additional 30 days per year.	$2,225	$5,000	8.59	2.2
5	Setback Thermostat: Water Treatment Plant	Implement a heating temperature unoccupied setback to 50.0 deg F for the water treatment plant space.	$50	$200	3.75	4.0

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]**
6	Setback Thermostat: Washeteria (Unused)	Implement a heating temperature unoccupied setback to 50.0 deg F for the washeteria (unused) space.	$12	$100	1.74	8.6
7	Lighting: Exterior Lighting	Replace with 2 LED 17W wall-packs	$70	$400	1.53	5.7
8	Implement Heat Recovery from Power Plant	Add heat recovery from the power plant to the water plant by adding the recovered heat to the circulation loop and then taking some of that heat and using it to heat the potable water storage tank.	$8,646	$120,000	1.10	13.9
	TOTAL, all measures		**$11,931**	**$125,700**	**1.47**	**10.5**

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 $11,931 per year, or 62.5% of the buildings' total energy costs. These measures are estimated to cost $125,700, for an overall simple payback period of 10.5 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**	**Generator Heat Circulation**	**Water Storage & Circulation**	**Vent. Fans**	**Service Fees**	**Total**
Existing Building	$3,369	$0	$0	$220	$5,310	$426	$9,759	$0	$0	**$19,084**
With All Proposed Retrofits	$1,144	$0	$0	$150	$4,747	$0	$1,113	$0	$0	**$7,153**
SAVINGS	$2,225	$0	$0	$70	$564	$426	$8,646	$0	$0	**$11,931**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

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. Sleetmute Water Treatment Plant

3.1. Building Description

The 693 square foot Sleetmute Water Treatment Plant was constructed in 1990. It has a normal occupancy of 1 person. The number of hours of operation for this building average 1.7 hours per day, considering all seven days of the week. The building consists of the water treatment plant, the unused washeteria, and the mechanical room.

The building is mounted on pads, has a 2 X 12 floor joist with R38 insulation, 6 inch studded walls with R19 insulation and an eight inch sloped roof with a cathedral ceiling and 8 inches of insulation.

The building has one small double pane window and the two insulated steel doors. It has one door for the water treatment plant and one door for the unused washeteria. Overall, the building is in fair condition.

A heated water storage tank is located next to the water treatment plant. Within the water treatment plant is all the process equipment necessary to treat the raw well water and the pumps necessary to both circulate the water throughout the village and maintain system pressure.

A back-up generator is located next to the water plant as well. The generator is kept warm with heat off the boilers even though it has not been used for years.

Description of Heating Plant

The Heating Plants used in the building are:

Toyotomi Laser 73

Nameplate Information: L 73 Toyostove has three firing rates, 40,000, 27,000, and 15,000 btu/hr
Fuel Type: #1 Oil
Input Rating: 40,000 BTU/hr
Steady State Efficiency: 87 %
Idle Loss: 1 %
Heat Distribution Type: Air
Notes: This heater is located in the WTP as are three unit heaters that run off the boilers.

Weil McLain 480 Boilers (Two identical boilers)

Fuel Type: #1 Oil
Input Rating: 396,000 BTU/hr
Steady State Efficiency: 83 %
Idle Loss: 3 %
Heat Distribution Type: Water
Boiler Operation: Sep - May

Space Heating Distribution Systems

The Laser 73 is located in the water treatment plant and used to heat that area of the building. There are also three boiler fed unit heaters in the water treatment plant. The old washeteria is heated with baseboard from the boilers and the mechanical room is heated by a combination of convection and radiation off the boilers.

The largest load on the boilers is heating the potable water storage tank and the potable water circulation loop.

Domestic Hot Water System

The hot water system was designed for washeteria use. Since the washeteria is no longer used, hot water consumption is very small.

Waste Heat Recovery Information

No heat recovery from the power plant to the water treatment plant presently exists.

Description of Building Ventilation System

The existing building ventilation system consists of louvered forced air vents. The system is in disrepair and should be fixed to allow proper operation. The primary function of the ventilation system is to control humidity and associated condensation. A second ventilation system serves the mechanical room. The main purpose of this second system is to exhaust excess heat from the boilers.

Lighting

The existing interior lighting consists of fourteen two lamp fluorescent fixtures with standard ballasts and 32 watt T8 lamps.

The existing exterior lighting consists of two 100 watt metal halide fixtures.

Plug Loads

The existing plug loads are minimal and normal for a water treatment plant.

Major Equipment

The major equipment is that used for the treatment, storage and circulation of potable water. It consists mainly of filters, pumps, and the potable water storage tank. The washeteria equipment is no longer used.

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). One kWh usage is equivalent to 1,000 watts running for one hour. 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.

Electricity for the facility is provided by the Middle Kuskokwim Electric Cooperative.

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	$ 0.23/KWH
#1 Oil	$ 6.00/gallon

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Sleetmute Traditional Council pays approximately $19,084 annually for electricity and fuel oil for the Sleetmute Water Treatment 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

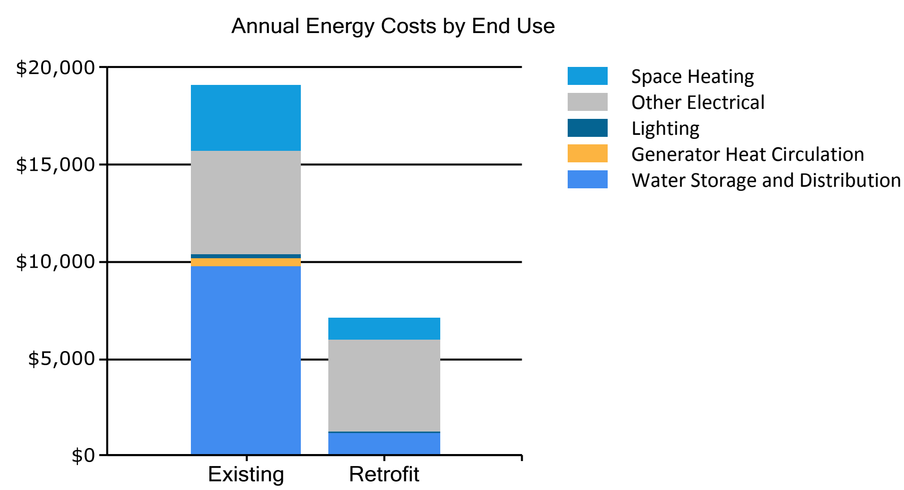


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

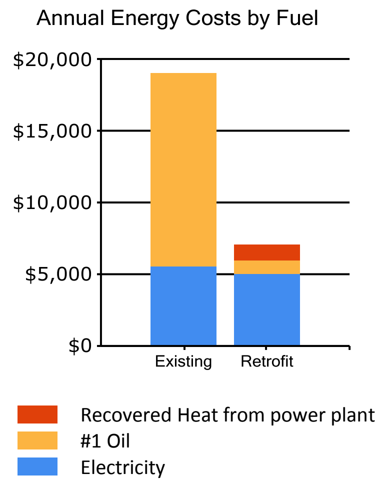
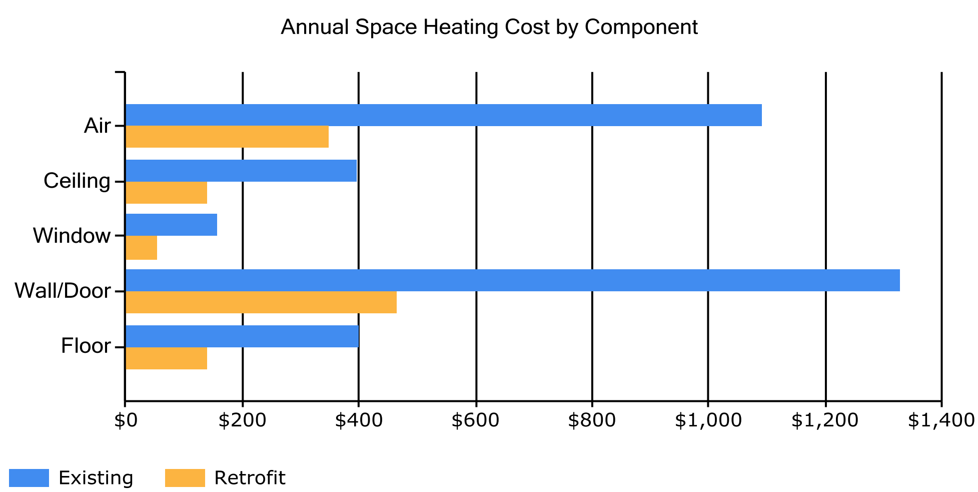


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the existing 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.

Electrical Consumption (KWH)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	97	88	97	94	73	48	50	50	72	97	94	97
Other Electrical	2702	2462	2702	2615	1555	465	480	480	1611	2702	2615	2702
Generator Heat Circulation	0	0	0	0	0	0	0	0	0	0	0	0
Water Storage and Circulation	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
Domestic Hot Water	0	0	0	0	0	0	0	0	0	0	0	0
Space Heating	23	20	22	22	15	14	15	15	22	22	22	22
Space Cooling	0	0	0	0	0	0	0	0	0	0	0	0

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Generator Heat Circulation	8	7	8	8	8	0	0	0	8	8	8	8
Water Storage and Circulation	185	168	185	179	185	0	0	0	179	185	179	185
Domestic Hot Water	0	0	0	0	0	0	0	0	0	0	0	0
Space Heating	71	63	69	67	2	2	2	2	67	69	67	71

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):

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

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

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

Table 3.4
Sleetmute Water Treatment 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	24,278 KWH	82,861	3.340	276,756
#1 Oil	2,250 gallons	297,000	1.010	299,970
Total		**379,861**		**576,726**
BUILDING AREA		693	Square Feet	
BUILDING SITE EUI		548	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		832	**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 Sleetmute Water Treatment Plant was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Sleetmute 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 Sleetmute. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the fuel oil 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.

Table 4.1 Sleetmute Water Treatment Plant, Sleetmute, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**
1	Standby generator heating	Shut off generator heat since the generator has not been used in years	$406	$0	>100	0.0
2	Other Electrical: Circulation Pumps	Shut off the circulation pumps an additional 30 days per year	$470	$0	>100	0.0
3	Other Electrical: Tank Heat Circulation Pumps	Improve Manual Switching	$52	$0	>100	0.0
4	Heating and Domestic Hot Water	Convert the boiler from an always hot to a run on demand by any of the three zones, the potable water tank, or the circulation loop only. This can be accomplished with a fairly simple boiler controller. Also, shut off the boiler and Toyotomi Laser 73 an additional 30 days per year.	$2,225	$5,000	8.59	2.2
5	Setback Thermostat: Sleetmute Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Sleetmute Water Treatment Plant space.	$50	$200	3.75	4.0
6	Setback Thermostat: Washeteria (Unused)	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Washeteria (Unused) space.	$12	$100	1.74	8.6
7	Lighting: Exterior Lighting	Replace with 2 LED 17W wall-packs	$70	$400	1.53	5.7

Table 4.1 Sleetmute Water Treatment Plant, Sleetmute, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**
8	Implement Heat Recovery from Power Plant	Add heat recovery from the power plant to the water plant by adding the recovered heat to the circulation loop and then taking some of that heat and using it to heat the potable water storage tank.	$8,646	$120,000	1.10	13.9
	TOTAL, all measures		**$11,931**	**$125,700**	**1.47**	**10.5**

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 Heating Measures

4.3.1. EEM Heating Plants and Distribution Systems

A heating system is expected to last approximately 20-25 years, depending on the system. If the system is nearing the end of its life, it is better to replace it sooner rather than later to avoid being without heat for several days when it fails. This way, you will have time to compare bids, check references and ensure the contractors are bonded and insured.

Recommendation: Convert the boilers from an always hot to a run on demand by any of the three zones, the potable water tank, or the circulation loop only. This can be accomplished with a fairly simple boiler controller and a control panel. Also, shut off the boiler and Toyotomi Laser 73 an additional 30 days per year.

Estimated Cost: $5,000

Estimate Savings per Year: $2,225

Energy Auditor Comments: This EEM will require both a plumber and an electrician to implement. It is recommended that it be implemented at the same time as the heat recovery to minimize travel costs.

4.3.1.1. EXISTING SYSTEMS

4.3.1.1.1 Toyotomi Laser 73
Description: L 73 Toyostove has three firing rates, 40,000, 27,000, and 15,000 btu/hr heating plant fueled by #1 Fuel Oil, with a forced Induced draft.
Size : 40,000 BTU/h
Efficiency (Steady State & Idle): 87%
Portion of heat supplied by this unit: 70%
Notes: This heater is located in the WTP as are three unit heaters that run off the boilers.

4.3.1.1.2 Weil McLain 480 Boilers (2 identical)
Description: Heating plant fueled by #1 fuel oil, with a natural draft.
Size : 396,000 BTU/hr
Efficiency (Steady State & Idle): 83%
Portion of heat supplied by this unit: 100%
Notes: These boilers are located in the mechanical room.

4.3.1.1.3 Mechanical Room

Notes: The mechanical room is heated by the convection and radiation losses off the boiler.

4.3.1.1.4 Water treatment plant

Notes: The water treatment plant is heated by a combination of the boiler and the Laser 73.

Notes: The washeteria is heated by the boiler but is not in use at this time.

4.3.1.2. PROPOSED SYSTEMS

4.3.1.2.1 Toyotomi Laser 73
Description: L 73 Toyostove has three firing rates, 40,000, 27,000, and 15,000 btu/hr heating plant fueled by #1 Fuel Oil, with a Forced Induced draft.
Size : 40,000 BTU/Hr
Efficiency (Steady State & Idle): 87%
Portion of heat supplied by this unit: 70%
Notes: This heater is located in the WTP as are three unit heaters that run off the boilers.

4.3.1.2.2 Weil McLain 480 Boiler
Description: heating plant fueled by #1 Fuel Oil, with a Natural draft.
Size: 396,000 BTU/Hr
Efficiency (Steady State & Idle): 83%
Portion of heat supplied by this unit: 100%
Notes:

4.3.1.2.3 Mechanical Room

Notes: The mechanical room is heated by the convection and radiation losses off the boiler.

4.3.1.2.4 Water treatment plant

Notes: The water treatment plant is heated by a combination of the boiler and the Laser 73.

4.3.1.2.5 Washeteria

Notes: The washeteria is heated by the boiler but is not in use at this time.

4.3.2 Programmable Thermostats

Location	Existing Situation	Recommended Improvement	Install Cost	Annual Savings	Notes
Sleetmute Water Treatment Plant	Existing Unoccupied Heating Setpoint: 65.0 deg F	Implement a heating temperature unoccupied Setback to 50.0 deg F for the Water Treatment Plant space.	$200	$50	
Washeteria (Unused)	Existing Unoccupied Heating Setpoint: 70.0 deg F	Implement a heating temperature unoccupied Setback to 50.0 deg F for the washeteria (Unused) space.	$100	$12	

4.4 LIGHTING UPGRADES

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

4.4.1 Lighting Upgrade – Replace Existing Fixtures and Bulbs

Location	Existing Lighting	Recommended Improvement	Install Cost	Annual Savings	Notes
Exterior Lighting	2 MH 100 Watt Magnetic with Photocell	Replace with 2 LED 17W wall-packs	$400	$70	Replace the two 100 watt metal halide exterior light fixtures with new 17 watt LED wallpacks.

Description:
This EEM includes replacement of the existing fixtures containing a 100watt metal halide lamp and magnetic ballasts with fixtures containing a 17 watt LED lamp. The new energy efficient, LED fixtures will provide adequate lighting and will save the owner on electrical costs due to the better performance of the lamp. There is no ballast. This EEM will also provide maintenance savings through the reduced number of lamps replaced per year. The expected lamp life of a

LED lamp is approximately 50,000 burn-hours, in comparison to the existing metal halide lamp which is approximately 15,000 burn-hours.

4.5 Back Up Generator

Location	Life in Years	Description	Recommendation	Cost	Savings	Notes
	15	Generator Heat	Shut off generator heat since the generator has not been used in years.	$0	$406	

During the audit, the water plant operator mentioned that the back-up generator has not been started for many years, probably would not run if the operator tried to start it, and the operator does not see a time in the future when it would be used. If this is the case, there is no reason to continue to heat it.

4.6 Heat Recovery

Location	Life in Years	Energy Source	Description	Recommendation	Cost	Savings	Notes
Water Treatment Plant	15	Power Plant		Add heat recovery from the power plant to the water plant by adding the recovered heat to the circulation loop and then taking some of that heat and using it to heat the potable water storage tank.	$120,000	$8,646	

An analysis of both the waste heat available from the power plant and the heat needed by the water plant for process loads such as the potable water tank and the potable water circulation loop indicate that this would project would significantly reduce the fuel oil consumed by the water treatment plant. The analysis shows that the savings would be approximately $8,646 annually and that the oil consumption would be reduced by approximately 2,068 gallons per year.

Implementation of this project would require some design effort. Based on the many projects completed recently by the Energy Projects Group of ANTHC, the design would cost approximately $25,000.

The power plant is located too far from the water treatment plant to run recovered heat lines between them. Another method used often is to locate a heat exchanger in the power plant and run heat recovery lines from the power plant to the nearest water line outside the power plant. This is feasible in Sleetmute. Another heat exchanger would then be located in the water treatment plant and some of the heat would be extracted from the loop and used to heat the potable water tank. These two uses comprise the majority of the heat load in the water treatment plant.

4.7 Other Electrical

Location	Life in Years	Description	Recommendation	Cost	Savings	Notes
Circulation Pumps	7	Potable Water Circulation Pumps with Manual Switching	Improve Manual Switching	$0	$470	Shut off potable water circulation heat 30 days sooner.
Tank Heat Circulation Pumps	7	Circulation Pumps for Storage Tank Heat with Manual Switching	Improve Manual Switching	$0	$52	Shut off potable water circulation pumps thirty days sooner.

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 contractor is used to install both the heat recovery and the mechanical room upgrades, implementation of these measures should be scheduled to occur simultaneously.

APPENDIX

Attached to this report is Appendix A. The objective of appendix A is to provide the Tribal Council with a wide range of energy conservation and renewable energy websites to further your knowledge.

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