Comprehensive Energy Audit
For
Chefornak Water Treatment Plant

Prepared For
City of Chefornak

June 6, 2012

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the City of Chefornak. The authors of this report are Carl Remley, 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 Tom Mael, Water Plant Operator, and Bernard Mael, City Administrator.

1. EXECUTIVE SUMMARY

This report was prepared for the City of Chefornak. The scope of the audit focused on Chefornak 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, 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 $5,485 for Electricity and $8,690 for #1 Oil, with total energy costs of $14,175 per year.

It should be noted that this facility received the power cost equalization (PCE) subsidy from the State of Alaska last year. If this facility had not received PCE, total electrical costs would have been $8,913.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Chefornak 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	Other Electrical - Power Retrofit: Loop Circulation Pumps	Shut off one circulation pump.	$595	$10	368.40	0.0
2	Cooking and Clothes Drying – Clothes Dryer	Savings resulting from less heat loss to stored water due to temperature setback.	$1,484	$500	40.28	0.3
3	Setback Thermostat: Water Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Plant space.	$1,527	$1,800	11.49	1.2
4	Lighting - Controls Retrofit: Fluorescent Lighting	Install exterior LED wall packs and stop using interior lighting for locating the building.	$356	$600	4.79	1.7
5	Other Electrical - Controls Retrofit: Well Line Heat Tape	Install flow switch on the well line heat so that the heat tape shuts off unless the flow is zero.	$830	$1,200	4.28	1.4
6	Exposed Floor: WTP	Install R-14 rigid board insulation	$278	$1,688	3.90	6.1
7	Air Tightening	Perform air sealing to reduce air leakage by 125 cfm at 50 Pascals.	$104	$950	1.02	9.1
	TOTAL, all measures		**$5,175**	**$6,748**	**8.90**	**1.3**

Table Notes:

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

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

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $5,175 per year, or 36.5% of the buildings' total energy costs. These measures are estimated to cost $6,748, for an overall simple payback period of 1.3 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	Total Cost
Existing Building	$5,718	$0	$0	$630	$0	$4,354	$0	$3,474	$0	**$14,175**
With All Proposed Retrofits	$3,951	$0	$0	$130	$0	$2,929	$0	$1,989	$0	**$9,000**
SAVINGS	$1,766	$0	$0	$500	$0	$1,425	$0	$1,484	$0	**$5,175**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

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

1) Water Plant: 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. Chefornak Water Treatment Plant

3.1. Building Description

The 600 square foot Chefornak Water Treatment Plant was constructed in 1982, with a normal occupancy of one person. The number of hours of operation for this building average one hour per day, considering all seven days of the week.

The Chefornak Water Plant receives water from a fairly shallow well, which operates on a variable frequency drive and constantly pumps water at a slow rate. The well has a salt water intrusion problem, and the water is considered undrinkable, but usable for non-drinking purposes. Most residents use ice water in the winter and rain water in the summer of drinking water. The school uses water from the well and treats it with a reverse osmosis system on site.

Water is pumped into an indoor storage tank and run through sand filters, and when the pump is working, chlorine is added. The water storage tank rests on a severely damaged floor and has a history of leaks. The water is then circulated throughout town to about twelve functioning watering points. There is the capability of adding heat to this water in the water plant; however, currently recovered heat from the power plant supplies the circulation loop with all of its heat requirements.

The watering points are all heated electrically and some have small strips of heat tape in the hose supplying water to the exterior of the small watering points. The heat tapes have been removed in most watering points, and it appears they may be unnecessary in all of them. The heat in most of the watering points is turned up to 80 degrees. By reducing this heat to 40 degrees or just enough to keep the watering points from freezing, a substantial electrical load could be removed. Though the watering points aren’t charged for electricity, by reducing their load, it could very well reduce the demand at the power plant and allow the power plant to run on a smaller generator.

Description of Building Shell

The exterior walls are constructed with 6 inch structurally insulated panels and have 5.5 inches of very damaged polyurethane insulation.

The roof of the building is a cold roof with 5.5 inches of polyurethane insulation.

The floor of the building is built on pilings with 2 inches of very damaged polyurethane insulation.

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

Doors are metal, with a fiberglass core and metal edges.

Description of Heating Plants

The Heating Plants used in the building are:

Weil McLain Boiler #1

Nameplate Information:	WGO-7
Fuel Type:	#1 Oil
Input Rating:	242,000 BTU/hr
Steady State Efficiency:	84 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	Oct - Jun
Notes:	2.0 gph, Beckett AFG burner, 1/7 hp

Space Heating Distribution Systems

The only heat provided to the building is a single small unit heater. The heat in the building keeps the facility from freezing and is maintained at 70 degrees. A good amount of the heat required for this facility goes into the interior water storage tank, which is maintaining water coming in from the well at 34 degrees.

Heat Recovery Information

Heat from the AEA power plant is added directly to the circulating water loop. This heat is more than sufficient to keep the circulation loop from freezing.

Lighting

Lighting in the facility is made up primarily of three fluorescent T8 electronic ballasts with four 32 watt bulbs each.

Major Equipment

The submersible well pump is the largest single electrical load in the building. The well is 56 feet deep, runs automatically controlled by a VFD and pumps about 10 gallons per minute. It was installed in 2011.

Within the well line is a heat tape which is currently on all winter long.

The circulation pumps for the town circulation loop are Grundfos UPS40-160-2F, set on Speed 3. Both pumps, which are piped in parallel, are used all winter long.

There is also an electric well box heater, which runs about 25% of the time all winter long.

There are two single phase one horsepower pumps, which maintain pressure, and also are used to backwash the filters on the water treatment system.

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: Naterkaq Light Plant - 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	$ 0.32/kWh
#1 Oil	$ 7.14/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Chefornak pays approximately $14,175 annually for electricity and other fuel costs for the Chefornak 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

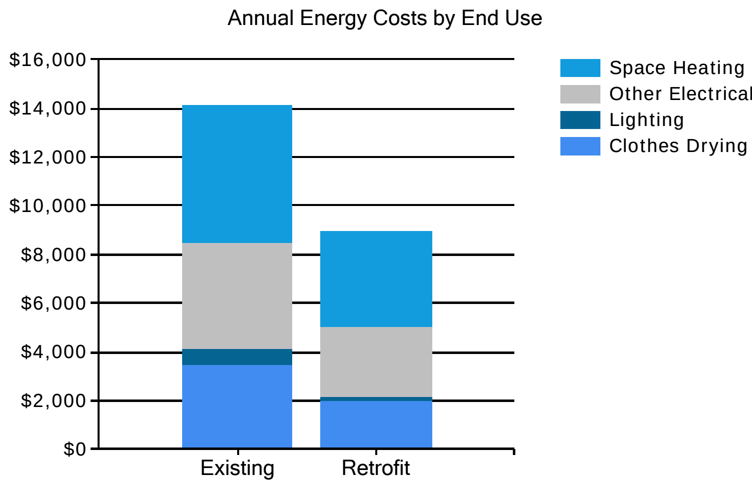


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

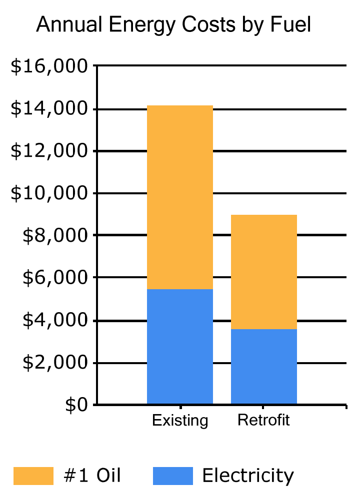
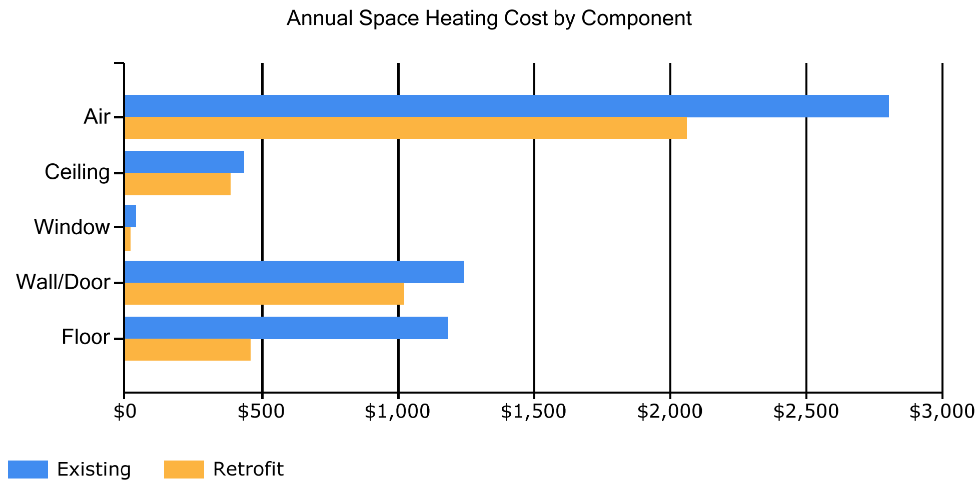


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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. 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	1361	1240	1361	1317	1080	790	816	816	790	1361	1317	1361
Lighting	167	152	167	162	167	162	167	167	162	167	162	167
Space_Heating	214	195	210	195	102	9	9	9	9	199	200	214

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Clothes_Drying	62	57	62	60	62	0	0	0	0	62	60	62
Space_Heating	102	92	87	58	35	32	33	33	32	51	73	102

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):

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

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

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

Table 3.4
Chefornak 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	17,141 kWh	58,501	3.340	195,392
#1 Oil	1,217 gallons	160,663	1.010	162,269
Total		**219,163**		**357,661**
BUILDING AREA		600	Square Feet	
BUILDING SITE EUI		365	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		596	**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 Chefornak Water Treatment Plant was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Chefornak 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 Chefornak. 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
Chefornak Water Treatment Plant, Chefornak, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Other Electrical - Power Retrofit: Loop Circulation Pumps	Shut off one circulation pump.	$595	$10	368.40	0.0
2	Cooking and Clothes Drying - ClothesDryer	Savings resulting from less heat loss to stored water due to temperature setback.	$1,484	$500	40.28	0.3
3	Setback Thermostat: Water Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Plant space.	$1,527	$1,800	11.49	1.2
4	Lighting - Controls Retrofit: Fluorescent Lighting	Install exterior LED wall packs and stop using interior lighting for locating the building.	$356	$600	4.79	1.7
5	Other Electrical - Controls Retrofit: Well Line Heat Tape	Install flow switch on the well line heat so that the heat tape shuts off unless the flow is zero.	$830	$1,200	4.28	1.4
6	Exposed Floor: WTP	Install R-14 rigid board insulation	$278	$1,688	3.90	6.1

Table 4.1 Chefornak Water Treatment Plant, Chefornak, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**
7	Air Tightening	Perform air sealing to reduce air leakage by 125 cfm at 50 Pascals.	$104	$950	1.02	9.1
	TOTAL, all measures		**$5,175**	**$6,748**	**8.90**	**1.3**

4.2 Interactive Effects of Projects

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

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

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

4.3 Building Shell Measures

4.3.1 Insulation Measures

Rank	**Location**	**Existing Type/R-Value**		**Recommendation Type/R-Value**	
6	Exposed Floor: WTP	Framing Type: 2 x Lumber Insulating Sheathing: None Top Insulation Layer: None Bottom Insulation Layer: Polyurethane (PLUR), 2 inches Insulation Quality: Very Damaged Modeled R-Value: 11.6		Install R-14 rigid board insulation	
Installation Cost	$1,688	**Estimated Life of Measure (yrs)**	30	**Energy Savings (/yr)**	$278
Breakeven Cost	$6,583	**Savings-to-Investment Ratio**	3.9	**Simple Payback yrs**	6
Auditors Notes: The floor is badly water damaged and in needs of repairs. If the floor is repaired, further insulation would help reduce heating costs.					

4.3.2 Air Sealing Measures

Rank	Location	Existing Air Leakage Level (cfm@50/75 Pa)		Recommended Air Leakage Reduction (cfm@50/75 Pa)	
7		Air Tightness estimated as: 1400 cfm at 50 Pascals		Perform air sealing to reduce air leakage by 125 cfm at 50 Pascals.	
Installation Cost	$950	Estimated Life of Measure (yrs)	10	Energy Savings (/yr)	$104
Breakeven Cost	$969	Savings-to-Investment Ratio	1.0	Simple Payback yrs	9
Auditors Notes: Properly close up old stacks to prevent air leakage and heat transfer.					

4.4 Mechanical Equipment Measures

4.4.1 Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
3	Water Plant			Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Plant space.	
Installation Cost	$1,800	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	$1,527
Breakeven Cost	$20,685	Savings-to-Investment Ratio	11.5	Simple Payback yrs	1
Auditors Notes: Install a Tekmar to control the boilers and control the temperature of the building based on outdoor temperatures. The facility only needs to be maintained at a temperature of 50 degrees to prevent freeze ups, since the facility is very rarely occupied.					

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	Fluorescent Lighting	3 FLUOR (4) T8 4' F32T8 32W Standard Instant Electronic with Manual Switching		Install Exterior LED wall packs and stop leaving the interior fluorescent lighting on for safety.	
Installation Cost	$600	Estimated Life of Measure (yrs)	10	Energy Savings (/yr)	$356
Breakeven Cost	$2,876	Savings-to-Investment Ratio	4.8	Simple Payback yrs	2
Auditors Notes: Installing two LED 20W Exterior Wall packs with daylight sensors would allow the operators to turn off the interior lights at night but still provide a safety margin for finding the facility.					

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
1	Loop Circulation Pumps	1 Loop Circulation Pump with Manual Switching		Replace with Loop Circulation Pump	
Installation Cost	$10	Estimated Life of Measure (yrs)	7	Energy Savings (/yr)	$595
Breakeven Cost	$3,684	Savings-to-Investment Ratio	368.4	Simple Payback yrs	0
Auditors Notes: The pumps are piped in parallel, only one should be running at a time. The other should be turned off, valved off and used as a backup in case the primary pump fails.					

Rank	Location	Description of Existing	Efficiency Recommendation		
5	Well Line Heat Tape	Heat Tape with Manual Switching	Improve Manual Switching		
Installation Cost	$1,200	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$830
Breakeven Cost	$5,136	**Savings-to-Investment Ratio**	4.3	**Simple Payback yrs**	1
Auditors Notes: The heat tape should be primarily for recovery purposes. Since the pump is always pumping water on A VFD, the water should always be moving out of the well. By placing the heat tape on a flow switch, it would only activate if the flow rate was zero, preventing a freeze up, otherwise the heat tape should be off and the flow of the water should be enough to prevent freezing.					

4.5.3 Clothes Drying Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
2			Savings resulting from less heat loss to stored water due to temperature setback.		
Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,484
Breakeven Cost	$20,138	**Savings-to-Investment Ratio**	40.3	**Simple Payback yrs**	0
Auditors Notes: By reducing the heating level in the building, and carefully maintain it at 50 degrees, the facility should make a significant savings. Because the water storage is located inside the facility, heat is required to bring that water up to room temperature. By reducing the temperature to 50 degrees, there would be even less heating demand in the facility.					

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