



Comprehensive Energy Audit For Chefornak Washeteria



Prepared For
City of Chefornak

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Prepared By:

ANTHC-DEHE
1901 Bragaw Street, Suite 200
Anchorage, Alaska 99508

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the City of Chefnak. 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 Chefnak. The scope of the audit focused on Chefnak Washeteria. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, HVAC systems, and plug loads.

Based on electricity and fuel oil prices in effect at the time of the audit, the annual predicted energy costs for the buildings analyzed are \$9,587 for Electricity and \$5,295 for #1 Oil, with total energy costs of \$14,882 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 \$15,107.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Chefnak Washeteria. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.1 PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
1	Setback Thermostat: Boiler Room	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Boiler Room space.	\$46	\$10	60.00	0.2
2	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Washeteria space.	\$111	\$200	7.30	1.8
3	Other Electrical - Power Retrofit: Domestic Water Heat Tape	Replace Water Circulation Pump and use the circulation pump in place of the heat tape on the water service.	\$684	\$800	5.29	1.2
4	Lighting - Controls Retrofit: Washeteria Lighting	Add new Occupancy Sensor	\$389	\$1,000	3.22	2.6
5	Air Tightening: Boiler Room	Perform air sealing to reduce air leakage by 250 cfm at 50 Pascals.	\$102	\$300	3.06	2.9

Table 1.1
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

1	Setback Thermostat: Boiler Room	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Boiler Room space.	\$46	\$10	60.00	0.2
6	HVAC And DHW	Complete the heat recovery installation, insulate piping in the boiler room and the washeteria, installed Tekmar unit to control the boiler and heat recovery system. The heat recovery line between the washeteria and the power plant has been installed. The remaining work on the heat recovery system is to add a heat exchanger at both plants and install the necessary pumps and controls.	\$6,068 + \$350 Maint. Savings	\$55,000	1.95	9.1
7	Lighting - Power Retrofit: Exterior Lighting	Replace with LED 20W Module Electronic wall packs	\$55 + \$10 Maint. Savings	\$300	1.83	5.5
8	Other Electrical - Controls Retrofit: Sewer Outfall Heat Tape	Repair insulation and leak on sewage tank outfall.	\$242	\$1,000	1.50	4.1
	TOTAL, all measures		\$7,697 + \$360 Maint. Savings	\$58,610	2.04	7.6

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 \$7,697 per year, or 51.7% of the buildings' total energy costs. These measures are estimated to cost \$58,610, for an overall simple payback period of 7.6 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	\$1,820	\$0	\$5,202	\$1,087	\$0	\$2,037	\$0	\$4,735	\$0	\$14,882
With All Proposed Retrofits	\$136	\$0	\$641	\$561	\$0	\$1,112	\$0	\$4,735	\$0	\$7,185
SAVINGS	\$1,684	\$0	\$4,562	\$526	\$0	\$926	\$0	\$0	\$0	\$7,697

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Chefnak Washeteria. The scope of this project included evaluating building shell, lighting and other electrical systems, and HVAC equipment, motors and pumps. Measures were analyzed based on life-cycle-cost techniques, which include the initial cost of the equipment, life of the equipment, annual energy cost, annual maintenance cost, and a discount rate of 3.0%/year in excess of general inflation.

2.2 Audit Description

Preliminary audit information was gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is used and what opportunities exist within a building. The entire site was surveyed to inventory the following to gain an understanding of how each building operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Building-specific equipment

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from Chefnak Washeteria enable a model of the building's energy usage to be developed, highlighting the building's total energy consumption, energy consumption by specific building component, and equivalent energy cost. The analysis involves distinguishing the different fuels used on site, and analyzing their consumption in different activity areas of the building.

Chefnak Washeteria is classified as being made up of the following activity areas:

- 1) Washeteria: 270 square feet
- 2) Boiler Room: 80 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 $SIR \geq 1$ 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 Washeteria

3.1. Building Description

The 350 square foot Chefornak Washeteria was constructed in 2008 and has a normal occupancy of one person. The number of hours of operation for this building average 8.7 hours per day, considering all seven days of the week.

The building is heated by a detached boiler room, which supplies the facility with both heat and hot water. This model reflects the costs of heating both spaces.

Description of Building Shell

The exterior walls of the washeteria are constructed with double structurally insulated panels, with a total of 11.5 inches of polyurethane insulation.

The roof of the building is a cold roof with 8 inches of polyurethane insulation.

The floor of the facility is built on pilings with 7 inches total of polyurethane insulation.

Typical windows throughout the building are double paned insulated vinyl windows.

Doors are metal with a polyurethane core.

The boiler room is built on piling, has a warm roof, 6 inches structurally insulated panel walls, and a single metal door with no windows. The facility is fairly well insulated with polyurethane insulation.

Description of Heating Plants

The Heating Plants used in the building are:

Burnham MPO-IQ Boiler

Fuel Type:	#1 Oil
Input Rating:	112,000 BTU/hr
Steady State Efficiency:	85 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year

Electric Heater

Fuel Type:	Electricity
Input Rating:	0 BTU/hr
Steady State Efficiency:	100 %
Idle Loss:	0 %
Heat Distribution Type:	Air

Space Heating Distribution Systems

Several unit heaters heat the building and there is baseboard or in floor heating for the showers. There is an electric heater that heats the building when the facility runs out of fuel.

Unit heaters 3 and 4 pull 2.5 amps. Unit Heaters #1 is 1/25 HP and #2 and the boiler building UH pulls 1.3 amps

There is about 40 feet of 1 1/2 inch uninsulated copper piping, 60 feet of 3/4 inch uninsulated copper piping, and 20 feet of 1/2 inch uninsulated copper piping in the facility.

Domestic Hot Water System

The boiler room features a Superstar Ultra 60 gallon hot water tank heated by the boiler. The washeteria uses about 180 gallons of hot water per day, primarily in the washing machines and showers.

Lighting

Lighting in the facility is made up primarily of five t8 electronic ballast fixtures with three 32 watt bulbs each controlled by manual switching. In the entry way there is a T5 electronic fixture with two 45 watt bulbs. The exterior lighting is made up of a single 70 watt metal halide fixture.

Plug Loads

The main plug loads in the facility are the three Maytag washing machines.

Major Equipment

The largest electrical load in the facility is the four ADE 330 Electric Dryers.

In the boiler room there is a heat tape keeping the domestic water line from freezing. There is an additional heat tap wrapped around the sewer outfall line going into the sewage holding tank.

The pumps circulating the hot water in the facility are Grundfos UPS 32-160F circulation pumps, of which only one is running, the other is piped in parallel and a backup.

The water circulation pump has frozen and is broken and no longer functioning.

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	\$ 0.33/kWh
#1 Oil	\$ 7.43/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Chefnak pays approximately \$15,798 annually for electricity and other fuel costs for the Chefnak Washeteria.

Figure 3.1 below reflects the estimated distribution of costs across the primary end uses of energy based on the AkWarm© computer simulation. Comparing the “Retrofit” bar in the figure to the “Existing” bar shows the potential savings from implementing all of the energy efficiency measures shown in this report.

Figure 3.1
Annual Energy Costs by End Use

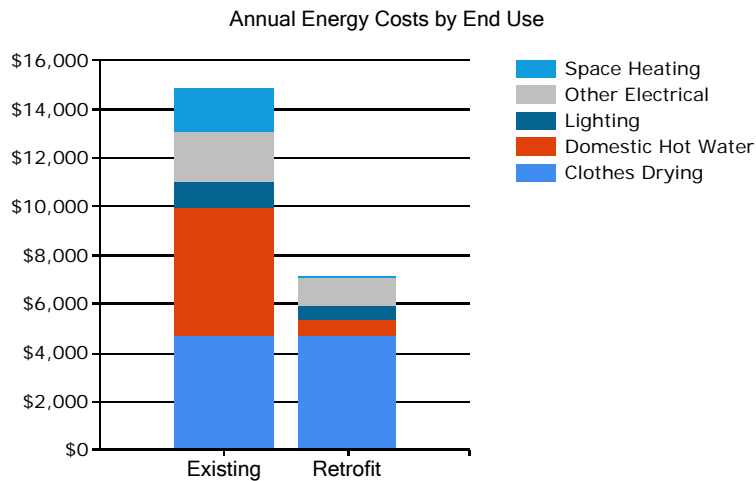


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

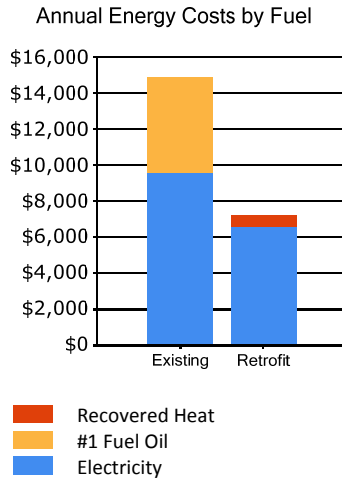
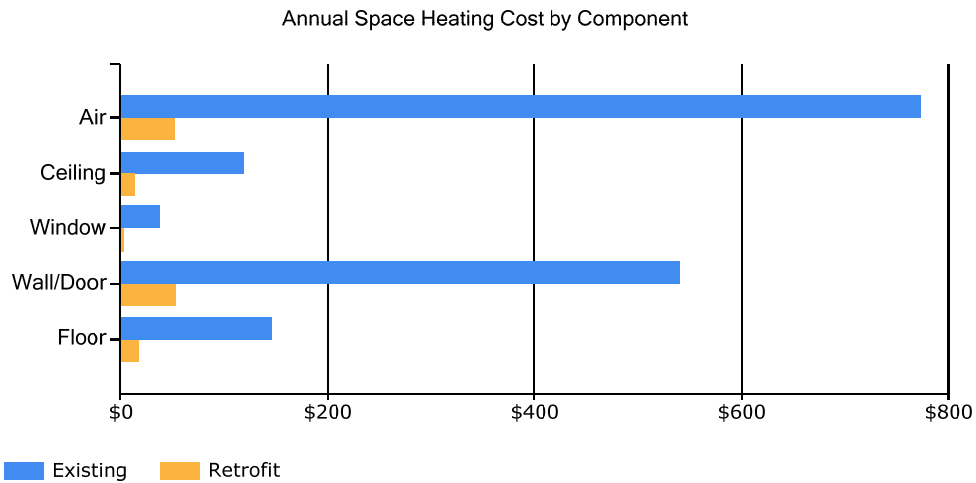


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

Figure 3.3
Annual Space Heating Cost by Component



The tables below show AkWarm’s estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below “DHW” refers to Domestic Hot Water heating.

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	280	255	280	271	280	271	280	280	271	280	271	280
Other_Electrical	735	670	735	712	735	99	102	102	99	735	712	735
Clothes_Drying	1218	1110	1218	1179	1218	1179	1218	1218	1179	1218	1179	1218
DHW	13	12	13	13	13	13	13	13	13	13	13	13
Space_Heating	476	431	439	401	413	400	413	413	400	414	406	476

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	58	53	59	57	59	57	59	59	57	59	57	58
Space_Heating	7	6	0	0	0	0	0	0	0	0	0	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):

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

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

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

**Table 3.4
Chefornak Washeteria EUI Calculations**

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	28,881 kWh	98,572	3.340	329,232
#1 Oil	843 gallons	111,334	1.010	112,447
Total		209,906		441,679
BUILDING AREA 350 Square Feet				
BUILDING SITE EUI 600 kBTU/Ft ² /Yr				
BUILDING SOURCE EUI 1,262 kBTU/Ft ² /Yr				
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

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 Washeteria 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 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 Chefnak Washeteria, Chefnak, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Setback Thermostat: Boiler Room	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Boiler Room space.	\$46	\$10	60.00	0.2
2	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Washeteria space.	\$111	\$200	7.30	1.8
3	Other Electrical - Power Retrofit: Domestic Water Heat Tape	Replace Water Circulation Pump and use the circulation pump in place of the heat tape on the water service.	\$684	\$800	5.29	1.2
4	Lighting - Controls Retrofit: Washeteria Lighting	Add new Occupancy Sensor	\$389	\$1,000	3.22	2.6
5	Air Tightening: Boiler Room	Perform air sealing to reduce air leakage by 250 cfm at 50 Pascals.	\$102	\$300	3.06	2.9
6	HVAC And DHW	Complete the heat recovery installation, insulate piping in the boiler room and the washeteria, installed Tekmar unit to control the boiler and heat recovery system. The heat recovery line between the washeteria and the power plant has been installed. The remaining work on the heat recovery system is to add a heat exchanger at both plants and install the necessary pumps and controls.	\$6,068 + \$350 Maint. Savings	\$55,000	1.95	9.1
7	Lighting - Power Retrofit: Exterior Lighting	Replace with LED 20W Module Electronic wall packs	\$55 + \$10 Maint. Savings	\$300	1.83	5.5

Table 4.1
Chefornak Washeteria, Chefornak, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
8	Other Electrical - Controls Retrofit: Sewer Outfall Heat Tape	Repair insulation and leak on sewage tank outfall.	\$242	\$1,000	1.50	4.1
	TOTAL, all measures		\$8,613 + \$360 Maint. Savings	\$58,610	2.32	6.8

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)
5	Boiler Room	Air Tightness estimated as: 725 cfm at 50 Pascals	Perform air sealing to reduce air leakage by 250 cfm at 50 Pascals.
	Installation Cost	\$300	Estimated Life of Measure (yrs) 10
	Breakeven Cost	\$349	Savings-to-Investment Ratio 2.9
			Energy Savings (/yr) \$102
			Simple Payback yrs 8
Auditors Notes: Seal all air access to the boiler room to reduce heat loss as well as to help make sure the boiler stays lit. The main area of leakage is where the heat recovery pipes enter and exit the boiler room. Due to the leakage, a freeze-up occurred during the winter that fractured the housing of the circulation pump.			

4.4 Mechanical Equipment Measures

4.4.1 Heating/ Domestic Hot Water Measure

Rank	Recommendation				
6	Complete the heat recovery installation, insulate piping in the boiler room and the washeteria, installed Tekmar unit to control the boiler and heat recovery system. The heat recovery line between the washeteria and the power plant has been installed. The remaining work on the heat recovery system is to add a heat exchanger at both plants and install the necessary pumps and controls.				
Installation Cost	\$55,000	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$6,068
				Maintenance Savings (/yr)	\$350
Breakeven Cost	\$125,031	Savings-to-Investment Ratio	1.95	Simple Payback yrs	8
Auditors Notes: Though the current power plant is already providing about 100,000 btu/hr of heat to the towns water circulation loop, there should be about 200,000 btu/hr left over for use in the washeteria, which is more than sufficient to cover the buildings heating needs.					

4.4.2 Night Setback Thermostat Measures

Rank	Building Space	Recommendation			
1	Boiler Room	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Boiler Room space.			
Installation Cost	\$10	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$46
Breakeven Cost	\$61	Savings-to-Investment Ratio	.2	Simple Payback yrs	2
Auditors Notes: The boiler room should only be heated to 50 degrees. Turn the thermostat to 50 and lock it in place. The room does not need to be heated to comfortable temperatures as it is almost never occupied.					

Rank	Building Space	Recommendation			
2	Washeteria	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Washeteria space.			
Installation Cost	\$200	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$111
Breakeven Cost	\$456	Savings-to-Investment Ratio	1.8	Simple Payback yrs	6
Auditors Notes: When the washeteria is closed, the temperature in the building should be set back to 50 degrees to reduce heating costs. A setback thermostat can be installed and programmed to call for heat only when the facility is occupied or scheduled to be open.					

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.

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition	Recommendation		
7	Exterior Lighting	MH 70 Watt Electronic with Manual Switching	Replace with LED 20W Module Electronic		
Installation Cost	\$300	Estimated Life of Measure (yrs)	10	Energy Savings (/yr)	\$55
				Maintenance Savings (/yr)	\$10
Breakeven Cost	\$548	Savings-to-Investment Ratio	1.8	Simple Payback yrs	5
Auditors Notes: Replacing current metal halide exterior lighting with an LED wall pack will reduce electrical usage, increase bulb life, and increase performance in the cold.					

4.5.1b Lighting Measures – Lighting Controls

Rank	Location	Existing Condition	Recommendation		
4	Washeteria Lighting	5 FLUOR (3) T8 4' F32T8 32W Standard (2) Instant Electronic with Manual Switching	Add new Occupancy Sensor		
Installation Cost	\$1,000	Estimated Life of Measure (yrs)	10	Energy Savings (/yr)	\$389
Breakeven Cost	\$3,862	Savings-to-Investment Ratio	3.2	Simple Payback yrs	2
Auditors Notes: Installing Occupancy Sensors in the washeteria would ensure the lights aren't left on when there is no one in the facility.					

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
3	Domestic Water Heat Tape	Heat Tape Maintaining the domestic water circulation Line with Manual Switching	Replace with Water Circulation Pump		
Installation Cost	\$800	Estimated Life of Measure (yrs)	7	Energy Savings (/yr)	\$684
Breakeven Cost	\$4,234	Savings-to-Investment Ratio	5.3	Simple Payback yrs	1
Auditors Notes: Replacing the broken water circulation pump, and turning off the heat tape would be a substantial electrical savings. The circulation pump maintaining the waters movement would be enough to keep the water line from freezing. The heat tape can be used for thaw recovery if the line should freeze. The heat tape should certainly be turned off in the summer time.					

Rank	Location	Description of Existing	Efficiency Recommendation		
8	Sewer Outfall Heat Tape	Heat Tape into the Sewage holding tank with Manual Switching	Improve Manual Switching		
Installation Cost	\$1,000	Estimated Life of Measure (yrs)	7	Energy Savings (/yr)	\$242
Breakeven Cost	\$1,497	Savings-to-Investment Ratio	1.5	Simple Payback yrs	4
Auditors Notes: Repairing the leak and insulating the sewage tank outfall would reduce the heating load on the heat tape and improve performance of the washeteria sewage system. The heat tape should be turned off in the summer.					

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 simultaneousl

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>