



# Comprehensive Energy Audit For Teller Water Plant and Washeteria



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Prepared For  
**City of Teller**

**September 14, 2011**

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## PREFACE

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

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

## ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of the City, Tribal, and operations staff for the City of Teller and the staff at the James C. Isabell School in Teller.

# 1. EXECUTIVE SUMMARY

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

Based on electricity and fuel oil prices in effect at the time of the audit, the annual predicted energy costs for the buildings analyzed are \$7,996 for Electricity and \$47,144 for #1 Oil, with total energy costs of \$55,141 per year.

It should be noted that the Washeteria side of the building receives the power cost equalization (PCE) subsidy from the state of Alaska. Without PCE the electricity costs would be \$20,353, fuel oil would be \$47,144, and total energy costs would be \$67,497.

It should also be noted that the school pays for the building fuel, maintenance, and most of the electricity. Electrical costs and savings for the facility were used at a PCE rate, however since the electricity is mostly run through the school, and the school does not receive PCE, the cost is likely much higher. Fuel records were not available for the water plant and washeteria for the facility, as fuel is shared with the school. Records from 2004 were used, and the modeled fuel usage closely reflects those numbers.

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

<b>Table 1.1</b> <b>PRIORITY LIST – ENERGY EFFICIENCY MEASURES</b>						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>
1	Setback Thermostat: Water Plant	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant space.	\$928	\$600	23.21	0.6

**Table 1.1**  
**PRIORITY LIST – ENERGY EFFICIENCY MEASURES**

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>
2	HVAC And DHW	Nozzles in Boilers should be 2.0 gph nozzles as a summer, non essential season setting. This will increase burn time, and reduce cycling, thereby increasing efficiency. Price includes one day of utility support for help in cleaning and changing nozzles. Additionally, by removing the domestic hot water heater from heating the storage tank, demand on the hot water heater would be lowered, and there would be fewer pipes to be circulating hot water through.	\$1,989	\$2,400	15.99	1.2
3	Setback Thermostat: Washeteria and Hallways	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria and Hallways space.	\$648	\$600	16.22	0.9
4	Water Storage Tank	Using a bigger, double walled heat exchanger w/ controls to accurately control tank instead of keeping it with extreme safety margins year round. Should be run off boiler instead of domestic hot water. Additionally, repairing the roof of the water storage tank with insulation.	\$1,621	\$13,500	1.80	8.3
5	Lighting: Exterior Lighting	Replace with 4 LED 20W Module Electronic	\$177	\$1,000	1.55	5.6
6	Clothes Drying - Clothes Dryer	Current configuration for dryers on hydronic heating coils providing makeup air at 100 degrees, which dryer coils add additional 20 degrees. Recommend makeup air at 50 degrees, with the final dryer coil adding the additional heat. This will reduce ambient losses. Additionally copper piping to and from the dryer coils should be insulated to reduce heat loss.	\$482	\$5,000	1.45	10.4
<b>TOTAL, all measures</b>			<b>\$5,846</b>	<b>\$23,100</b>	<b>4.12</b>	<b>4.0</b>

**Table Notes:**

<sup>1</sup> 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.

<sup>2</sup> 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 \$5,846 per year, or 10.6% of the buildings' total energy costs. These measures are estimated to cost \$23,100, for an overall simple payback period of 4.0 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.

<b>Description</b>	<b>Space Heating</b>	<b>Space Cooling</b>	<b>Water Heating</b>	<b>Lighting</b>	<b>Other Electrical</b>	<b>Water Storage Tank</b>	<b>Clothes Drying</b>	<b>Ventilation Fans</b>	<b>Service Fees</b>	<b>Total Cost</b>
Existing Building	\$20,521	\$0	\$7,495	\$1,705	\$1,213	\$12,514	\$11,693	\$0	\$0	<b>\$55,140</b>
With All Proposed Retrofits	\$18,077	\$0	\$6,374	\$1,528	\$1,213	\$10,893	\$11,211	\$0	\$0	<b>\$49,295</b>
SAVINGS	\$2,444	\$0	\$1,121	\$177	\$0	\$1,621	\$482	\$0	\$0	<b>\$5,846</b>

## **2. AUDIT AND ANALYSIS BACKGROUND**

### **2.1 Program Description**

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

## ***2.2 Audit Description***

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

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

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

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

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

- 1) Washeteria and Hallways: 891 square feet
- 2) Teller School Space: 1,376 square feet
- 3) Mechanical Room: 228 square feet
- 4) Water Plant: 544 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. Water Plant and Washeteria**

## ***3.1. Building Description***

The 3,039 square foot Water Plant and Washeteria was constructed in 1970, with a normal occupancy of 3 people. The Washeteria is open eight hours per day, seven days per week. The water plant is occupied about two to three hours per day, seven days per week.

### **Description of Building Shell**

The exterior walls are constructed with 2x8 studs, and over seven inches of batt insulation.

The roof of the building is a cold roof attic with a bottom insulation layer of eight inches, and a top insulation layer of over an inch.

The floor is on a concrete slab foundation with polyurethane insulation.

Typical windows throughout the building are double paned wood/vinyl framed windows.

Doors are metal urethane with no thermal break.

### **Description of Heating Plants**

The Heating Plants used in the building are:

Bock C Glass Water Heater

Nameplate Information:	Beckett Standard B5000, Model A, AF
Fuel Type:	#1 Oil
Input Rating:	242,000 BTU/hr
Steady State Efficiency:	75 %
Idle Loss:	1 %



Heat Distribution Type: Water  
Boiler Operation: All Year  
Notes: 1.25 gph nozzle

#### Bock C Glass Water Heater

Nameplate Information: Beckett Standard B5000, Model A, AF  
Fuel Type: #1 Oil  
Input Rating: 242,000 BTU/hr  
Steady State Efficiency: 75 %  
Idle Loss: 1 %  
Heat Distribution Type: Water  
Boiler Operation: All Year  
Notes: 1.25 gph nozzle

#### Weil McClain Gold Oil #1

Nameplate Information: AFG Beckett Burner  
Fuel Type: #1 Oil  
Input Rating: 330,000 BTU/hr  
Steady State Efficiency: 75 %  
Idle Loss: 1.5 %  
Heat Distribution Type: Water  
Boiler Operation: All Year  
Notes: 2.5 gph nozzle

#### Weil McClain Gold Oil #2

Fuel Type: #1 Oil  
Input Rating: 330,000 BTU/hr  
Steady State Efficiency: 75 %  
Idle Loss: 1.5 %  
Heat Distribution Type: Water  
Boiler Operation: All Year  
Notes: 2.5 gph nozzle

### **Space Heating Distribution Systems**

Baseboard heating supplies the building with heat. In practice radiant heat off the dryers supplies much of the heat to the building.

### **Domestic Hot Water System**

There are two Bock Hot water heaters, each with a 67 gallon capacity, though currently only one of the hot water heaters is working. The facility uses roughly 293 gallons of hot water per day.

### **Lighting**

The building is lit primarily by T8, two or four foot fluorescent magnetic ballast fixtures. Outside lights are metal halide 50 or 70 watt fixtures. There is one metal halide bulb at the workstation in the water plant and several CFL light bulbs in the water plant as well.

### **Plug Loads**

Plug loads in the building are made up of several exercise machines, a mini bunn coffee machine that is shut off when not in use, and the washing machines.

## ***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: Teller Power Company - 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:

<b>Table 3.1 – Average Energy Cost</b>	
<b>Description</b>	<b>Average Energy Cost</b>
Electricity	\$ 0.22/kWh
#1 Oil	\$ 6.11/gallons

#### **3.2.1.1 Total Energy Use and Cost Breakdown**

At current rates, City of Teller pays approximately \$55,141 annually for electricity and other fuel costs for the Water Plant and Washeteria.

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

**Figure 3.1**  
**Annual Energy Costs by End Use**

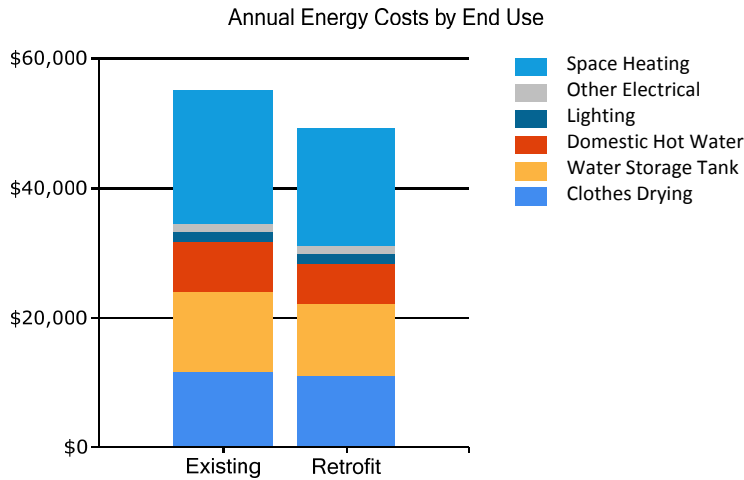


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

**Figure 3.2**  
**Annual Energy Costs by Fuel Type**

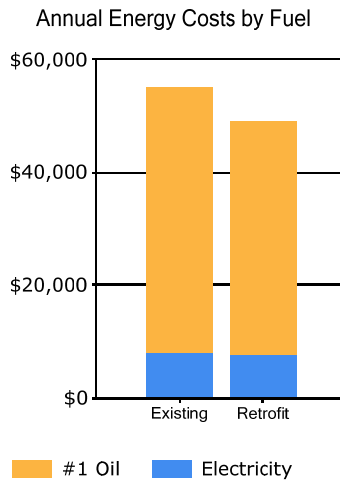
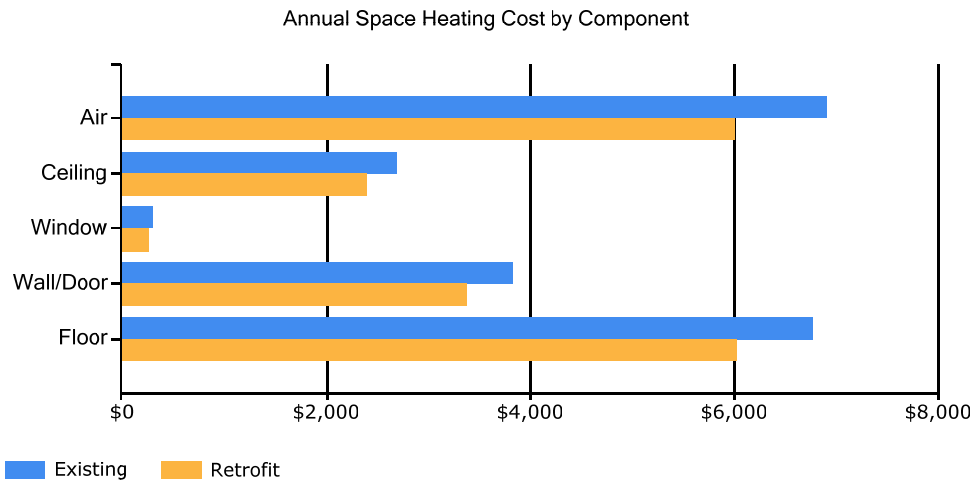


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing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

**Figure 3.3**  
**Annual Space Heating Cost by Component**



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

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Other Electrical	468	426	468	453	468	453	468	468	453	468	453	468
Lighting	745	679	745	721	745	468	484	484	468	745	721	745
Water Storage Tank	48	44	48	47	48	0	0	0	0	48	47	48
Clothes Drying	630	574	630	610	630	610	630	630	610	630	610	630
Ventilation Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	168	153	168	163	168	163	168	168	163	168	163	168
Space Heating	1134	1034	1133	1094	1125	1087	1122	1122	1088	1128	1095	1134

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Water Storage Tank	259	236	259	251	259	0	0	0	0	259	251	259
Clothes Drying	140	127	140	135	140	135	140	140	135	140	135	140
DHW	98	89	98	95	98	95	98	98	95	98	95	98
Space Heating	383	359	364	274	168	106	83	90	134	229	303	388

### 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):

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

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

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

**Table 3.4**  
**Water Plant and Washeteria EUI Calculations**

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	36,346 kWh	124,050	3.340	414,326
#1 Oil	7,716 gallons	1,018,502	1.010	1,028,687
<b>Total</b>		<b>1,142,552</b>		<b>1,443,013</b>
<b>BUILDING AREA</b> 3,039 Square Feet				
<b>BUILDING SITE EUI</b>		376 kBTU/Ft <sup>2</sup> /Yr		
<b>BUILDING SOURCE EUI</b>		475 kBTU/Ft <sup>2</sup> /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 Water Plant and Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Teller 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 Teller. 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.

<b>Table 4.1</b> <b>Water Plant and Washeteria, Teller, Alaska</b> <b>PRIORITY LIST – ENERGY EFFICIENCY MEASURES</b>						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Setback Thermostat: Water Plant	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant space.	\$928	\$600	23.21	0.6

**Table 4.1**  
**Water Plant and Washeteria, Teller, Alaska**  
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5	Lighting: Exterior Lighting	Replace with 4 LED 20W Module Electronic	\$177	\$1,000	1.55	5.6
6	Cooking and Clothes Drying - Clothes Dryer	Current configuration for dryers on hydronic heating coils providing makeup air at 100 degrees, which dryer coils add additional 20 degrees. Recommend makeup air at 50 degrees, with the final dryer coil adding the additional heat. This will reduce ambient losses. Additionally copper piping to and from the dryer coils should be insulated to reduce heat loss.	\$482	\$5,000	1.45	10.4
	<b>TOTAL, all measures</b>		<b>\$5,846</b>	<b>\$23,100</b>	<b>4.12</b>	<b>4.0</b>

## 4.2 Interactive Effects of Projects

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

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

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

## 4.3 Mechanical Equipment Measures

### 4.3.1 Heating/Cooling/Domestic Hot Water Measure

Rank	Recommendation				
2	Nozzles in Boilers should be 2.0 gph nozzles as a summer, and fringe of winter season setting. This will increase burn time, and reduce cycling, thereby increasing efficiency. Price includes one day of utility support for help in cleaning and changing nozzles. Additionally, by removing the domestic hot water heater from heating the storage tank, demand on the hot water heater would be lowered, and there would be fewer pipes to be circulating hot water through.				
<b>Installation Cost</b>	\$2,400	<b>Estimated Life of Measure (yrs)</b>	20	<b>Energy Savings (/yr)</b>	\$1,989
<b>Breakeven Cost</b>	\$38,368	<b>Savings-to-Investment Ratio</b>	16.0	<b>Simple Payback yrs</b>	1
Auditors Notes:					

### 4.3.2 Night Setback Thermostat Measures

Rank	Building Space	Recommendation			
3	Washeteria and Hallways	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria and Hallways space.			
<b>Installation Cost</b>	\$600	<b>Estimated Life of Measure (yrs)</b>	15	<b>Energy Savings (/yr)</b>	\$648
<b>Breakeven Cost</b>	\$9,729	<b>Savings-to-Investment Ratio</b>	16.2	<b>Simple Payback yrs</b>	1
Auditors Notes: Implementing a nighttime and weekend setback thermostat would allow the space to be heated to only 60 degrees instead of 70 degrees when the building is not occupied. This will save heating costs and maintain comfortable and functioning level of the space.					



Rank	Building Space	Recommendation			
1	Water Plant	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant space.			
<b>Installation Cost</b>	\$600	<b>Estimated Life of Measure (yrs)</b>	15	<b>Energy Savings (/yr)</b>	\$928
<b>Breakeven Cost</b>	\$13,925	<b>Savings-to-Investment Ratio</b>	23.2	<b>Simple Payback yrs</b>	1
Auditors Notes: Implementing a nighttime and weekend setback thermostat would allow the space to be heated to only 60 degrees instead of 70 degrees when the building is not occupied. This will save heating costs and maintain comfortable and functioning level of the space.					

## 4.4 Electrical & Appliance Measures

### 4.4.1 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		
5	Exterior Lighting	4 MH 50 Watt Magnetic with Manual Switching	Replace with 4 LED 20W Module Electronic		
<b>Installation Cost</b>	\$1,000	<b>Estimated Life of Measure (yrs)</b>	10	<b>Energy Savings (/yr)</b>	\$177
<b>Breakeven Cost</b>	\$1,551	<b>Savings-to-Investment Ratio</b>	1.6	<b>Simple Payback yrs</b>	6
Auditors Notes: Replacing current metal halide exterior lighting fixtures with LED wall packs would provide significant energy savings, reduce maintenance and bulb replacement, and allow for better functioning in cold weather.					

### 4.5.4 Water Storage Tank Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
4			Install double-walled heat exchanger on tank heat add and transition to hydronic heat. Install controls to thermostatically control tank temperature, and if possible prioritize tank load. Repair roof insulation.		
<b>Installation Cost</b>	\$13,500	<b>Estimated Life of Measure (yrs)</b>	15	<b>Energy Savings (/yr)</b>	\$1,621
<b>Breakeven Cost</b>	\$24,334	<b>Savings-to-Investment Ratio</b>	1.8	<b>Simple Payback yrs</b>	8
Auditors Notes: Water storage tank has excessive heat loss through the roof due to insulation disrepair. Heat to the tank is provided through the facility's domestic hot water. Often time's tank heat will be the only demand placed on the hot water boiler which is not designed to accept this type of load. The tank heat add is currently controlled only by circuit setter. The tank heat add needs to be controlled by temperature, and use the facility hydronic system for heat source. Additional savings can be realized by prioritizing the tank heat add load to coincide with demands inside the facility.					

## 4.5.5 Clothes Drying Measures

Rank	Location	Description of Existing	Efficiency Recommendation
6			Current configuration for dryers on hydronic heating coils providing makeup air at 100 degrees, which dryer coils add additional 20 degrees. Recommend makeup air at 50 degrees, with the final dryer coil adding the additional heat. This will reduce ambient losses. Additionally copper piping to and from the dryer coils should be insulated to reduce heat loss.
<b>Installation Cost</b>	\$5,000	<b>Estimated Life of Measure (yrs)</b>	15
<b>Breakeven Cost</b>	\$7,232	<b>Savings-to-Investment Ratio</b>	1.4
		<b>Energy Savings (/yr)</b>	\$482
		<b>Simple Payback yrs</b>	10
Auditors Notes:			

## 5. ENERGY EFFICIENCY ACTION PLAN

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

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

## APPENDICES

### 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](http://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/](http://apps1.eere.energy.gov/consumer/your_workplace/)

Energy Star – [http://www.energystar.gov/index.cfm?c=lighting.pr\\_lighting](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](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](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/](http://apps1.eere.energy.gov/consumer/your_workplace/)

Energy Star – [http://www.energystar.gov/index.cfm?fuseaction=find\\_a\\_product](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/](http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/)

State and Utility Incentives and Utility Policies - <http://www.dsireusa.org>