



Comprehensive Energy Audit For Nunapitchuk Water Plant and Washeteria



Prepared For
City of Nunapitchuk

June 14, 2012

Prepared By:

**ANTHC-DEHE
1901 Bragaw Street, Suite 200
Anchorage, AK 99508**

Table of Contents

1. EXECUTIVE SUMMARY	3
2. AUDIT AND ANALYSIS BACKGROUND	5
2.1 Program Description	5
2.2 Audit Description	5
2.3. Method of Analysis	6
2.4 Limitations of Study	7
3. WTP-Washeteria	7
3.1. Building Description	7
3.2 Predicted Energy Use	9
3.2.1 Energy Usage / Tariffs	9
3.2.2 Energy Use Index (EUI)	12
3.3 AkWarm© Building Simulation	13
4. ENERGY COST SAVING MEASURES	14
4.1 Summary of Results	14
4.2 Interactive Effects of Projects	15
5. ENERGY EFFICIENCY ACTION PLAN	17
Appendix A – Listing of Energy Conservation and Renewable Energy Websites.....	17

PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the City of Nunapitchuk. 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 Molly Berlin, water treatment plant operator for the City of Nunapitchuk and Walter Riley, City Administrator for the City of Nunapitchuk.

1. EXECUTIVE SUMMARY

This report was prepared for the City of Nunapitchuk. The scope of the audit focused on WTP-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 \$5,196 for Electricity and \$26,437 for #1 Oil. The total energy costs are \$31,633 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 the PCE subsidy total electrical costs would have been \$15,588.

Table 1.1 below summarizes the energy efficiency measures analyzed for the WTP-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						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR ¹	Simple Payback (Years) ²
1	Dryers, Tank Heat Add, Raw Water Heat Add, West Watering Point Heat Add	Revise the boiler controls to add a Tekmar controller that will properly stage the boilers, reset the boiler set point based on outside temperature except when the washeteria is operational and set back the building temperature when the building is unoccupied. Re-commission the water storage tank heat add controls and lower the tank temperature to 40 degrees. Re-commission the raw water heat add controls and lower the temperature setting to 40 degrees.	\$8,270	\$10,000	11.22	1.2
2	HVAC And DHW	Utilize the new Tekmar controller to only circulate the hot water when the washeteria is open and reduce boiler loses by utilizing the outdoor reset function on the Tekmar.	\$1,464	\$2,500	7.95	1.7

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
3	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	\$442	\$1,000	6.00	2.3
4	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	\$221	\$1,000	3.00	4.5
5	Other Electrical - Controls Retrofit: Lift Station Heat Tape	Improve Manual Switching	\$269	\$1,150	1.45	4.3
6	Lighting - Power Retrofit: Exterior Lighting	Replace with 2 LED 25W Module Electronic Wall Packs.	\$83	\$500	1.03	6.0
TOTAL, all measures			\$10,750	\$16,150	8.87	1.5

Table Notes:

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

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

With all of these energy efficiency measures in place, the annual utility cost can be reduced by \$10,750 per year, or 34.0% of the buildings’ total energy costs. These measures are estimated to cost \$16,150, for an overall simple payback period of 1.5 years.

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

**Table 1.2
Annual Energy Cost Estimate**

Description	Space Heating	Space Cooling	Water Heating	Lighting	Other Electrical	Sauna	Dryers, Tank Heat Add, Raw Water Heat Add, West Watering Point Heat Add	Total Cost
Existing Building	\$4,125	\$0	\$4,025	\$450	\$3,078	\$2,233	\$17,721	\$31,633
With All Proposed Retrofits	\$3,440	\$0	\$2,583	\$367	\$2,809	\$2,233	\$9,451	\$20,883
SAVINGS	\$685	\$0	\$1,443	\$83	\$269	\$0	\$8,270	\$10,750

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

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

- 1) Water Treatment Plant: 1,328 square feet
- 2) Washeteria: 934 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. WTP-Washeteria

3.1. Building Description

The 2,262 square foot WTP-Washeteria was constructed in 1978, with a normal occupancy of one person. The number of hours of operation for this building average 6.8 hours per day, considering all seven days of the week.

The Nunapitchuk water treatment plant and washeteria produces water from a well located under the facility. Water is heated, pre-treated, and then filtered through a green-sand

pressure vessel. Treated water is stored in the adjacent water storage tank, and served to the washeteria services and a watering point. Additionally water is shared with a watering point located across the river, via an underwater circulating water line.

Description of Building Shell

The exterior walls are 2x6 construction with 5.5 inches of damaged fiberglass batt insulation.

The roof of the building is a warm roof with 6.75 inches of fiberglass batt insulation.

The floor of the building is built on pilings with 6.75 inches of damaged fiberglass batt insulation.

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

Doors are metal with a polyurethane core and a metal edge.

Description of Heating Plants

The Heating Plants used in the building are:

Burnham Boiler

Nameplate Information:	Boiler PF 35 Serial Number 7537899
Fuel Type:	#1 Oil
Input Rating:	375,000 BTU/hr
Steady State Efficiency:	78 %
Idle Loss:	2 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Notes:	Carlin Burner

Burnham Boiler

Fuel Type:	#1 Oil
Input Rating:	375,000 BTU/hr
Steady State Efficiency:	78 %
Idle Loss:	2 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year

Space Heating Distribution Systems

The building has a hydronic heating distribution system which supplies heat to the facility with several unit heaters. Most of the buildings heating needs are provided by jacket losses off the boilers and heat given off by the dryers.

Domestic Hot Water System

Hot water in the facility is stored in a 300 gallon insulated hot water storage tank and water is maintained at 110 degrees. About 100 gallons of hot water is used per day, primarily in the washing machines and showers of the washeteria. Hot water is circulated 24 hours a day and is circulated through 100 feet of 1.5 inch insulated piping and 100 feet of .5 inch insulated piping. The hot water circulation pump is a ¼ horsepower Grundfos pump which runs twenty four hours a day, all year long.

Lighting

There is a variety of lighting in the facility. The water plant is lit by nine T8 electronic ballast fixtures with two to four 28 watt bulbs each. The hallways and restrooms are lit by six compact fluorescent 20 watt light bulbs. The washeteria is lit by four T8 electronic ballast fixtures with two 28 watt bulbs each. Exterior lighting in the facility is made up of two 100 watt metal halide fixtures.

Major Equipment

A well pump draws 1 kilowatt and is used about 5.5 hours per day. The well pump has an accompanying electric heat tape which keeps the well line from freezing when the well is not pumping.

The water is then heated with the small raw water heat add pump, which is shut off in the summer time, and stored in the eighty-four thousand gallon storage tank.

The tank is kept heated to 48.5 degrees and is circulated by an 87 watt circulation pump which is shut off in the summer time.

A circulation pump circulates water to the west watering point and is 1.5 horsepower. The heat add for this circulating loop is circulated by a 60 watt circulation pump running on demand for heat in the line.

The lift station pump is a 3 horsepower pump for the washeteria and school and runs about 3.5 hours per week. The lift station also has a heat tape to prevent freezing during the winter season

The facility has 6 washing machines which are used sporadically during the Washeteria open hours.

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: AVEC-Nunapitchuk/Kasig - 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	\$ 0.16/kWh
#1 Oil	\$ 3.90/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Nunapitchuk pays approximately \$31,633 annually for electricity and other fuel costs for the WTP-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

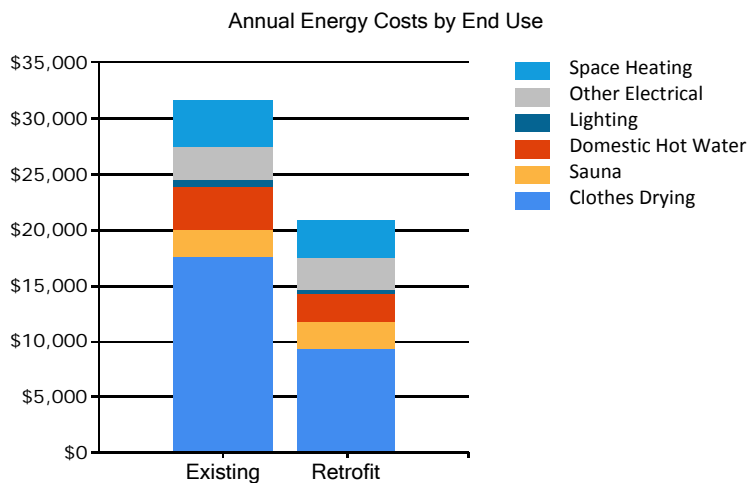


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

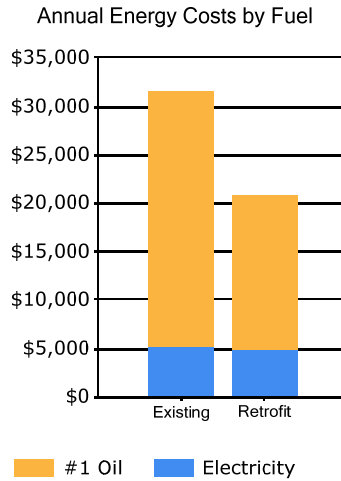
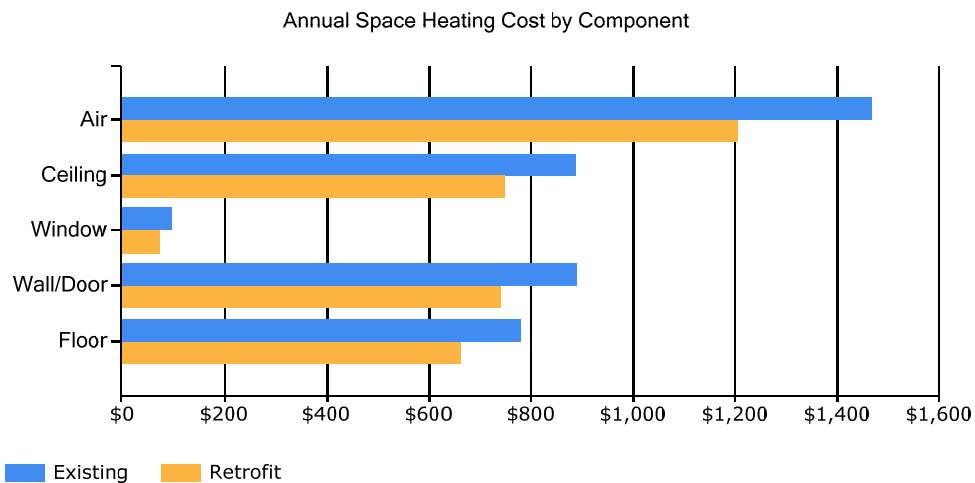


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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	259	236	259	250	259	175	181	181	250	259	250	259
Other Electrical	2354	2145	2354	2278	761	736	761	761	736	1721	2278	2354
Sauna	7	6	7	7	7	7	7	7	7	7	7	7
Dryers, Tank Heat Add, Raw Water Heat Add, West Watering Point Heat Add	372	339	372	360	372	360	372	372	360	372	360	372
DHW	141	129	142	138	147	142	147	147	142	143	137	141
Space Heating	366	334	365	350	357	346	357	357	346	362	352	366

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Sauna	48	44	48	47	48	47	48	48	47	48	47	48
Dryers, Tank Heat Add, Raw Water Heat Add, West Watering Point	527	480	527	510	216	209	216	216	209	216	510	527
DHW	49	45	54	70	115	111	115	115	111	72	57	49
Space Heating	170	152	137	71	0	0	0	0	0	73	110	170

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
WTP-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	32,475 kWh	110,836	3.340	370,194
#1 Oil	6,779 gallons	894,792	1.010	903,740
Total		1,005,629		1,273,934
BUILDING AREA 2,262 Square Feet				
BUILDING SITE EUI 445 kBTU/Ft ² /Yr				
BUILDING SOURCE EUI 563 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 WTP-Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Nunapitchuk 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 Nunapitchuk. 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 WTP-Washeteria, Nunapitchuk, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Dryers, Tank Heat Add, Raw Water Heat Add, West Watering Point Heat Add	Revise the boiler controls to add a Tekmar controller that will properly stage the boilers, reset the boiler set point based on outside temperature except when the washeteria is operational and set back the building temperature when the building is unoccupied. Recommission the water storage tank heat add controls and lower the tank temperature to 40 degrees. Recommission the raw water heat add controls and lower the temperature setting to 40 degrees.	\$8,270	\$10,000	11.22	1.2
2	HVAC And DHW	Utilize the new Tekmar controller to only circulate the hot water when the washeteria is open and reduce boiler loses by utilizing the outdoor reset function on the Tekmar.	\$1,464	\$2,500	7.95	1.7

Table 4.1
WTP-Washeteria, Nunapitchuk, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
3	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	\$442	\$1,000	6.00	2.3
4	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	\$221	\$1,000	3.00	4.5
5	Other Electrical - Controls Retrofit: Lift Station Heat Tape	Improve Manual Switching	\$269	\$1,150	1.45	4.3
6	Lighting - Power Retrofit: Exterior Lighting	Replace with 2 LED 25W Module Electronic Wall Packs.	\$83	\$500	1.03	6.0
TOTAL, all measures			\$10,750	\$16,150	8.87	1.5

4.2 Interactive Effects of Projects

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

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

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

4.3 Mechanical Equipment Measures

4.3.1 Heating/Domestic Hot Water Measure

Rank	Recommendation						
2	Utilize the new Tekmar controller to only circulate the hot water when the washeteria is open and reduce boiler losses by utilizing the outdoor reset function on the Tekmar.						
Installation Cost		\$2,500	Estimated Life of Measure (yrs)		15	Energy Savings (\$/yr)	\$1,464
Breakeven Cost		\$19,866	Savings-to-Investment Ratio		7.9	Simple Payback yrs	2
Auditors Notes: Reducing the hot water circulation time will reduce heat losses.							

4.4.3 Night Setback Thermostat Measures

Rank	Building Space	Recommendation			
3	Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.			
Installation Cost	\$1,000	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$442
Breakeven Cost	\$5,997	Savings-to-Investment Ratio	6.0	Simple Payback yrs	2
Auditors Notes: The water plant should reduce the temperature set point to 60 degrees when no one is occupying the facility, such as at nights and on weekends.					

Rank	Building Space	Recommendation			
4	Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.			
Installation Cost	\$1,000	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$221
Breakeven Cost	\$3,004	Savings-to-Investment Ratio	3.0	Simple Payback yrs	5
Auditors Notes: The water plant should reduce the temperature set point to 60 degrees when no one is occupying the facility, such as at nights and on weekends.					

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		
6	Exterior Lighting	2 MH 100 Watt Magnetic with Manual Switching	Replace with 2 LED 25W Module Electronic Wall Pack		
Installation Cost	\$500	Estimated Life of Measure (yrs)	7	Energy Savings (/yr)	\$83
Breakeven Cost	\$515	Savings-to-Investment Ratio	1.0	Simple Payback yrs	6
Auditors Notes: Convert the exterior lighting from existing metal halide to new LED wall packs, which will save energy, reduce the need to switch light bulbs and increase performance in the cold.					

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation
5	Lift Station Heat Tape	Heat Tape with Manual Switching	Improve Manual Switching
Installation Cost	\$1,150	Estimated Life of Measure (yrs)	7
Energy Savings (/yr)			\$269
Breakeven Cost	\$1,664	Savings-to-Investment Ratio	1.4
		Simple Payback yrs	4
Auditors Notes: Improve control of heat tape to minimize use to that required to prevent freezing. Would include appropriate temperature controls. Assumes ANTHC electricians do the work and ANTHC does the design on the new controls retrofit .			

4.5.3 Dryers, Tank Heat Add, Raw Water Heat add, West Watering Point Heat Add Measures

Rank	Location	Description of Existing	Efficiency Recommendation
1			Revise the boiler controls to add a Tekmar controller that will properly stage the boilers, reset the boiler set point based on outside temperature except when the washeteria is operational and set back the building temperature when the building is unoccupied. Recommission the water storage tank heat add controls and lower the tank temperature to 40 degrees. Recommission the raw water heat add controls and lower the temperature setting to 40 degrees.
Installation Cost	\$10,000	Estimated Life of Measure (yrs)	15
Energy Savings (/yr)			\$8,270
Breakeven Cost	\$112,216	Savings-to-Investment Ratio	11.2
		Simple Payback yrs	1
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.

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>