Comprehensive Energy Audit
For
Pilot Station Water and Sewer System

Prepared For

City of Pilot Station

March 18, 2013

Prepared By:

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Pilot Station Traditional Council. 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 the water plant staff and the tribal council.

1. EXECUTIVE SUMMARY

This report was prepared for the City of Pilot Station. The scope of the audit focused on Pilot Station Water and Sewer System. 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 $17,136 for Electricity and $19,671 for #1 Oil, with total energy costs of $36,807 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 $59,975.

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

Table 1.1
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]
1	Other Electrical - Controls Retrofit: Tank Circulation Pump	Shut off circulation pump, unless town water use declines.	$1,258	$10	778.68	0.0
2	Other Electrical - Controls Retrofit: Well A Heat Tape	Shut off the well heat tape. The well pump operates on a VFD; heat tape should be only used for recovery.	$2,140	$500	26.49	0.2
3	Other Electrical - Controls Retrofit: Lift Station Electric Heating/ Heat Tapes	Shut off heat tape except when the line is frozen.	$3,606	$3,000	7.44	0.8
4	HVAC And DHW	Boilers need to be cleaned and tuned. A boiler should be isolated in spring and fall seasons to reduce losses and increase efficiency. The backup circulation pump should be valved off to reduce the load on the active circulation pump. Boilers should be shut off in mid May and turned back on in October.	$1,361 + $100 Maint. Savings	$2,000	6.73	1.5

Table 1.1 PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
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5	Circulation Loops	Heat add controls need to be fixed for circulation Loop #1The loops should be set to 40 degrees and maintained at 40 degrees based on return temperature. Current copper service lines should be replaced with 150 feet of pex pipe and a small circulation pump in each home on the loop.	$8,366 + $1,000 Maint. Savings	$78,500	1.10	9.4
	TOTAL, cost-effective measures		**$16,731 + $1,100 Maint. Savings**	**$84,010**	**1.70**	**5.0**
	The following measures were *not* found to be cost-effective:					
6	Other Electrical - Controls Retrofit: Lift Station Pumps and Controls	The pumps are currently running too often because of high ground water infiltration. Finding the source of the infiltration and stopping it will reduce pump run time, and keep the lagoon from over filling.	$98	$2,000	0.30	20.4
7	Window/Skylight: Water Plant	Replace existing window with U-0.35 wood window	$0	$329	0.00	999.9
8	Window/Skylight: Water Plant	Replace existing window with U-0.30 vinyl window	$0	$297	0.00	999.9
	TOTAL, all measures		**$16,830 + $1,100 Maint. Savings**	**$86,637**	**1.66**	**5.1**

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 $16,830 per year, or 45.7% of the buildings' total energy costs. These measures are estimated to cost $86,637, for an overall simple payback period of 5.1 years. If only the cost-effective measures are implemented, the annual utility cost can be reduced by $16,731 per year, or

45.5% of the buildings' total energy costs. These measures are estimated to cost $84,010, for an overall simple payback period of 5.0 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.

Table 1.2
Annual Energy Cost Estimate

Description	Space Heating	Space Cooling	Water Heating	Lighting	Refrigeration	Other Electrical	Clothes Drying	Circulation Loops	Ventilation Fans	Total Cost
Existing Building	$3,285	$0	$21	$127	$0	$16,634	$0	$16,740	$0	**$36,807**
With All Proposed Retrofits	$1,923	$0	$21	$127	$0	$9,532	$0	$8,374	$0	**$19,977**
SAVINGS	$1,361	$0	$0	$0	$0	$7,102	$0	$8,366	$0	**$16,830**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Pilot Station Water and Sewer System. 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
- Water consumption, treatment (optional) & disposal

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 Pilot Station Water and Sewer System 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.

Pilot Station Water and Sewer System is classified as being made up of the following activity areas:

1) Pilot Station Water Plant: 800 square feet

In addition, the methodology involves taking into account a wide range of factors specific to the building. These factors are used in the construction of the model of energy used. The factors include:

- Occupancy hours
- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

Data collected was processed using AkWarm© Energy Use Software to estimate energy savings for each of the proposed energy efficiency measures (EEMs). The recommendations focus on the building envelope; HVAC; lighting, plug load, and other electrical improvements; and motor and pump systems that will reduce annual energy consumption.

EEMs are evaluated based on building use and processes, local climate conditions, building construction type, function, operational schedule, existing conditions, and foreseen future plans. Energy savings are calculated based on industry standard methods and engineering estimations.

Our analysis provides a number of tools for assessing the cost effectiveness of various improvement options. These tools utilize **Life-Cycle Costing**, which is defined in this context as a method of cost analysis that estimates the total cost of a project over the period of time that includes both the construction cost and ongoing maintenance and operating costs.

Savings to Investment Ratio (SIR) = **Savings** divided by **Investment**

Savings includes the total discounted dollar savings considered over the life of the improvement. When these savings are added up, changes in future fuel prices as projected by the Department of Energy are included. Future savings are discounted to the present to account for the time-value of money (i.e. money's ability to earn interest over time). The **Investment** in the SIR calculation includes the labor and materials required to install the measure. An SIR value of at least 1.0 indicates that the project is cost-effective—total savings exceed the investment costs.

Simple payback is a cost analysis method whereby the investment cost of a project is divided by the first year's savings of the project to give the number of years required to recover the cost of the investment. This may be compared to the expected time before replacement of the system or component will be required. For example, if a boiler costs $12,000 and results in a savings of $1,000 in the first year, the payback time is 12 years. If the boiler has an expected life to replacement of 10 years, it would not be financially viable to make the investment since the payback period of 12 years is greater than the project life.

The Simple Payback calculation does not consider likely increases in future annual savings due to energy price increases. As an offsetting simplification, simple payback does not consider the need to earn interest on the investment (i.e. it does not consider the time-value of money). Because of these simplifications, the SIR figure is considered to be a better financial investment indicator than the Simple Payback measure.

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

It is important to note that the savings for each recommendation is calculated based on implementing the most cost effective measure first, and then cycling through the list to find the next most cost effective measure. Implementation of more than one EEM often affects the savings of other EEMs. The savings may in some cases be relatively higher if an individual EEM is implemented in lieu of multiple recommended EEMs. For example implementing a reduced operating schedule for inefficient lighting will result in relatively high savings. Implementing a reduced operating schedule for newly installed efficient lighting will result in lower relative savings, because the efficient lighting system uses less energy during each hour of operation. If multiple EEM's are recommended to be implemented, AkWarm calculates the combined savings appropriately.

Cost savings are calculated based on estimated initial costs for each measure. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers.

2.4 Limitations of Study

All results are dependent on the quality of input data provided, and can only act as an approximation. In some instances, several methods may achieve the identified savings. This report is not intended as a final design document. The design professional or other persons following the recommendations shall accept responsibility and liability for the results.

3. Pilot Station Water and Sewer System

3.1. Building Description

The 800 square foot Pilot Station Water and Sewer System was constructed in 2005, with a normal occupancy of 1 people. The number of hours of operation for this building average 2 hours per day, considering all seven days of the week.

Water is sourced from a well, pumped with a VFD well pump up to the water storage tank. Water is treated with chlorine. Two circulation loops distribute water to the town. Many services off the loops are copper and freeze and break often.

A lift station low in the town pumps water up to a sewage lagoon in the middle of town.

The town uses about 1.2 million gallons of water per month.

Description of Building Shell

The exterior walls are six inch structurally insulated panels with 5.5 inches of polyurethane insulation.

The roof of the building is a warm roof with six inches of polyurethane insulation.

The floor of the building is built on pilings with six inches of polyurethane insulation.

Typical windows throughout the building are double paned vinyl frame windows, however two of the windows are broken.

Doors are metal with a polyurethane core.

Description of Heating Plants

The Heating Plants used in the building are:

Weil McLain WGO-07 Gold Oil Boiler #1

Fuel Type:	#1 Oil
Input Rating:	200,000 BTU/hr
Steady State Efficiency:	70 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Notes:	.85 gph, 140 PSI

Weil McLain WGO-07 Gold Oil Boiler #2

Fuel Type:	#1 Oil

Input Rating:	200,000 BTU/hr
Steady State Efficiency:	70 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Notes:	.85 gph, 140 PSI

OM-148

Fuel Type:	#1 Oil
Input Rating:	148,000 BTU/hr
Steady State Efficiency:	93 %
Idle Loss:	0 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

Space Heating Distribution Systems

Unit heaters off the boilers supply heat to the facility.

Domestic Hot Water System

An OM 148 Hot water heater is shut off at the breaker and never used.

Lighting

Electronic T8 fluorescent lighting with 32 watt bulbs makes up all the lighting in the facility.

Major Equipment

A VFD controlled well pump is operated 24/7, pumping about 28 gallons per minute of water at full throttle.

A tank circulation pump is currently operating, but valved off. The town uses water so quickly that the tank never fills completely and water is exchanged rapidly.

Two 5 horsepower circulation pumps circulate water in the town's two circulation loops.

An LMI chemical pump injects chlorine into the water supply.

A small heat tape is used to keep the building drain sump from freezing.

A long heat tape labeled Heat Tape A runs to the well.

The lift station operates a pair of grinder/discharge pumps, which at the time of the audit were set to operate based on a single float level. They were adjusted to have a high and low level settings.

The lift station has three heat tapes, one for the water service, one for the arctic box, and one for the force main up to the lagoon. Additionally the building is heated by a pair of electric heaters, which are set by hand at 60 degrees. The facility is in good condition and well insulated.

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-Pilot Station - 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	$ 0.14/kWh
#1 Oil	$ 7.32/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Pilot Station pays approximately $36,807 annually for electricity and other fuel costs for the Pilot Station Water and Sewer System.

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

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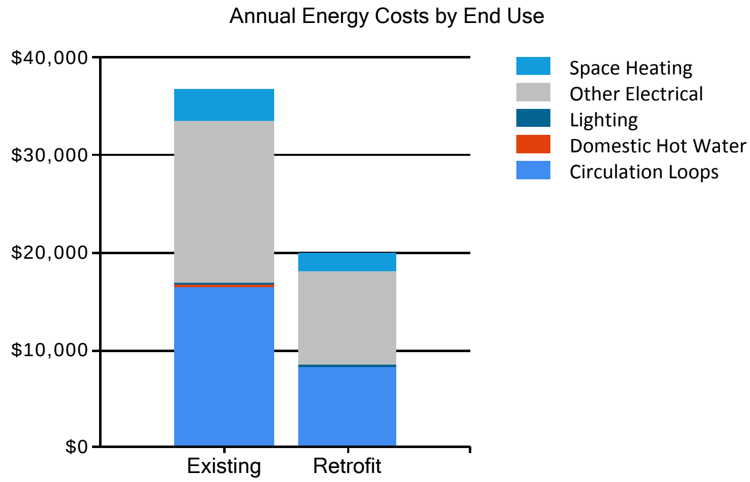


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

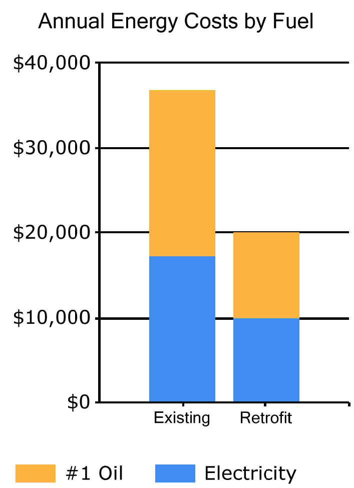
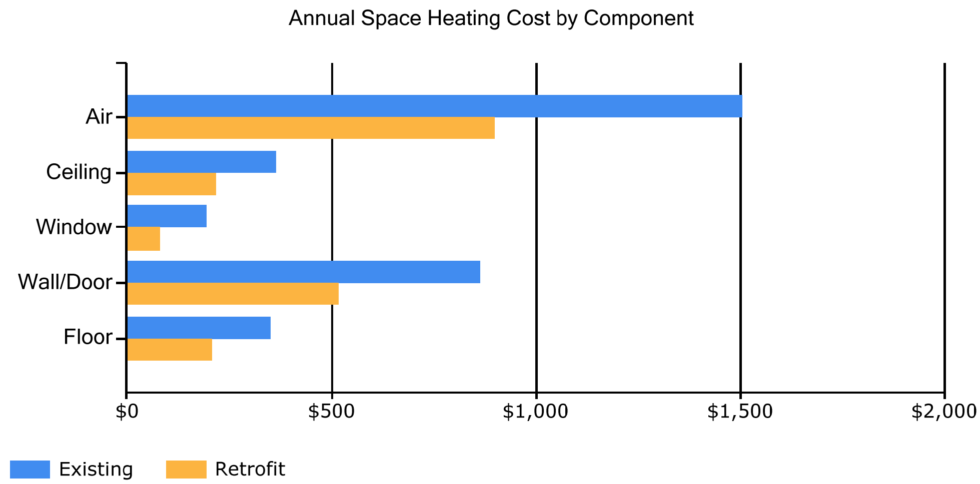


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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	14101	12850	14101	13646	9512	5042	5210	5210	5042	6357	13646	14101
Lighting	77	70	77	75	77	75	77	77	75	77	75	77
Circulation Loops	0	0	0	0	0	0	0	0	0	0	0	0
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	4	3	4	4	4	4	4	4	4	4	4	4

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Circulation Loops	469	427	469	454	0	0	0	0	0	0	0	469
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	34	31	34	33	34	33	34	34	33	34	33	34

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):

Building Site EUI = *(Electric Usage in kBtu + Fuel Oil Usage in kBtu)* / *Building Square Footage*

Building Source EUI = *(Electric Usage in kBtu X SS Ratio + Fuel Oil Usage in kBtu X SS Ratio)* / *Building Square Footage*

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

Table 3.4
Pilot Station Water and Sewer System 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	122,398 kWh	417,743	3.340	1,395,263
#1 Oil	2,687 gallons	354,726	1.010	358,274
Total		**772,470**		**1,753,537**
BUILDING AREA		800	Square Feet	
BUILDING SITE EUI		966	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		2,192	**kBTU/Ft²/Yr**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

3.3 AkWarm© Building Simulation

An accurate model of the building performance can be created by simulating the thermal performance of the walls, roof, windows and floors of the building. The HVAC system and central plant are modeled as well, accounting for the outside air ventilation required by the building and the heat recovery equipment in place.

The model uses local weather data and is trued up to historical energy use to ensure its accuracy. The model can be used now and in the future to measure the utility bill impact of all types of energy projects, including improving building insulation, modifying glazing, changing air handler schedules, increasing heat recovery, installing high efficiency boilers, using variable air volume air handlers, adjusting outside air ventilation and adding cogeneration systems.

For the purposes of this study, the Pilot Station Water and Sewer System was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage.

Climate data from Pilot Station 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 Pilot Station. 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
Pilot Station Water and Sewer System, Pilot Station, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

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4	HVAC And DHW	Boilers need to be cleaned and tuned. A boiler should be isolated in spring and fall seasons to reduce losses and increase efficiency. The backup circulation pump should be valved off to reduce the load on the active circulation pump. Boilers should be shut off in mid May and turned back on in October.	$1,361 + $100 Maint. Savings	$2,000	6.73	1.5
5	Circulation Loops	Heat add controls need to be fixed for circulation Loop #1The loops should be set to 40 degrees and maintained at 40 degrees based on return temperature. Current copper service lines should be replaced with 150 feet of pex pipe and a small circulation pump in each home on the loop.	$8,366 + $1,000 Maint. Savings	$78,500	1.10	9.4
	TOTAL, cost-effective measures		**$16,731 + $1,100 Maint. Savings**	**$84,010**	**1.70**	**5.0**
	The following measures were *not* found to be cost-effective:					
6	Other Electrical - Controls Retrofit: Lift Station Pumps and Controls	The pumps are currently running too often because of high ground water infiltration. Finding the source of the infiltration and stopping it will reduce pump run time, and keep the lagoon from over filling.	$98	$2,000	0.30	20.4
7	Window/Skylight: Water Plant	Replace existing window with U-0.35 wood window	$0	$329	0.00	999.9
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	TOTAL, all measures		**$16,830 + $1,100 Maint. Savings**	**$86,637**	**1.66**	**5.1**

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 Window Measures

Rank	Location		Size/Type, Condition		Recommendation	
7	Window/Skylight: Water Plant		Glass: Single, Glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.94 Solar Heat Gain Coefficient including Window Coverings: 0.52		Replace existing window with U-0.35 wood window	
Installation Cost		$329	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$
Breakeven Cost		$	**Savings-to-Investment Ratio**	0.0	**Simple Payback yrs**	1000
Auditors Notes:						

Rank	Location		Size/Type, Condition		Recommendation	
8	Window/Skylight: Water Plant		Glass: No glazing - broken, missing Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.94 Solar Heat Gain Coefficient including Window Coverings: 0.11		Replace existing window with U-0.30 vinyl window	
Installation Cost		$297	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$
Breakeven Cost		$	**Savings-to-Investment Ratio**	0.0	**Simple Payback yrs**	1000
Auditors Notes:						

4.4 Mechanical Equipment Measures

4.4.1 Heating/Cooling/Domestic Hot Water Measure

Rank	Recommendation					
4	Boilers need to be cleaned and tuned. A boiler should be isolated in spring and fall seasons to reduce losses and increase efficiency. The backup circulation pump should be valved off to reduce the load on the active circulation pump. Boilers should be shut off in mid May and turned back on in October.					
Installation Cost		$2,000	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$1,361
					Maintenance Savings (/yr)	$100
Breakeven Cost		$13,456	**Savings-to-Investment Ratio**	6.7	**Simple Payback yrs**	1
Auditors Notes:						

4.5 Electrical & Appliance Measures

4.5.1 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation
1	Tank Circulation Pump	Grundfos C4100 6063 P1 9818, 1.5 HP with Manual Switching	Improve Manual Switching

Installation Cost	$10	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$1,258
Breakeven Cost	$7,787	**Savings-to-Investment Ratio**	778.7	**Simple Payback yrs**	0

Auditors Notes: Shut off circulation pump, as it is not needed. It should be used if there is trouble maintaining heat in the water storage tank, but currently the well pump is putting warm enough water into the tank, and water is getting used so quickly in the town that there is no need to even circulate water.

Rank	Location	Description of Existing	Efficiency Recommendation
2	Well A Heat Tape	Well A Heat Tape with Manual Switching	Improve Manual Switching

Installation Cost	$500	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$2,140
Breakeven Cost	$13,245	**Savings-to-Investment Ratio**	26.5	**Simple Payback yrs**	0

Auditors Notes: The heat tape is currently on all winter long. The well pump is on a VFD and is running almost 24/7. As long as the pump is running the heat tape can be off. A flow switch should be installed so that when the well pump shuts off in the winter time, the heat tape will turn on.

Rank	Location	Description of Existing	Efficiency Recommendation
3	Lift Station Electric Heating/ Heat Tapes	3 Electric Heat Tapes, Two Electric Heaters with Manual Switching	Improve Manual Switching

Installation Cost	$3,000	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$3,606
Breakeven Cost	$22,325	**Savings-to-Investment Ratio**	7.4	**Simple Payback yrs**	1

Auditors Notes: For the force main heat trace: The heat tape should be turned on only if the high level alarm and both pumps are running, or you are using a pumper truck. This line is an emergency heat tape, and should be shut off the majority of the time.

For the water service heat trace: A small circulation pump (15-85W) should be put on the water line coming into the lift station and used in place of the heat tape. Additionally an RPZA needs to be installed on the water line to prevent sewage from accidently flowing back from the lift station to the water main.

Electric heaters in the facility should be set to 40 degrees, and only manually tuned up for comfort when working in the facility for extended periods. Otherwise there is no need to keep the facility heated above the freezing point.

Rank	Location	Description of Existing	Efficiency Recommendation
6	Lift Station Pumps and Controls	2 Grinder/Discharge Pumps and Control Panels with Manual Switching	Improve Manual Switching

Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$98
Breakeven Cost	$608	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	20

Auditors Notes: Currently groundwater is infiltrating the system and supply about 25% of the water that is being pumped up to the lagoon. Finding the source of this groundwater and stopping it would reduce pump run time and help prevent the lagoon from flooding.

4.5.2 Circulation Loop Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
5			Heat add controls need to be fixed for circulation Loop #1. turning the loop temperature up to 40 degrees does not prevent freezeups, it only serves to use more fuel to heat leaking water. Old service lines and leaky mains are what is breaking and causing freezups, not too low of temperatures. The loops should be set to 40 degrees and maintained at 40 degrees based on return temperature. Because the lines are buried the heat losses through the circulation loops should be quite low. Current copper service lines should be replaced with 150 feet of pex pipe and a small circulation pump in each home on the loop. Assume one day of work for the operator and one local laborer, plus 3 hours of backhoe time per house. 40 houses. Provide three days of training for the operator on maintenance and heating demand of circulation loops and water service. (67,500 for project, 6,000 for training, 5,000 for two days fixing controls on loops in the plant.) Maintenance costs are based on reduced winter freeze up repairs.		
Installation Cost	$78,500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$8,366
				Maintenance Savings (/yr)	$1,000
Breakeven Cost	$86,321	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	9
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

Appendix B – Direct Vent Oil Heater Programming

Using the temperature setbacks built into most direct vent oil heaters, such as Toyotomi Lasers and Monitor MPIs is a simple, cost effective way to save energy. We recommend setback temperatures of 60 degrees for nights and weekends in offices and other frequently occupied facilities. In buildings that are occupied intermittently, such as Bingo Halls, we recommend a setback of 50 or 55 degrees. Facilities that are never occupied, such as lift stations and well houses, should be setback to 40 degrees, to prevent freezeups. Check the following websites for tips on programming the built in temperature setback capabilities of your specific direct vent oil heater.

http://www.toyotomiusa.com/ownersManuals_ventedHeaters.php

http://www.monitorproducts.com/customer-support/manuals