Comprehensive Energy Audit
For

Atmautluak Washeteria

Prepared For

Village of Atmautlauk

September 30, 2016

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PREFACE

This energy audit was conducted using funds from the United States Department of Agriculture Rural Development as well as the State of Alaska Department of Environmental Conservation. Coordination with the State of Alaska Remote Maintenance Worker (RMW) Program and the associated RMW for each community has been undertaken to provide maximum accuracy in identifying audits and coordinating potential follow up retrofit activities.

The Rural Energy Initiative at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for The Na, Alaska. The authors of this report are Kevin Ulrich, Assistant Engineering Project Manager and Energy Manager-in-Training (EMIT); and Bailey Gamble, Mechanical Engineer I.

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in May of 2016 by the Rural Energy Initiative of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy conservation measures. Discussions of site-specific concerns, non-recommended measures, and an energy conservation action plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Rural Energy Initiative gratefully acknowledges the assistance of Atmautluak Tribal Administrator Daniel Waska, Atmautluak Bookkeeper Andrew Steven, and Water Treatment Plant Operators Louis Nicholai and Matthew Gilman.

1. EXECUTIVE SUMMARY

This report was prepared for the Village of Atmautluak. The scope of the audit focused on Atmautluak Washeteria. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, heating and ventilation systems, and plug loads.

The total predicted energy cost for the Atmautluak Washeteria is $43,494 based on fuel and electricity costs at the time of the site visit. Electricity represents the largest portion with an annual cost of approximately $39,766. Fuel oil represents the remaining portion with an annual cost of approximately $1,634.

The Power Cost Equalization (PCE) program through the State of Alaska provides subsidies to rural communities across the state to lower electricity costs and make energy affordable in rural Alaska. The Atmautluak Washetria currently does not receive any benefits from the PCE program. The benefits of the PCE program are not considered in the energy model of the building or in the recommendations. The facility should be eligible for power cost equalization, ANTHC recommends the community contact the Alaska Energy Authority Power Cost Equalization program and work with their utility to complete paperwork for eligibility to receive PCE for the facility going forward.

There is an active heat recovery system from the power plant to the washeteria, store, and post office buildings. The heat recovery system was installed in 2015 and had operated for a little more than a year at the time of the site visit. The system transports heat from the generator cooling loop in the power plant to the circulating glycol line in the washeteria and the heating systems in the store and post office. The power plant is owned and operated by Atmautluak Tribal Utilities. The use of the recovered heat is offered free of charge since both the utility and the washeteria are managed by the Village of Atmautluak.

Table 1.1 lists the total usage of electricity, #1 oil and recovered heat before and after the proposed retrofits.

Table 1.1: Predicted Annual Fuel Usage for the Atmautluak Washeteria

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	47,165 kWh	20,805 kWh
#1 Oil	243 gallons	641 gallons
Heat Recovery	195.40 million Btu	397.11 million Btu

Benchmark figures facilitate comparing energy use between different buildings. Table 1.2 lists several benchmarks for the audited building. More details can be found in section 3.2.2.

Table 1.2: Building Benchmarks for the Atmautluak Washeteria

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	196.2	14.97	$20.08

With Proposed Retrofits	279.1	21.30	$10.80
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

Table 1.3 below summarizes the energy efficiency measures analyzed for the Atmautluak Washeteria. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
1	Lighting: Washeteria Lights 1	Replace with direct-wire LED equivalent light bulbs.	$1,394	$320	51.08	0.2	2,381.1
2	Lighting: Arctic Entry	Replace with direct-wire LED equivalent light bulbs.	$92	$50	21.65	0.5	172.9
3	Lighting: Water Treatment Plant Main Lights	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	$1,343	$880	17.88	0.7	2,274.3
4	Washeteria Sewage Line Heat Trace	Turn off heat tape and use only for emergency purposes. Full heat tape is estimated to be around 2.0 kW	$1,499	$1,000	17.61	0.7	2,813.0
5	Lighting: Exterior Lighting	Replace with direct-wire LED equivalent light bulbs. And add a new photocell sensor.	$983	$901	9.19	0.9	1,845.3
6	Sewage Line Heat Trace	Repair Heat-Add to prevent the need for hand-hauling using ATV's. Assume saving 5 gallon's of fuel per week = $2000 annually. Assume 10 hours of paid time per week for this @ $10/hr for 8 months = $1800. Repair the heat tape to allow for an emergency backup option to heat the sewage line. This was completed in the summer of 2016.	$231 + $3,800 Maint. Savings	$8,500	6.92	2.1	-3,211.7
7	Lighting: Water Tank Light	Replace with direct-wire LED equivalent light bulbs.	$26	$50	6.06	1.9	43.6

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]	CO_2 Savings
8	Lighting: Washeteria Light 2 (office)	Replace with direct-wire LED equivalent light bulbs.	$40	$80	5.90	2.0	67.8
9	Lighting: Dryer Plenum Light 2	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor.	$69	$150	5.35	2.2	113.8
10	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Treatment Plant space.	$445	$1,000	5.33	2.2	1,637.9
11	Lighting: Water Treatment Plant Main Lights	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	$191	$500	4.49	2.6	326.9
12	Heating, Ventilation, and Domestic Hot Water.	Reprogram Tekmar, Clean and Tune Boilers	$1,803	$5,000	4.30	2.8	3,310.5
13	Well Line Heat Add	Add insulation around well pump line to prevent freezing. Shut off heat tape and use only for emergency purposes. Convert pipe to arctic pipe material	$2,569 + $500 Maint. Savings	$11,500	3.95	3.7	6,264.4
14	Lighting: Dryer Plenum Light 1	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	$192	$580	3.88	3.0	321.6
15	Other Electrical: Lift Station Pumps	Replace lift station pumps with newer, more efficient models.	$1,020	$4,000	3.00	3.9	1,914.5
16	Lighting: Washer Plenum LIght	Replace with direct-wire LED equivalent light bulbs.	$16	$80	2.33	5.0	26.9
17	Lighting: Bathroom Light	Replace with direct-wire LED equivalent light bulbs.	$15	$80	2.27	5.2	26.1
18	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	$167	$1,000	2.05	6.0	886.1

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**[1]	**Simple Payback (Years)**[2]	**CO_2 Savings**
19	Other Electrical: Lift Station Exhaust Fan	Reduce exhaust fan run time in the lift station. The fan was set to run constantly during the site visit.	$161	$1,500	1.26	9.3	302.5
20	Dryers	Replace hydronic dryers and convert usage from electric to hydronic units.	$3,022	$30,000	1.02	9.9	-7,583.5
21	Lift Station Heating	Add Heat Recovery to Lift Station from existing line. Repair thermostat in lift station and set temperature to 50 deg. F.	$2,772	$32,000	1.01	11.5	4,235.5
22	Air Tightening	Add weatherization and insulation to the exterior doors and windows.	$143	$2,000	0.62	14.0	755.0
23	Other Electrical: Transfer Pump	Replace with newer, more efficient model.	$139	$3,000	0.54	21.6	236.9
24	Window/Skylight: WTP Window 5, South facing	Replace existing window with triple pane window.	$23	$1,449	0.24	63.4	120.0
25	Window/Skylight: WTP Window 2, North facing	Replace existing window with triple pane window.	$19	$1,449	0.20	76.1	99.8
26	Lighting: Washer Plenum LIght	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	$5	$500	0.11	110.7	7.7
27	Window/Skylight: WTP Window 1, West facing	Replace existing window with triple pane window.	$4	$1,449	0.04	408.3	19.0
28	Window/Skylight: WTP Window 3, South facing	Replace existing window with triple pane window.	$3	$1,449	0.03	577.3	13.5
29	Window/Skylight: WTP Window 4, South facing	Replace existing window with triple pane window.	$3	$1,449	0.03	577.3	13.5
	TOTAL, all measures		**$18,389 + $4,300 Maint. Savings**	**$111,915**	**2.50**	**4.9**	**19,434.8**

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 $18,389 per year, or 46.2% of the buildings' total energy costs. These measures are estimated to cost $111,915, for an overall simple payback period of 4.9 years.

Table 1.4 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 1.4: Detailed Breakdown of Energy Costs in the Building

Annual Energy Cost Estimate							
Description	**Space Heating**	**Water Heating**	**Clothes Drying**	**Lighting**	**Other Electrical**	**Raw Water Heat Add**	**Total Cost**
Existing Building	$8,201	$4,692	$7,256	$6,712	$9,122	$3,352	**$39,766**
With Proposed Retrofits	$3,187	$2,732	$4,716	$2,032	$7,795	$486	**$21,377**
Savings	$5,014	$1,961	$2,541	$4,680	$1,327	$2,866	**$18,389**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Atmautluak 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
- Water treatment and processing

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 Atmautluak 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.

Atmautluak Washeteria is made up of the following activity areas:

1) Washeteria: 750 square feet
2) Water Treatment Plant: 1,230 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
- 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. Atmautluak Water Treatment Plant/Washeteria

3.1. Building Description

The 1,980 square foot Atmautluak Washeteria was constructed in 1980, with a normal occupancy of 3 people. The number of hours of operation for this building average 8 hours per day, considering all seven days of the week. The Atmautluak Washeteria serves as the central location for water treatment, processes, and distribution to the residents of the community as well as the central location for laundromat services.

Raw water is pumped from a well beneath the washeteria building into the facility where it is held in a large 10,000 gallon settling tank. The water is injected with potassium permanganate in the settling tank where it stays for 24 hours for the chemical to work at collecting the contaminants from the water. After settling, the water is pumped out of the tank where it is sent through a greensand filter and injected with chlorine. The water is then transferred to the 10,000 gallon water storage tank where it is available for the public to withdraw water. This process takes place approximately twice per week. Water is also distributed to the school with a separate circulation loop.

The building houses four electric clothes washers for use by the community. Two of the four washers were operating properly at the time of the site visit. There are three hydronic dryers that have been out of service for years and four electric clothes dryers that are currently in use.

There is a lift station approximately 275ft. west of the washeteria. The lift station collects sewage from the washeteria and pumps it through a 3000ft. sewage line to the lagoon. The building houses the controls for a heat tape on the sewage line. In the winter of 2016, the control panel had a failure and the lift station power was shut down for safety purposes. This was accomplished by closing one leg of the three-phase power to the facility. Because the washeteria and lift station share the same power, this caused a phase imbalance at the washeteria that affected the efficiency and capability of the equipment in the facility. This also forced the operator to use an ATV and trailer to haul the community sewage in multiple trips to the lagoon 2-3 times per week. Since the time of the energy audit site visit, this has been repaired and the sewage line is not in danger of freezing. The maintenance savings from this work are included in the energy audit report.

Figure 3.1: Atmautluak Lift Station

Description of Building Shell

The exterior walls are single stud 2x6 lumber construction with approximately 5.5 inches of polyurethane foam insulation. The average wall height is 12.5 feet and there is approximately 2,090 square feet of wall space in the building.

The building has a cathedral ceiling that is constructed with standard 2x6 lumber framing with 24 inch spacing and approximately 5.5 inches of polyurethane foam insulation. There is approximately 2,087 square feet of roof space in the building.

The building is built on pilings above the ground with a concrete floor and 12 inches of R-38 fiberglass batt insulation in the floor beneath the building frame.

There are five windows in the building, each of which is approximately 38 & 3/8 "x 34 & 3/8" with wood framing and double-pane glass. Two windows are located in the washeteria room with one of the windows in functioning condition and one being broken. Two windows are located in the process room in good condition and one window is in the washer and dryer plenum and is broken.

There are two entrances to the building. One entrance is in the washeteria and one entrance is in the process room. Both entrances have arctic entries with single metal doors, but neither set of doors closes easily and air leaks through as a result.

Description of Heating Plants

The heating plants used in the building are:

Boiler 1

Nameplate Information:	Burnham/MPO-IQ231
Fuel Type:	#1 Oil
Input Rating:	203,000 BTU/hr

Steady State Efficiency:	74 %
Idle Loss:	0.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	Oct – Apr

Boiler 2

Nameplate Information:	Burnham/MPO-IQ231
Fuel Type:	#1 Oil
Input Rating:	203,000 BTU/hr
Steady State Efficiency:	74 %
Idle Loss:	0.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	Oct – Apr

Boiler 3

Nameplate Information:	Burnham/MPO-IQ231
Fuel Type:	#1 Oil
Input Rating:	203,000 BTU/hr
Steady State Efficiency:	74 %
Idle Loss:	0.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	Oct – Apr

Figure 3.2: Boilers in the Atmautluak Washeteria

The boilers were replaced in 2014 with new, efficient models installed. These units do not run very often with the use of the heat recovery system and because of this the overall efficiency of the boilers are lowered within the energy model. Boiler 1 is programmed as a fixed lead

Heat Recovery

Fuel Type:	Heat Recovery
Input Rating:	150,000 BTU/hr

Steady State Efficiency:	95 %
Idle Loss:	0 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year

Figure 3.3: Heat Recovery System Heat Exchanger in the Atmautluak Washeteria

Space Heating Distribution Systems

There are three unit heaters in the building that are used for space heating purposes. One unit heater is in the mechanical process room and is rated for 20,000 BTU. One unit heater is in the washeteria room and is rated for 5,000 BTU. One unit heater is in the dryer plenum and is estimated to produce 10,000 BTU. There is a pump that provides heated glycol for the dryer plenum that is rated for 197 Watts. There is a pump that provides heated glycol to the washeteria and process room unit heaters as well as some baseboards in the restroom and washeteria that is rated for 150 Watts.

Domestic Hot Water System

There is an old hot water generator in the building that has approximately 120 gallons of storage and is heated through the main glycol loop of the building. The hot water temperature is set at 120 deg. F. The Atmautluak Washeteria uses an estimated 123 gallons of water per day and it is estimated that 1/3 of the water is hot water. This comes from an average of 9 washer loads per day with 11.6 gallons of water per load and an estimated 10 gallons of water use per day for the rest room and sinks.

Heat Recovery Information

The heat recovery system was installed in 2015 and had been active for more than a full year by the time of the site visit. This included heating for an entire winter heating season. The system transports heated glycol from the generator cooling loop of the power plant, approximately 500 feet away from the washeteria, to the heating systems of the store, post office, and washeteria. The power plant is very new with four generators rated for 210 kW each. During the site visit, it was observed that the washeteria side of the heat recovery was 176 deg. F supply and 172 deg F. return. The power plant loop had a supply temperature of 182 deg. F and a return temperature of 180 deg. F. The exterior weather conditions were overcast with temperatures in the 50's.

Description of Building Ventilation System

The lift station has an exhaust fan in the dry side of the building that was in constant operation during the site visit. This fan is rated for 125 Watts and 150 CFM.

Lighting

Table 3.1 below shows detailed information on the lights in the Atmautluak Washeteria.

Table 3.1: Lighting Details for the Atmautluak Washeteria

Location	Bulb Type	Fixtures	Total Bulbs	Annual kWh
Washeteria Room	Fluorescent T8's 4ft.	8	4	2,985.5
Washeteria Office	Fluorescent T8's 4ft.	1	2	190.7
Dryer Plenum	Fluorescent T8's 4ft.	1	4	263.3
Dryer Plenum	Incandescent 60 Watt	1	1	105.2
Process Room	Fluorescent T8's 4ft.	11	4	2,896.2
Process Room	Incandescent 60 Watt	1	1	43.8
Washer Plenum	Fluorescent T8's 4ft.	1	4	32.9
Restroom	Fluorescent T8's 4ft.	1	2	29.7
Exterior	Metal Halide 70 Watt	3	3	1,627.0
Arctic Entry	CFL Spiral 42 Watt	1	1	182.7

The exterior lights were on constantly during the site visit including in the daylight hours. This results in an excessively high usage in electricity by these lights.

Plug Loads

The Atmautluak Washeteria has a variety of power tools, a telephone, and some other miscellaneous loads that require a plug into an electrical outlet. The use of these items is infrequent and consumes a small portion of the total energy demand of the building.

Major Equipment

Table 3.2 below shows detailed information on all the major equipment and their energy usage in the Atmautluak Washeteria.

Table 3.2: Major Equipment Details for the Atmautluak Washeteria

Equipment	Description	Rating (HP)	Operating Schedule	Annual Energy Consumption (kWh)
Well Pump	Pumps raw water from well into the building	1/2	2 days per week	934.2
Discharge Pump	Pumps water from water settling tank out of the building to be discharged during the tank cleaning process.	1.5	1 hour per day 2 days per week	817.4
Transfer Pump	Pumps water from water settling tank to water storage tank for community use.	1/2	2 days per week.	934.2
Portable Air Compressor	Used to add air to the pressure tank on a daily basis.	2.5	30 minutes per day	87.2
Chlorine Injection Pump	Injects chlorine into the water for treatment purposes	73 Watts	2 days per week	182.8
Backwash Pump	Pumps water back through the filters for cleaning purposes	3	30 minutes every 2 days	821.8
Pressure Pump	Pressurizes the water system for better flow	1.5	5% of the time	490.5
Pressure Pump 2	Pressurizes the water system for better flow	2	5% of the time	653.9
Lift Station Drain Pump	Mobile pump used to drain the lift station during freezing periods.	1/2	2 hours per day 2 days per week in winter.	547.9
Lift Station Pumps	Pump sewage collected in the lift station through the sewage line to the lagoon.	3	20% of the time	2,552.7

There is an electric heater in the lift station that is used to provide space heat to the building. The heater is rated for 1.0 kW and operates during the winter months.

There is a heat tape on the sewage line that extends for the entire length of the 3000 ft. sewage pipe. The heat tape has not been functioning because of a power failure at the control panel in the lift station. This has since been repaired by the community.

There is a heat tape on the washeteria sewage line between the washeteria and the lift station. The heat tape is used throughout the winter heating months constantly for freeze protection. There is also a glycol heat trace on the same line.

There are four electric clothes washers in the building that are used by the community. The washers average 9 loads per day and are each rated for 1,176 Watts. They consumes approximately 3,682 kWh annually..

There are heat-add glycol lines for the washeteria sewage line and the well line. The washeteria sewage line has a small pump rated near 200 Watts. The well line heat add has a small pump rated near 800 Watts.

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. One KW of electric demand is equivalent to 1,000 watts running at a particular moment. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges.

The natural gas usage profile shows the predicted natural gas energy usage for the building. If actual gas usage records were available, the model used to predict usage was calibrated to approximately match actual usage. Natural gas is sold to the customer in units of 100 cubic feet (CCF), which contains approximately 100,000 BTUs of energy.

The propane usage profile shows the propane usage for the building. Propane is sold by the gallon or by the pound, and its energy value is approximately 91,800 BTUs per gallon.

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: Atmautluak Joint Utilities - Commercial - Sm

The average cost for each type of fuel used in this building is shown below in Table 3.3. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.3: Energy Rates for Each Fuel Source

Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.81/kWh
#1 Oil	$ 6.73/gallons
Heat Recovery	$ 0.01/million Btu

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Village of Atmautluak pays approximately $39,766 annually for electricity and other fuel costs for the Atmautluak Washeteria.

Figure 3.4 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.

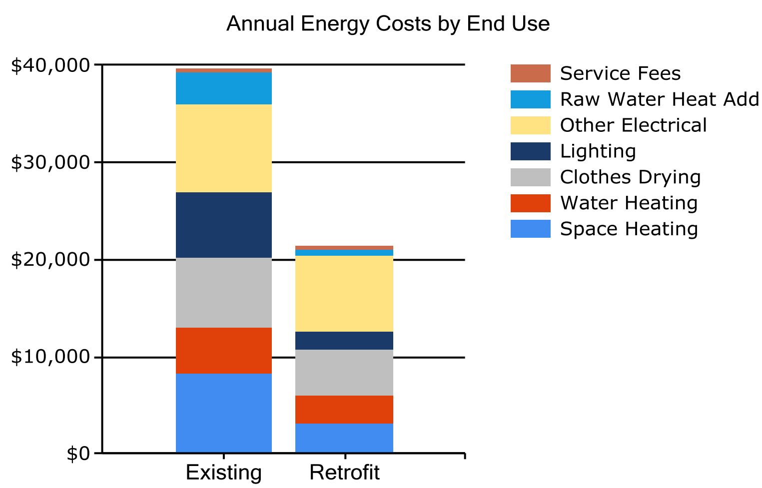


Figure 3.4: Annual Energy Costs by End Use

Figure 3.5 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.

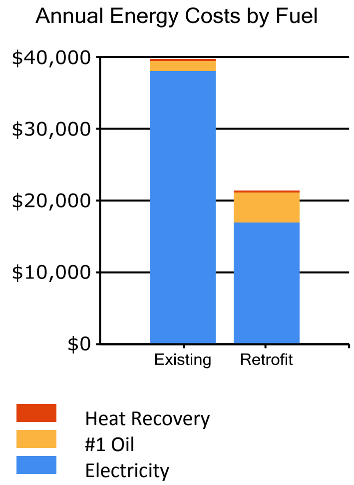


Figure 3.5: Annual Energy Costs by Fuel Type

Figure 3.6 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.

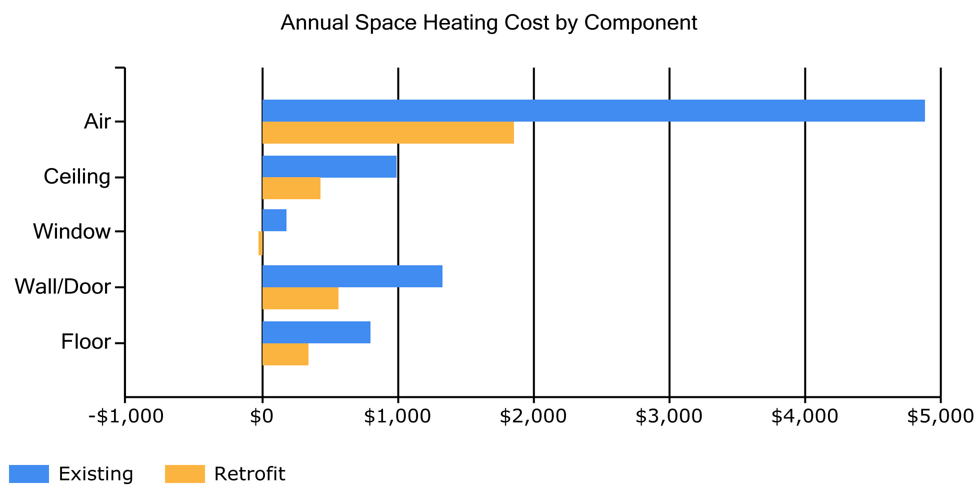


Figure 3.6: Annual Space Heating Cost by Component

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
Space Heating	1617	1468	1482	852	269	173	157	173	228	428	1337	1617
DHW	918	836	916	465	48	46	48	48	46	48	885	918
Clothes Drying	768	700	768	744	768	744	768	768	744	768	744	768
Lighting	755	688	755	731	698	623	643	643	623	752	731	755
Other Electrical	969	883	969	937	969	937	969	969	937	969	937	969
Raw Water Heat Add	614	560	611	292	0	0	0	0	0	0	588	615

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	9	8	6	10	3	1	0	1	2	0	4	9
DHW	11	10	11	2	1	1	1	1	1	17	9	11
Raw Water Heat Add	23	21	21	3	0	0	0	0	0	0	18	23

Heat Recovery Consumption (Million Btu)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	19	17	15	9	3	1	0	1	2	7	12	19
DHW	6	5	5	2	1	1	1	1	1	1	4	6
Raw Water Heat Add	12	11	10	3	0	0	0	0	0	0	7	12

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):

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

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

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

Table 3.4: Atmautluak 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	47,165 kWh	160,975	3.340	537,656
#1 Oil	243 gallons	32,052	1.010	32,372
Heat Recovery	195.40 million Btu	195,402	1.280	250,115
Total		**388,429**		**820,143**
BUILDING AREA		1,980	Square Feet	
BUILDING SITE EUI		196	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		414	**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.				

Table 3.5: Atmautluak Washeteria Building Benchmarks

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	196.2	14.97	$20.08
With Proposed Retrofits	279.1	21.30	$10.80
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

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 Atmautluak Water Treatment Plant/Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Atmautluak 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 Atmautluak. 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 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 heating loads across different parts of the building.

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.

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
1	Lighting: Washeteria Lights 1	Replace with direct-wire LED equivalent light bulbs.	$1,394	$320	51.08	0.2	2,381.1
2	Lighting: Arctic Entry	Replace with direct-wire LED equivalent light bulbs.	$92	$50	21.65	0.5	172.9
3	Lighting: Water Treatment Plant Main Lights	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	$1,343	$880	17.88	0.7	2,274.3
4	Washeteria Sewage Line Heat Trace	Turn off heat tape and use only for emergency purposes. Full heat tape is estimated to be around 2.0 kW	$1,499	$1,000	17.61	0.7	2,813.0
5	Lighting: Exterior Lighting	Replace with direct-wire LED equivalent light bulbs. And add a new photocell sensor.	$983	$901	9.19	0.9	1,845.3

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
6	Sewage Line Heat Trace	Repair Heat-Add to prevent the need for hand-hauling using ATV's. Assume saving 5 gallon's of fuel per week = $2000 annually. Assume 10 hours of paid time per week for this @ $10/hr for 8 months = $1800. Repair the heat tape to allow for an emergency backup option to heat the sewage line. This was completed in the summer of 2016.	$231 + $3,800 Maint. Savings	$8,500	6.92	2.1	-3,211.7
7	Lighting: Water Tank Light	Replace with direct-wire LED equivalent light bulbs.	$26	$50	6.06	1.9	43.6
8	Lighting: Washeteria Light 2 (office)	Replace with direct-wire LED equivalent light bulbs.	$40	$80	5.90	2.0	67.8
9	Lighting: Dryer Plenum Light 2	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor.	$69	$150	5.35	2.2	113.8
10	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Treatment Plant space.	$445	$1,000	5.33	2.2	1,637.9
11	Lighting: Water Treatment Plant Main Lights	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	$191	$500	4.49	2.6	326.9
12	Heating, Ventilation, and Domestic Hot Water.	Reprogram Tekmar, Clean and Tune Boilers	$1,803	$5,000	4.30	2.8	3,310.5
13	Well Line Heat Add	Add insulation around well pump line to prevent freezing. Shut off heat tape and use only for emergency purposes. Convert pipe to arctic pipe material	$2,569 + $500 Maint. Savings	$11,500	3.95	3.7	6,264.4

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
14	Lighting: Dryer Plenum Light 1	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	$192	$580	3.88	3.0	321.6
15	Other Electrical: Lift Station Pumps	Replace lift station pumps with newer, more efficient models.	$1,020	$4,000	3.00	3.9	1,914.5
16	Lighting: Washer Plenum LIght	Replace with direct-wire LED equivalent light bulbs.	$16	$80	2.33	5.0	26.9
17	Lighting: Bathroom Light	Replace with direct-wire LED equivalent light bulbs.	$15	$80	2.27	5.2	26.1
18	Setback Thermostat: Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.	$167	$1,000	2.05	6.0	886.1
19	Other Electrical: Lift Station Exhaust Fan	Reduce exhaust fan run time in the lift station. The fan was set to run constantly during the site visit.	$161	$1,500	1.26	9.3	302.5
20	Dryers	Replace hydronic dryers and convert usage from electric to hydronic units.	$3,022	$30,000	1.02	9.9	-7,583.5
21	Lift Station Heating	Add Heat Recovery to Lift Station from existing line. Repair thermostat in lift station and set temperature to 50 deg. F.	$2,772	$32,000	1.01	11.5	4,235.5
22	Air Tightening	Add weatherization and insulation to the exterior doors and windows.	$143	$2,000	0.62	14.0	755.0
23	Other Electrical: Transfer Pump	Replace with newer, more efficient model.	$139	$3,000	0.54	21.6	236.9
24	Window/Skylight: WTP Window 5, South facing	Replace existing window with triple pane window.	$23	$1,449	0.24	63.4	120.0
25	Window/Skylight: WTP Window 2, North facing	Replace existing window with triple pane window.	$19	$1,449	0.20	76.1	99.8

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
26	Lighting: Washer Plenum LIght	Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	$5	$500	0.11	110.7	7.7
27	Window/Skylight: WTP Window 1, West facing	Replace existing window with triple pane window.	$4	$1,449	0.04	408.3	19.0
28	Window/Skylight: WTP Window 3, South facing	Replace existing window with triple pane window.	$3	$1,449	0.03	577.3	13.5
29	Window/Skylight: WTP Window 4, South facing	Replace existing window with triple pane window.	$3	$1,449	0.03	577.3	13.5
	TOTAL, all measures		**$18,389 + $4,300 Maint. Savings**	**$111,915**	**2.50**	**4.9**	**19,434.8**

4.2 Interactive Effects of Projects

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

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

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

4.3 Building Shell Measures

4.3.1 Window Measures

Rank	Location		Size/Type, Condition		Recommendation	
24	Window/Skylight: WTP Window 5, South facing		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 triple pane window.	
Installation Cost		$1,449	**Estimated Life of Measure (yrs)**	20	**Installation Cost**	$1,449
Breakeven Cost		$350	**Savings-to-Investment Ratio**	0.2	**Breakeven Cost**	$350
Auditors Notes: This window is broken and needs replaced.						

Rank	Location		Size/Type, Condition		Recommendation	
25	Window/Skylight: WTP Window 2, North facing		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 triple pane window.	
Installation Cost		$1,449	**Estimated Life of Measure (yrs)**	20	**Installation Cost**	$1,449
Breakeven Cost		$292	**Savings-to-Investment Ratio**	0.2	**Breakeven Cost**	$292
Auditors Notes: This window is broken and needs replaced.						

Rank	Location		Size/Type, Condition		Recommendation	
27	Window/Skylight: WTP Window 1, West facing		Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46		Replace existing window with triple pane window.	
Installation Cost		$1,449	**Estimated Life of Measure (yrs)**	20	**Installation Cost**	$1,449
Breakeven Cost		$55	**Savings-to-Investment Ratio**	0.0	**Breakeven Cost**	$55
Auditors Notes: The window can be better insulated with triple-pane glass in order to reduce heat transfer.						

Rank	Location	Size/Type, Condition	Recommendation
28	Window/Skylight: WTP Window 3, South facing	Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46	Replace existing window with triple pane window.

Installation Cost	$1,449	**Estimated Life of Measure (yrs)**	20	**Installation Cost**	$1,449
Breakeven Cost	$39	**Savings-to-Investment Ratio**	0.0	**Breakeven Cost**	$39

Auditors Notes: The window can be better insulated with triple-pane glass in order to reduce heat transfer.

Rank	Location	Size/Type, Condition	Recommendation
29	Window/Skylight: WTP Window 4, South facing	Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46	Replace existing window with triple pane window.

Installation Cost	$1,449	**Estimated Life of Measure (yrs)**	20	**Installation Cost**	$1,449
Breakeven Cost	$39	**Savings-to-Investment Ratio**	0.0	**Breakeven Cost**	$39

Auditors Notes: The window can be better insulated with triple-pane glass to prevent glass in order to reduce heat transfer.

4.3.2 Air Sealing Measures

Rank	Location	Existing Air Leakage Level (cfm@50/75 Pa)	Recommended Air Leakage Reduction (cfm@50/75 Pa)
22		Air Tightness estimated as: 3500 cfm at 50 Pascals	Add weatherization and insulation to the exterior doors and windows.

Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	10	**Installation Cost**	$2,000
Breakeven Cost	$1,238	**Savings-to-Investment Ratio**	0.6	**Breakeven Cost**	$1,238

Auditors Notes: The arctic entries for the doors consistently had doors left open. These can be shut to reduce cold air infiltration. Also, the gaps around the doors and windows can be sealed and insulated.

4.4 Mechanical Equipment Measures

4.4.1 Heating/Domestic Hot Water Measure

Rank	Recommendation				
12	Reprogram Tekmar, Clean Boilers				
Installation Cost	$5,000	**Installation Cost**	$5,000	**Installation Cost**	$5,000
Breakeven Cost	$21,497	**Breakeven Cost**	$21,497	**Breakeven Cost**	$21,497
Auditors Notes: The Tekmar is programmed for a fixed lead boiler with Boiler 1. Reprogramming the Tekmar to rotate boilers to extend the life of the boiler. The boilers had not been cleaned since their installation. The operators should be trained on proper cleaning of the boiler.					

4.4.2 Night Setback Thermostat Measures

Rank	Building Space		Recommendation		
10	Water Treatment Plant		Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Treatment Plant space.		
Installation Cost	$1,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$445
Breakeven Cost	$5,334	**Savings-to-Investment Ratio**	5.3	**Simple Payback yrs**	2
Auditors Notes: Lower the temperature to 50 deg. F when the room is unoccupied to reduce the energy consumption.					

Rank	Building Space		Recommendation		
18	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)**	$167
Breakeven Cost	$2,050	**Savings-to-Investment Ratio**	2.0	**Simple Payback yrs**	6
Auditors Notes: Lower the temperature to 50 deg. F when the room is unoccupied to reduce the energy consumption.					

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	
1	Washeteria Lights 1	8 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with direct-wire LED equivalent light bulbs.	
Installation Cost	$320	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$320
Breakeven Cost	$16,346	**Savings-to-Investment Ratio**	51.1	**Breakeven Cost**	$16,346
Auditors Notes: There are eight fixtures with four T8 4ft. fluorescent light bulbs in each fixtures. These will be replaced with two LED equivalent light bulbs in each fixture for a total of 16 new light bulbs to be replaced.					

Rank	Location	Existing Condition		Recommendation	
2	Arctic Entry	FLUOR CFL, Spiral 42 W		Replace with direct-wire LED equivalent light bulbs.	
Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$50
Breakeven Cost	$1,082	**Savings-to-Investment Ratio**	21.6	**Breakeven Cost**	$1,082
Auditors Notes: There is a single CFL light bulb to be replaced in this space.					

Rank	Location	Existing Condition		Recommendation	
3	Water Treatment Plant Main Lights	11 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with direct-wire LED equivalent light bulbs and add new occupancy sensor	
Installation Cost	$880	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$880
Breakeven Cost	$15,736	**Savings-to-Investment Ratio**	17.9	**Breakeven Cost**	$15,736
Auditors Notes: There are 11 fixtures with four T8 4ft. fluorescent light bulbs in each fixtures. These will be replaced with two LED equivalent light bulbs in each fixture for a total of 22 new light bulbs to be replaced. This retrofit deals with the light bulb installation.					

Rank	Location	Existing Condition		Recommendation	
5	Exterior Lighting	3 MH 70 Watt Magnetic		Replace with direct-wire LED equivalent light bulbs and add a new photocell sensor.	
Installation Cost	$901	**Estimated Life of Measure (yrs)**	10	**Installation Cost**	$901
Breakeven Cost	$8,280	**Savings-to-Investment Ratio**	9.2	**Breakeven Cost**	$8,280
Auditors Notes: There are three individual fixtures with a single metal halide light bulb in each fixture to be replaced. The light was on constantly during the site visit including in the daylight hours. Adding a photocell will reduce usage during unnecessary times of the day.					

Rank	Location	Existing Condition		Recommendation	
7	Water Tank Light	INCAN A Lamp, Std 60W		Replace with direct-wire LED equivalent light bulbs.	
Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$50
Breakeven Cost	$303	**Savings-to-Investment Ratio**	6.1	**Breakeven Cost**	$303
Auditors Notes: There is a single incandescent light bulb to be replaced.					

Rank	Location	Existing Condition		Recommendation	
8	Washeteria Light 2 (office)	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with direct-wire LED equivalent light bulbs.	
Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$80
Breakeven Cost	$472	**Savings-to-Investment Ratio**	5.9	**Breakeven Cost**	$472
Auditors Notes: There is a single fixture with two T8 4ft. fluorescent light bulbs for a total of two light bulbs to be replaced.					

Rank	Location	Existing Condition		Recommendation	
9	Dryer Plenum Light 2	INCAN A Lamp, Std 60W		Replace with direct-wire LED equivalent light bulbs.	
Installation Cost	$150	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$150
Breakeven Cost	$803	**Savings-to-Investment Ratio**	5.4	**Breakeven Cost**	$803
Auditors Notes: There is a single incandescent light bulb to be replaced.					

Rank	Location	Existing Condition		Recommendation	
14	Dryer Plenum Light 1	FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with direct-wire LED equivalent light bulbs and add a new occupancy sensor.	
Installation Cost	$580	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$580
Breakeven Cost	$2,253	**Savings-to-Investment Ratio**	3.9	**Breakeven Cost**	$2,253
Auditors Notes: There is one fixture with four T8 4ft. fluorescent light bulbs in the fixture. These will be replaced with two LED equivalent light bulbs for a total of two bulbs installed. Also install an occupancy sensor for the room.					

Rank	Location	Existing Condition		Recommendation	
16	Washer Plenum LIght	FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with direct-wire LED equivalent light bulbs and add a new occupancy sensor.	
Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$80
Breakeven Cost	$187	**Savings-to-Investment Ratio**	2.3	**Breakeven Cost**	$187
Auditors Notes: There is one fixture with four T8 4ft. fluorescent light bulbs in the fixture. These will be replaced with two LED equivalent light bulbs for a total of two bulbs installed. This retrofit deals with the light bulb installation.					

Rank	Location	Existing Condition		Recommendation	
17	Bathroom Light	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with direct-wire LED equivalent light bulbs.	
Installation Cost	$80	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$80
Breakeven Cost	$181	**Savings-to-Investment Ratio**	2.3	**Breakeven Cost**	$181
Auditors Notes: There is a single fixture with two T8 4ft. fluorescent light bulbs for a total of two light bulbs to be replaced.					

4.5.1b Lighting Measures – Lighting Controls

Rank	Location	Existing Condition		Recommendation	
11	Water Treatment Plant Main Lights	11 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with direct-wire LED equivalent light bulbs and add a new occupancy sensor.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$500
Breakeven Cost	$2,243	**Savings-to-Investment Ratio**	4.5	**Breakeven Cost**	$2,243
Auditors Notes: There are 11 fixtures with four T8 4ft. fluorescent light bulbs in each fixtures. These will be replaced with two LED equivalent light bulbs in each fixture for a total of 22 new light bulbs to be replaced. This retrofit deals with the occupancy sensor.					

Rank	Location	Existing Condition		Recommendation	
26	Washer Plenum LIght	FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with direct-wire LED equivalent light bulbs and add a new occupancy sensor.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$500
Breakeven Cost	$53	**Savings-to-Investment Ratio**	0.1	**Breakeven Cost**	$53
Auditors Notes: There is one fixture with four T8 4ft. fluorescent light bulbs in the fixture. These will be replaced with two LED equivalent light bulbs for a total of two bulbs installed. This retrofit deals with the occupancy sensor.					

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
15	Lift Station Pumps	Lift Station Pump		Replace with Lift Station Pump and Improve Manual Switching	
Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$4,000
Breakeven Cost	$11,983	**Savings-to-Investment Ratio**	3.0	**Breakeven Cost**	$11,983
Auditors Notes: Replace with VFD pumps and motors.					

Rank	Location	Description of Existing		Efficiency Recommendation	
19	Lift Station Exhaust Fan	Exhaust Fan		Improve Manual Switching	
Installation Cost	$1,500	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$1,500
Breakeven Cost	$1,893	**Savings-to-Investment Ratio**	1.3	**Breakeven Cost**	$1,893
Auditors Notes: The fan was on constantly during the site visit and a hose was in place on the fan withdrawing air from a corner that the end was tucked in. Turn the fan off to reduce waste and preserve the life of the fan. The fan should only need to be used when the space is occupied by the operator.					

Rank	Location	Description of Existing		Efficiency Recommendation	
23	Transfer Pump	Pump		Replace with Pump	
Installation Cost	$3,000	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$3,000
Breakeven Cost	$1,631	**Savings-to-Investment Ratio**	0.5	**Breakeven Cost**	$1,631
Auditors Notes: Replace with new, more efficient model.					

4.5.3 Other Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
4		Washeteria Sewage Line Heat Trace		Turn off heat tape and use only for emergency purposes. Full heat tape is estimated to be around 2.0 kW	
Installation Cost	$1,000	**Estimated Life of Measure (yrs)**	15	**Installation Cost**	$1,000
Breakeven Cost	$17,607	**Savings-to-Investment Ratio**	17.6	**Breakeven Cost**	$17,607
Auditors Notes: The heat tape is used throughout the winter as well as a glycol heat-add to heat the sewage collected in the washeteria and transported to the lift station. Using both methods is redundant and should not be necessary to prevent freezing. Shut off the heat tape and use only for emergency purposes.					

Rank	Location	Description of Existing	Efficiency Recommendation
6		Sewage Line Heat Trace	Repair Heat-Add to prevent the need for hand-hauling using ATV's. Assume saving 5 gallon's of fuel per week = $2000 annually. Assume 10 hours of paid time per week for this @ $10/hr for 8 months = $1800. Repair the heat tape to allow for an emergency backup option to heat the sewage line. $1000 cost. This was completed in the summer of 2016.

Installation Cost	$8,500	**Estimated Life of Measure (yrs)**	20	**Installation Cost**	$8,500
Breakeven Cost	$58,805	**Savings-to-Investment Ratio**	6.9	**Breakeven Cost**	$58,805

Auditors Notes: The sewer force main has a heat tape that runs the entire length of the pipe to prevent heat loss. The lift station power experienced a failure to cause this to not operate. When the pipe reached its freezing point in the winter, there was no method of thawing the sewage and the operators were forced to manually haul the sewage using a portable transfer pump and an ATV trailer. This creates many inconveniences and takes a lot of time and effort to do. Repairing the power will stabilize the lift station operation and reduce the manual labor needed for the sewage. This work was completed in the summer of 2016.

Rank	Location	Description of Existing	Efficiency Recommendation
13		Well Line Heat Add	Add insulation around well pump line to prevent freezing. Shut off heat tape and use only for emergency purposes. Convert pipe to arctic pipe material

Installation Cost	$11,500	**Estimated Life of Measure (yrs)**	20	**Installation Cost**	$11,500
Breakeven Cost	$45,391	**Savings-to-Investment Ratio**	3.9	**Breakeven Cost**	$45,391

Auditors Notes: The well line is contained in a utilidor that is in very poor condition with the pipe exposed to the outside. Insulating the pipe will reduce the heat losses and will allow the operator to shut off the heat tape and use for emergency thaw purposes.

Figure 4.1: Well Line Utilidor

<table>
<tr><th>Rank</th><th colspan="2">Location</th><th colspan="2">Description of Existing</th><th colspan="2">Efficiency Recommendation</th></tr>
<tr><td>20</td><td colspan="2"></td><td colspan="2">Dryers</td><td colspan="2">Replace hydronic dryers and convert usage from electric to hydronic units.</td></tr>
<tr><td colspan="2">Installation Cost</td><td>$30,000</td><td>Estimated Life of Measure (yrs)</td><td>15</td><td>Installation Cost</td><td>$30,000</td></tr>
<tr><td colspan="2">Breakeven Cost</td><td>$30,685</td><td>Savings-to-Investment Ratio</td><td>1.0</td><td>Breakeven Cost</td><td>$30,685</td></tr>
<tr><td colspan="7">Auditors Notes: The existing hydronic dryers have been out or order for years and the models are old enough that the manufacturer is no longer in operation. As a result, the washeteria has used electric dryers for standard operations. Replacing the hydronic dryers will allow the facility to use recovered heat as a primary heating source and will lower energy costs for the building.</td></tr>
</table>

<table>
<tr><th>Rank</th><th colspan="2">Location</th><th colspan="2">Description of Existing</th><th colspan="2">Efficiency Recommendation</th></tr>
<tr><td>21</td><td colspan="2"></td><td colspan="2">Lift Station Electric Heat</td><td colspan="2">Add Heat Recovery to Lift Station from existing line. Repair thermostat in lift station and set temperature to 50 deg. F.</td></tr>
<tr><td colspan="2">Installation Cost</td><td>$32,000</td><td>Estimated Life of Measure (yrs)</td><td>15</td><td>Installation Cost</td><td>$32,000</td></tr>
<tr><td colspan="2">Breakeven Cost</td><td>$32,419</td><td>Savings-to-Investment Ratio</td><td>1.0</td><td>Breakeven Cost</td><td>$32,419</td></tr>
<tr><td colspan="7">Auditors Notes: The existing heat recovery lines pass within 100 feet of the lift station. Expanding the heat recovery system on the return side to the lift station will reduce the heating cost of the building. This would require approximately 100 feet of above ground pipe to be installed from the existing line to the lift station where it could be tied into the heating system for the lift station.</td></tr>
</table>

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.

ANTHC is currently working with the Village of Atmautluak in an effort to realize the retrofits identified in this report through Rural Alaskan Village Grant (RAVG) program. ANTHC will continue to work with the Village of Atmautluak to secure any additional funding necessary to implement the recommended energy efficiency measures

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
Building: Atmautluak Washeteria	**Auditor Company:** ANTHC
Address: Washeteria	**Auditor Name:** Kevin Ulrich and Bailey Gamble
City: Atmautluak	**Auditor Address:** 4500 Diplomacy Dr. Anchorage, AK 99508
Client Name: Matthew Gillman, Louis Nikolai	**Auditor Phone:** (907) 729-3237
Client Address: P.O Box 6568 Atmautlauk, AK 99559	
	Auditor FAX: (907) 729-3729
Client Phone: (907) 553-5040	**Auditor Comment:**
Client FAX:	
Design Data	
Building Area: 1,980 square feet	
Typical Occupancy: 3 people	**Design Indoor Temperature:** 63.8 deg F (building average)
Actual City: Atmautluak	**Design Outdoor Temperature:** -39 deg F
Weather/Fuel City: Atmautluak	**Heating Degree Days:** 13,106 deg F-days
Utility Information	
Electric Utility: Atmautluak Tribal Utilities	
Building: Atmautluak Washeteria	**Auditor Company:** ANTHC

Annual Energy Cost Estimate							
Description	**Space Heating**	**Water Heating**	**Clothes Drying**	**Lighting**	**Other Electrical**	**Raw Water Heat Add**	**Total Cost**
Existing Building	$8,201	$4,692	$7,256	$6,712	$9,122	$3,352	**$39,766**
With Proposed Retrofits	$3,187	$2,732	$4,716	$2,032	$7,795	$486	**$21,377**
Savings	$5,014	$1,961	$2,541	$4,680	$1,327	$2,866	**$18,389**

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	196.2	14.97	$20.08
With Proposed Retrofits	279.1	21.30	$10.80

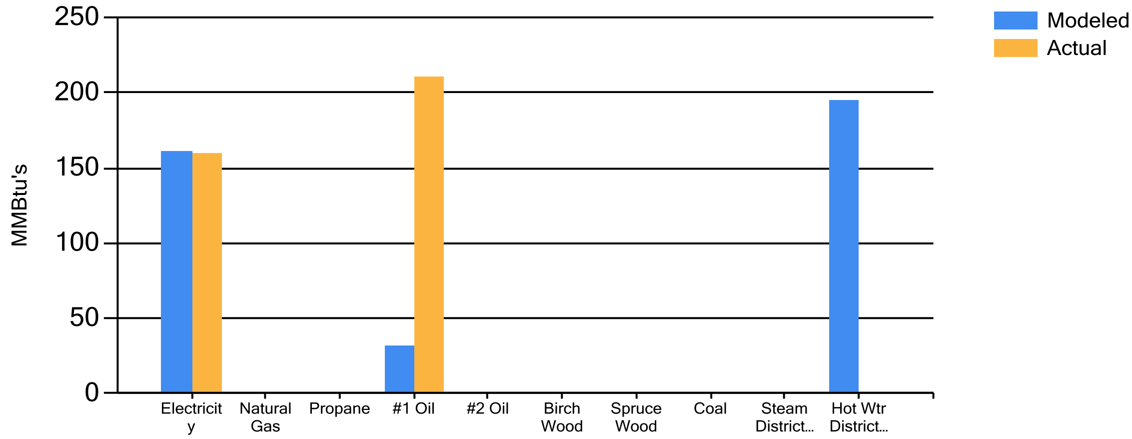
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area.
EUI/HDD: Energy Use Intensity per Heating Degree Day.
ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.

Appendix B – Actual Fuel Use versus Modeled Fuel Use

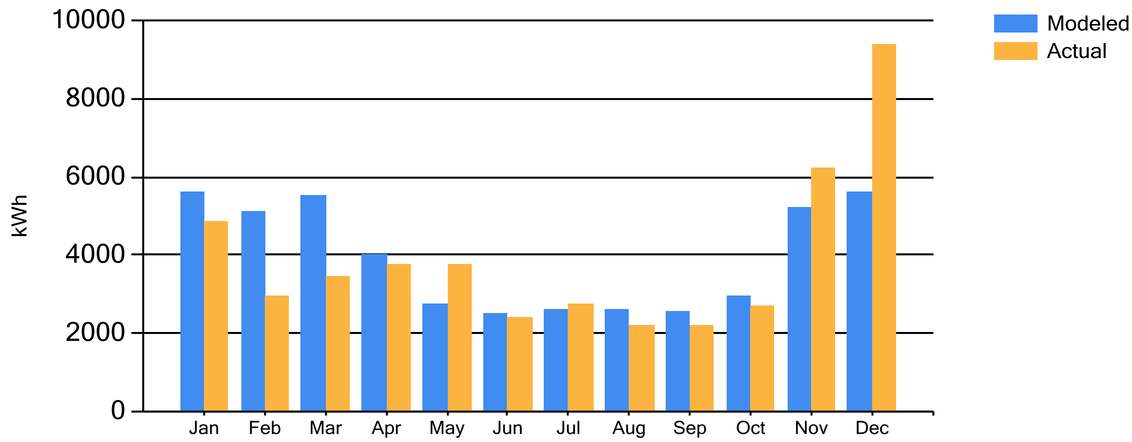
The graphs below show the modeled energy usage results of the energy audit process compared to the actual energy usage report data. The model was completed using AkWarm modeling software. The orange bars show actual fuel use, and the blue bars are AkWarm's prediction of fuel use.

The heat recovery data is from the 2015 calendar year prior to the completion of the heat recovery project. To determine the accuracy of the energy model, the modeled fuel usage was compared to the sum of the BTU equivalent of the heat recovery system and the fuel oil actually purchased.

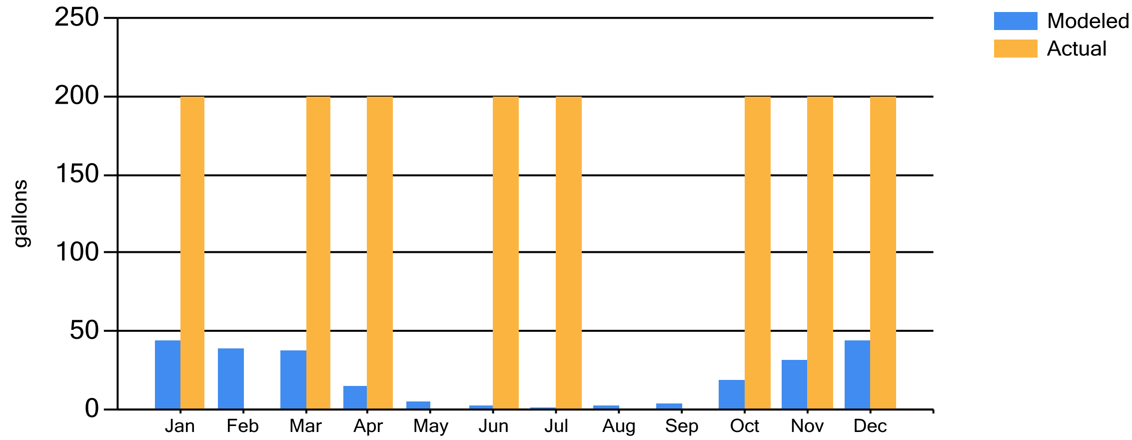
Annual Fuel Use



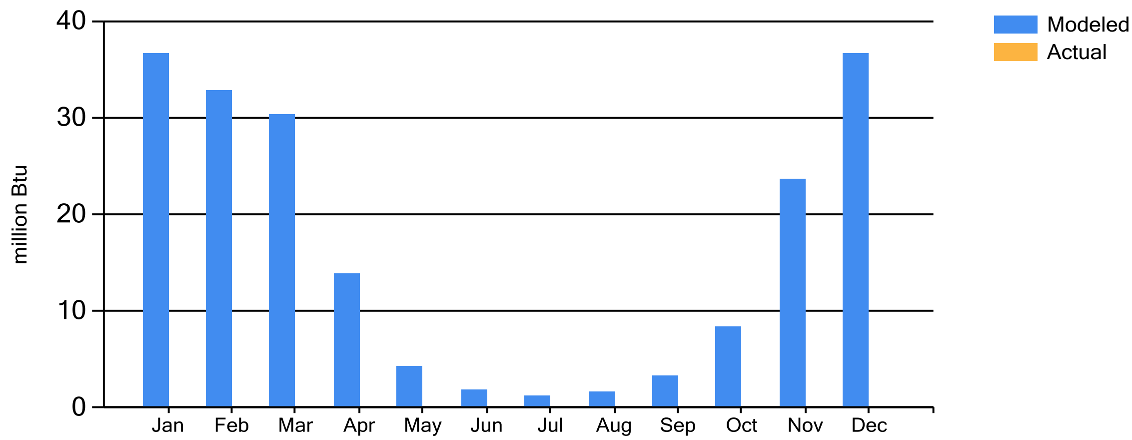
Electricity Use



#1 Fuel Oil Use



Heat Recovery Use



Appendix C - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current	19.1	19.1	18.8	16.9	15.0	14.8	14.8	14.8	14.9	15.3	18.6	19.1
As Proposed	9.4	9.4	9.3	8.8	8.3	8.3	8.2	8.3	8.3	8.4	9.2	9.4

AkWarmCalc Ver 2.5.3.0, Energy Lib 3/7/2016