Comprehensive Energy Audit
For

Circle Washeteria

Prepared For

Circle Native Community

April 28, 2017

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PREFACE

This energy audit was conducted using funds provided by the United States Department of Agriculture as part of the Rural Alaskan Village Grant (RAVG) program. Coordination with the Circle Native 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 Circle Native Community, Alaska. The authors of this report are Kevin Ulrich, Assistant Engineering Project Manager and Certified Energy Manager (CEM); and Cody Uhlig, Utility Support Engineer III, Professional Engineer (PE), and CEM.

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in January of 2017 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 Water Treatment Plant Operator Lawrence Crow, First Chief Jessica Fields, and Tribal Administrator Angela Ludwick.

1. EXECUTIVE SUMMARY

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

Based on electricity and fuel oil prices in effect at the time of the audit, the total predicted energy costs are $30,907 per year. Electricity represents the largest portion with an annual cost of approximately $24,364. This includes $13,727 paid by the tribe and $10,637 paid by the Power Cost Equalization (PCE) program through the State of Alaska. #1 Fuel Oil represents a portion of the energy costs with an annual cost of approximately $3,591. Propane represents the remaining energy costs with an annual cost of approximately $2,952.

The State of Alaska PCE program provides a subsidy to rural communities across the state to lower electricity costs and make energy affordable in rural Alaska. In Circle, the cost of electricity without PCE is $0.71/kWh and the cost of electricity with PCE is $0.40/kWh.

Table 1.1: Predicted Annual Fuel Use for the Circle Washeteria

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	41,742 kWh	17,596 kWh
#1 Oil	1,355 gallons	1,150 gallons
Propane	1,114 gallons	1,058 gallons

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 Circle Washeteria

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	326.8	19.99	$23.84
With Proposed Retrofits	238.4	14.58	$12.44
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 Circle Washeteria. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.3: Summary of Recommended Energy Efficiency Measures

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	Other Electrical: Well Loop Heat Tape	Repair raw water heat-add system. Shut off heat tape and use only for emergency thaw purposes.	$7,844	$3,500	26.33	0.4	29,566.4
2	Lighting - Power Retrofit: Washeteria Arctic Entry	Replace with new energy-efficient LED lighting.	$54	$50	12.62	0.9	202.5
3	Other Electrical: School Heat Tape	Relocate the heating controls and alarms to the school to allow the equipment and alarms to be monitored by the same entity and improve operations monitoring. Shut off heat tape and use only for emergency thaw purposes.	$5,705	$5,500	12.18	1.0	21,502.8
4	Setback Thermostat: Mechanical Room	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Mechanical Room space.	$313	$500	8.38	1.6	2,364.6
5	Setback Thermostat: Washeteria Space	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Washeteria Space space.	$131	$500	3.50	3.8	986.8
6	Other Electrical: Pressure Pump	Repair leaks in the hydronic system to minimize the operations of the pressure pumps.	$133	$500	3.06	3.8	423.8
7	Lighting: Washeteria Hallway	Replace with new energy-efficient LED lighting.	$57	$240	2.72	4.2	183.2
8	Lighting: Washeteria Main Room	Replace with new energy-efficient LED lighting	$84	$400	2.43	4.7	270.3
9	Dryers	Repair dryer ducting to eliminate heated air loss and improve air quality.	$148	$1,000	1.97	6.8	705.7
10	Lighting: Boiler Room	Replace with new energy-efficient LED lighting	$19	$160	1.36	8.5	61.1
11	Air Tightening	Add weather stripping to exterior doors, caulk all windows.	$116	$1,000	1.07	8.7	874.0
12	Lighting: Process Room	Replace with new energy-efficient LED lighting	$28	$480	0.68	16.9	92.0
13	Lighting: Loft Lights	Replace with new energy-efficient LED lighting	$16	$400	0.45	25.6	50.5
14	Lighting: Men's Restroom	Replace with new energy-efficient LED lighting	$6	$160	0.44	26.3	19.6
15	Lighting: Women's Restroom	Replace with new energy-efficient LED lighting	$6	$160	0.44	26.3	19.6

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
16	Electric Heater	Repair unit heater in washeteria room to reduce the usage of the electric heater.	$60	$2,000	0.43	33.2	569.9
17	Heating, Ventilation, and Domestic Hot Water	Clean boilers, lower hot water heater set point, repair heat circulation pumps to ensure proper heat flow, convert heating system to primary secondary, replumb hydronic loop for more efficient heat delivery, repair unit heaters in the mechanical room and washeteria room to allow minimal use of the Toyo stove, Add thermostats and control valves to baseboard heating elements in each of the two restrooms. Equipment repairs made in this retrofit are critical to the success of all retrofits involving thermostat setbacks, heat tape usage reduction, and pressure pump savings.	$67	$35,500	0.03	531.2	272.1
	TOTAL, all measures		**$14,785**	**$52,050**	**3.35**	**3.5**	**58,165.0**

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 $14,785 per year, or 47.8% of the buildings' total energy costs. These measures are estimated to cost $52,050, for an overall simple payback period of 3.5 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 Circle Washeteria

Annual Energy Cost Estimate							
Description	**Space Heating**	**Water Heating**	**Clothes Drying**	**Lighting**	**Other Electrical**	**Raw Water Heat Add**	**Total Cost**
Existing Building	$5,330	$654	$3,553	$1,571	$16,907	$2,891	**$30,907**
With Proposed Retrofits	$4,722	$646	$3,406	$1,270	$3,205	$2,873	**$16,122**
Savings	$608	$8	$148	$301	$13,703	$18	**$14,785**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

The Circle Washeteria is made up of the following activity areas:

1) Mechanical Room: 730 square feet
2) Washeteria Space: 566 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. Circle Washeteria

3.1. Building Description

The 1,296 square foot Circle Washeteria was constructed in 1989. The building houses central water intake and treatment systems along with a watering point for community access as well as the washeteria for community showers, rest rooms, and laundromat services. The water treatment plant side of the building is occupied by the operator approximately three hours per day. The washeteria side is open 24 hours per day but is most frequently operated between the hours of 2-8pm by residents who are using the laundromat services.

Raw water is pumped in from a groundwater well that is approximately 650 ft. away from the washeteria building. The well has a circulating heat-add system from the washeteria that is used for freeze protection. Once the water enters the building it is treated with chlorine before flowing to the 10,000 gallon water storage tank inside the mechanical space. Water is pumped approximately three hours for every two days to fill the tank completely. The watering point will draw water from the tank through two small filters when required. Additionally, there is a water line to the school that will get filled up by the Circle Washeteria approximately once per week as well as a small service to the Tribal Hall. The restrooms, showers, and clothes washers also use water from the water storage tank.

<u>Description of Building Shell</u>

The exterior walls are 2 x 6 wood-framed panel construction with foam insulation.

The building has a cathedral ceiling with a lofted area over the washeteria part of the building. The roof has 2x6 wood-framed construction with foam insulation.

The building is elevated on piles with 2x10 lumber and foam insulation.

There are five windows in the building, each of which is 31.25" wide and 27" tall with wood frames and double-paned glass.

There are two entrances to the building. The front entrance has an arctic entrance with wood doors. The outer door has no mechanism in the deadbolt space. The rear entrance has a single insulated metal door with noticeable air leakage and icing during the cold weather.

<u>Description of Heating Plants</u>

The heating plants used in the building are:

Boiler 1

Nameplate Information:	Weil McLain Gold WGO-4 Series 3
Fuel Type:	#1 Oil

Input Rating:	126,000 BTU/hr
Steady State Efficiency:	78 %
Idle Loss:	0.5 %
Heat Distribution Type:	Water
Boiler Operation:	Oct - May

Boiler 2

Nameplate Information:	Weil McLain Gold WGO-4 Series 3
Fuel Type:	#1 Oil
Input Rating:	126,000 BTU/hr
Steady State Efficiency:	78 %
Idle Loss:	0.5 %
Heat Distribution Type:	Water
Boiler Operation:	Oct – May

Figure 1: Fuel Oil Boilers in the Circle Washeteria

Hot Water Heater

Fuel Type:	#1 Oil
Input Rating:	100,000 BTU/hr
Steady State Efficiency:	75 %
Idle Loss:	0.5 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

Figure 2: Hot Water Heater in the Circle Washeteria

Toyotomi Laser 73

Fuel Type:	#1 Oil
Input Rating:	40,000 BTU/hr
Steady State Efficiency:	90 %
Idle Loss:	0 %
Heat Distribution Type:	Air

Figure 3: Toyo Laser 73 in the Circle Washeteria

Propane for Dryers

Fuel Type:	Propane
Input Rating:	100,000 BTU/hr
Steady State Efficiency:	80 %
Idle Loss:	0 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

Figure 4: Propane Tank outside the Circle Washeteria

Electric Heater – Portable

Fuel Type:	Electricity
Input Rating:	0 BTU/hr
Steady State Efficiency:	90 %
Idle Loss:	0 %
Heat Distribution Type:	Air

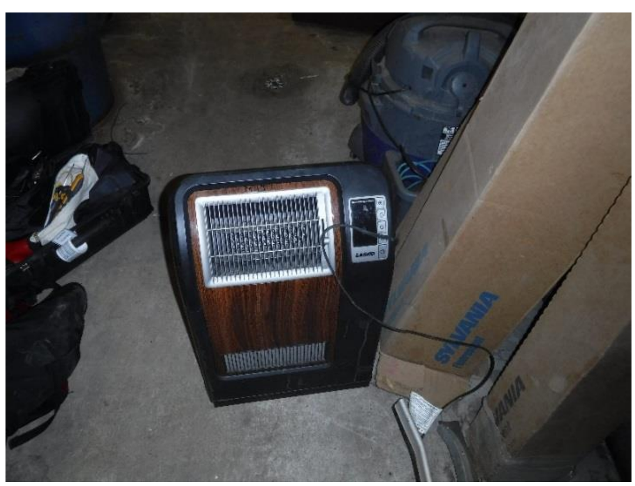


Figure 5: Portable Electric Heater in the Circle Washeteria

Space Heating Distribution Systems

There are three unit heaters in the building. Two are not in operation because they have corroded out. There is one functional unit heater in the washeteria space that has a leak in the piping, causing the water in the hydronic system to leak out and reducing the effectiveness of the heat distribution. For this reason, the unit heater is unable to meet the temperature setpoint of 75 degrees currently in the washeteria space. Additionally, the leaks cause the hydronic system to lose pressure, which forces the operator to pressurize the system each day by adding more water.

Figure 6: Broken Unit Heaters in the Circle Washeteria

Figure 7: Functional Unit Heater with leaks in the Circle Washeteria

The water treatment plant space is heated by a Toyo Laser 73 stove that has a rating of 40,000 BTU/hr. There are other stoves in the plant that are old and not connected for use.

Domestic Hot Water System

The washeteria is estimated to provide three loads of laundry through the clothes washer and dryers each day and approximately five showers per day. This yields an average hot water usage of approximately 67 gallons per day. The water is heated to 140 deg. F by an independent hot water heater.

Figure 8: Clothes Washers in the Circle Washeteria

Lighting

Table 3.1: Lighting Details for the Circle Washeteria

Room	Bulb Type	Fixtures	Bulbs per Fixture	Annual Usage (kWh)
Arctic Entry	CFL Spiral	1	1	228
Washeteria	Fluorescent T8 4ft.	5	2	568
Washeteria Hallway	Fluorescent T8 4ft	3	2	378
Men's Restroom	Fluorescent T8 2ft.	2	2	33
Women's Restroom	Fluorescent T8 2ft.	2	2	33
Process Room	Fluorescent T8 4ft.	6	2	189
Boiler Room	Fluorescent T8 4ft.	2	2	126
Loft	Fluorescent T8 4ft.	5	2	104
Exterior	LED Wall Pack	4	1	1,033

Plug Loads

The Circle 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: Major Equipment Information for the Circle Washeteria

Equipment	Rating (Watts)	Annual Usage (kWh)
Old Washers	1,176	644
New Washers	804	441
Well Pump	375	235
Well Loop Heat Tape	7,500	14,254
Chlorine Injection Pump	204	128
Pressure Pump	1,500	658
Lift Station Pump	2,185	798
Sewer Heat Tape	500	950
School Heat Tape	10,000	10,860
Heating System Circulation Pumps	1,050	5,652

The well pump is rated for ½ HP and runs approximately three hours for every two days to provide raw water to the facility.

The pressure pumps are used to maintain pressure in the system when the watering point has been used by a resident or from use of the services to the school and the tribal hall. The pumps were measured to operate approximately 5% of the time.

Figure 9: Pressure Pumps in the Circle Washeteria

The lift station pump is located in the underground wet well next to the washeteria and is used to pump sewage and wastewater from the washeteria to the sewage lagoon outside of town. The pump is rated for 3 HP.

Figure 10: Spare Lift Station Pump outside the Circle Washeteria

There are three heat tapes that are used to prevent the raw water line, the school line, and the sewer line from freezing. The raw water line heat tape is approximately 650 ft. long and is turned on in the winter when temperatures reach zero degrees Fahrenheit. The school heat tape is left on for the weekends when the temperatures get around -15 degrees Fahrenheit. The sewer heat tape is turned on when the temperatures get around 0 degrees Fahrenheit.

There are two circulation pumps in the hydronic heating system that are used to move the heated water from the boilers to the heat loads in the building. These pumps are rated for 1,050 Watts and consume approximately 5,652 kWh annually.

Figure 11: Heat Circulation Pumps in the Circle Washeteria

The clothes dryers in the washeteria use propane as the primary heat source. The propane is stored in a 2000 gallon storage tank outside of the facility.

Figure 12: Propane Clothes Dryers in the Circle Washeteria

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 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 Circle Native Community owns and operates a power plant that provides electricity service to all residential, commercial, and public facilities in the community.

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 Cost Rates for Each Fuel Type

Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.58/kWh
#1 Oil	$ 2.65/gallons
Propane	$ 2.65/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Circle Native Community pays approximately $30,953 annually for electricity and other fuel costs for the Circle Washeteria.

Figure 13 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.

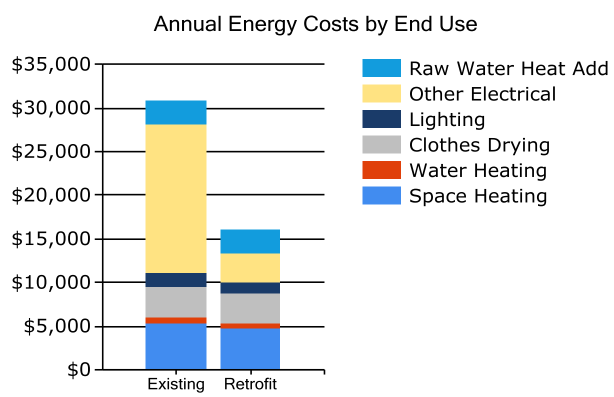


Figure 13: Annual Energy Costs by End Use

Figure 14 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.

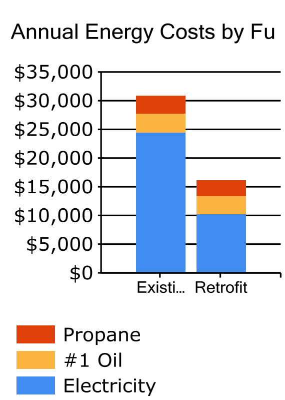


Figure 14: Annual Energy Costs by Fuel Type

Figure 15 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.

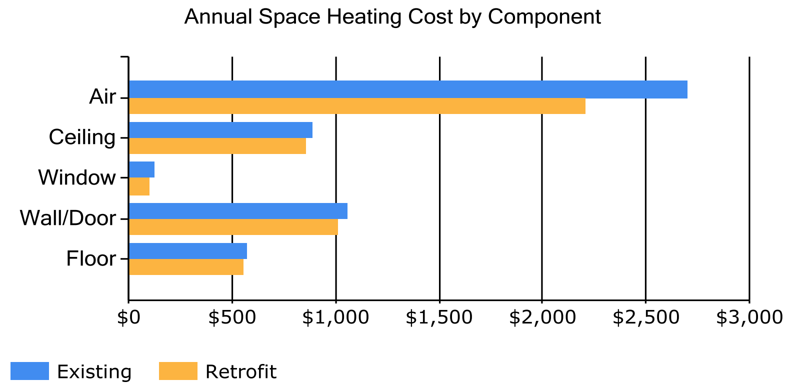


Figure 15: Annual Space Heating Costs

Tables 3.4, 3.5, and 3.6 below show AkWarm's estimate of the monthly usage for each energy source used in the building. For each energy source, the use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Table 3.4: Estimated Electrical Consumption by Category

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	854	768	824	775	361	2	1	4	14	807	807	851
DHW	2	2	2	2	2	2	2	2	2	2	2	2
Clothes Drying	87	80	87	85	87	85	87	87	85	87	85	87
Lighting	282	257	282	273	205	136	141	141	136	282	273	282
Other Electrical	3818	3479	3818	3694	1859	238	246	246	238	3818	3694	3818
Raw Water Heat Add	413	373	405	385	177	0	0	0	0	399	394	412

Table 3.5: Estimated Fuel Oil Consumption by Category

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	139	106	77	27	11	4	2	9	29	43	95	132
DHW	20	19	20	20	20	20	20	20	20	20	20	20
Raw Water Heat Add	83	67	60	37	6	0	0	0	0	43	63	80

Table 3.6: Estimated Propane Consumption by Category

Propane Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Clothes Drying	119	104	106	89	81	71	72	75	80	95	105	117

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 3.7 and 3.8 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 3.7: Building EUI Calculations for the Circle Washeteria

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	41,742 kWh	142,467	3.340	475,839
#1 Oil	1,355 gallons	178,870	1.010	180,658
Propane	1,114 gallons	102,271	1.010	103,293
Total		**423,607**		**759,790**
BUILDING AREA		1,296	Square Feet	
BUILDING SITE EUI		327	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		586	**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 3.8: Building Benchmarks for the Circle Washeteria

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	326.8	19.99	$23.84
With Proposed Retrofits	238.4	14.58	$12.44
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 Circle Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating energy usage. Climate data from Circle 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.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Circle. 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.

Table 4.1: Summary List of Recommended Energy Efficiency Measures Ranked by Economic Priority

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	Other Electrical: Well Loop Heat Tape	Repair raw water heat-add system. Shut off heat tape and use only for emergency thaw purposes.	$7,844	$3,500	26.33	0.4	29,566.4
2	Lighting - Power Retrofit: Washeteria Arctic Entry	Replace with new energy-efficient LED lighting.	$54	$50	12.62	0.9	202.5
3	Other Electrical: School Heat Tape	Relocate the heating controls and alarms to the school to allow the equipment and alarms to be monitored by the same entity and improve operations monitoring. Shut off heat tape and use only for emergency thaw purposes.	$5,705	$5,500	12.18	1.0	21,502.8
4	Setback Thermostat: Mechanical Room	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Mechanical Room space.	$313	$500	8.38	1.6	2,364.6
5	Setback Thermostat: Washeteria Space	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Washeteria Space space.	$131	$500	3.50	3.8	986.8
6	Other Electrical: Pressure Pump	Repair leaks in the hydronic system to minimize the operations of the pressure pumps.	$133	$500	3.06	3.8	423.8
7	Lighting: Washeteria Hallway	Replace with new energy-efficient LED lighting.	$57	$240	2.72	4.2	183.2
8	Lighting: Washeteria Main Room	Replace with new energy-efficient LED lighting	$84	$400	2.43	4.7	270.3
9	Dryers	Repair dryer ducting to eliminate heated air loss and improve air quality.	$148	$1,000	1.97	6.8	705.7
10	Lighting: Boiler Room	Replace with new energy-efficient LED lighting	$19	$160	1.36	8.5	61.1

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
11	Air Tightening	Add weather stripping to exterior doors, caulk all windows.	$116	$1,000	1.07	8.7	874.0
12	Lighting: Process Room	Replace with new energy-efficient LED lighting	$28	$480	0.68	16.9	92.0
13	Lighting: Loft Lights	Replace with new energy-efficient LED lighting	$16	$400	0.45	25.6	50.5
14	Lighting: Men's Restroom	Replace with new energy-efficient LED lighting	$6	$160	0.44	26.3	19.6
15	Lighting: Women's Restroom	Replace with new energy-efficient LED lighting	$6	$160	0.44	26.3	19.6
16	Electric Heater	Repair unit heater in washeteria room to reduce the usage of the electric heater.	$60	$2,000	0.43	33.2	569.9
17	Heating, Ventilation, and Domestic Hot Water	Clean boilers, lower hot water heater set point, repair heat circulation pumps to ensure proper heat flow, convert heating system to primary secondary, replumb hydronic loop for more efficient heat delivery, repair unit heaters in the mechanical room and washeteria room to allow minimal use of the Toyo stove, Add thermostats and control valves to baseboard heating elements in each of the two restrooms. Equipment repairs made in this retrofit are critical to the success of all retrofits involving thermostat setbacks, heat tape usage reduction, and pressure pump savings.	$67	$35,500	0.03	531.2	272.1
	TOTAL, all measures		**$14,785**	**$52,050**	**3.35**	**3.5**	**58,165.0**

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. Lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1 Air Sealing Measures

Rank	**Location**		**Existing Air Leakage Level (cfm@50/75 Pa)**		**Recommended Air Leakage Reduction (cfm@50/75 Pa)**	
11			Air Tightness estimated as: 1950 cfm at 50 Pascals		Add weather stripping to exterior doors, caulk all windows	
Installation Cost	$1,000		**Estimated Life of Measure (yrs)**	10	**Energy Savings ($/yr)**	$116
Breakeven Cost	$1,065		**Simple Payback (yrs)**	9	**Energy Savings (MMBTU/yr)**	5.3 MMBTU
			Savings-to-Investment Ratio	1.1		
Auditors Notes: Adding weather stripping to the doors, caulking windows, and replacing the locking mechanism in the exterior door will reduce the amount of heat loss through those penetrations and lower the heating load for the building.						

4.4 Mechanical Equipment Measures

4.4.1 Heating /Domestic Hot Water Measure

Rank	Recommendation				
17	Clean boilers, lower hot water heater set point, repair heat circulation pumps to ensure proper heat flow, convert heating system to primary secondary, replumb hydronic loop for more efficient heat delivery, repair unit heaters in the mechanical room and washeteria room to allow minimal use of the Toyo stove, Add thermostats and control valves to baseboard heating elements in each of the two restrooms.				
Installation Cost	$35,500	**Estimated Life of Measure (yrs)**	20	**Energy Savings ($/yr)**	$67
Breakeven Cost	$990	**Simple Payback (yrs)**	531	**Energy Savings (MMBTU/yr)**	0.6 MMBTU
		Savings-to-Investment Ratio	0.0		

Auditors Notes: Cleaning the boilers will improve the combustion of the boiler and allow the boiler to distribute heat more effectively.

The hot water heater was set at 140 deg. F during the site visit. Lower the heater to 120 deg. F. to satisfy the demands of the washeteria without using excess fuel.

The heat circulation pumps were tripping an overload switch when they would operate and as a result would shut off operations. This caused the boilers to keep their chambers hot without distributing the heat to the proper heating locations. Repair this electrical concern so that the hydronic system can operate as designed.

The heating system is plumbed such that both boilers will be circulating heated glycol even when only one is firing. Replumb the system such that each boiler can be isolated when in operation to prevent excess heat loss.

Replace the broken unit heaters in the washeteria and water treatment plant to allow for hydronic heating in the spaces.

Add thermostats and control valves to the restrooms to create new heating zones and reduce heat demands when not in use.

Boiler Cleaning: $2000
Lower Hot Water Heater Setpoint: $500
Repair Heat Circulation Pumps: $3000
Replace Unit Heater: $5000
Replumb Hydronic System: $17,000
Restroom Heating Zones: $8,000

Total: $35,500

Equipment repairs made in this retrofit are critical to the success of all retrofits involving thermostat setbacks, heat tape usage reduction, and pressure pump savings.

4.4.2 Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
4	Mechanical Room			Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Mechanical Room space.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$313
Breakeven Cost	$4,188	**Simple Payback (yrs)**	2	**Energy Savings (MMBTU/yr)**	14.2 MMBTU
		Savings-to-Investment Ratio	8.4		

Auditors Notes: This can be achieved through programming of the Toyo Laser 73 Stove.

Rank	Building Space			Recommendation	
5	Washeteria Space			Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Washeteria Space space.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$131
Breakeven Cost	$1,748	**Simple Payback (yrs)**	4	**Energy Savings (MMBTU/yr)**	5.9 MMBTU
		Savings-to-Investment Ratio	3.5		
Auditors Notes: This will require a new thermostat in the washeteria space that will control the existing unit heaters.					

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 loads. The building 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	
2	Washeteria Arctic Entry	FLUOR CFL, Spiral 26 W		Replace with new energy-efficient LED lighting.	
Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$54
Breakeven Cost	$631	**Simple Payback (yrs)**	1	**Energy Savings (MMBTU/yr)**	0.3 MMBTU
		Savings-to-Investment Ratio	12.6		
Auditors Notes: There is a single light bulb in the arctic entry to be replaced.					

Rank	Location	Existing Condition		Recommendation	
7	Washeteria Hallway	3 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost	$240	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$57
Breakeven Cost	$653	**Simple Payback (yrs)**	4	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	2.7		
Auditors Notes: There are three fixtures with two light bulbs in each fixture for a total of six light bulbs to be replaced.					

Rank	Location	Existing Condition		Recommendation	
8	Washeteria Main Room	5 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost	$400	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$84
Breakeven Cost	$971	**Simple Payback (yrs)**	5	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	2.4		
Auditors Notes: There are five fixtures with two light bulbs in each fixture for a total of ten light bulbs to be replaced.					

Rank	Location	Existing Condition	Recommendation
10	Boiler Room	2 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$19
Breakeven Cost	$218	**Simple Payback (yrs)**	8	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	1.4		

Auditors Notes: There are two fixtures with two light bulbs in each fixture for a total of four light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
12	Process Room	6 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$480	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$28
Breakeven Cost	$327	**Simple Payback (yrs)**	17	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.7		

Auditors Notes: There are six fixtures with two light bulbs in each fixture for a total of 12 light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
13	Loft Lights	5 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$400	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$16
Breakeven Cost	$180	**Simple Payback (yrs)**	26	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.4		

Auditors Notes: There are five fixtures with two light bulbs in each fixture for a total of ten light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
14	Men's Restroom	2 FLUOR (2) T8 4' F32T8 25W Energy-Saver Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$6
Breakeven Cost	$70	**Simple Payback (yrs)**	26	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.4		

Auditors Notes: There are two fixtures with two light bulbs in each fixture for a total of four light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
15	Women's Restroom	2 FLUOR (2) T8 4' F32T8 25W Energy-Saver Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$6
Breakeven Cost	$70	**Simple Payback (yrs)**	26	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
		Savings-to-Investment Ratio	0.4		

Auditors Notes: There are two fixtures with two light bulbs in each fixture for a total of four light bulbs to be replaced.

4.5.2 Other Electrical Measures

Rank	Location		Description of Existing		Efficiency Recommendation	
1	Well Loop Heat Tape		Heat Tape		Repair raw water heat-add system. Shut off heat tape and use only for emergency thaw purposes.	
Installation Cost	$3,500		**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$7,844
Breakeven Cost	$92,141		**Simple Payback (yrs)**	0	**Energy Savings (MMBTU/yr)**	45.9 MMBTU
			Savings-to-Investment Ratio	26.3		
Auditors Notes: Cost includes repair of raw water heat-add system, which must be repaired in order for this retrofit to be safely implemented. Repairs include assessment of existing circ. pumps and heat exchangers.						

Rank	Location		Description of Existing		Efficiency Recommendation	
3	School Heat Tape		Heat Tape		Relocate the heating controls and alarms to the school to allow the equipment and alarms to be monitored by the same entity and improve operations monitoring. Shut off heat tape and use only for emergency thaw purposes.	
Installation Cost	$5,500		**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$5,705
Breakeven Cost	$67,012		**Simple Payback (yrs)**	1	**Energy Savings (MMBTU/yr)**	33.4 MMBTU
			Savings-to-Investment Ratio	12.2		
Auditors Notes: Cost includes the relocation of the alarms and controls for the school loop heat-add to the school itself, which will allow for more effective controls and monitoring of the school loop by the end user. This will improve the safety of the water line usage and allow the shutdown of the heat tape to occur.						

Rank	Location		Description of Existing		Efficiency Recommendation	
6	Pressure Pump		Pressure Pump		Repair leaks in the hydronic system to minimize the operations of the pressure pumps.	
Installation Cost	$500		**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$133
Breakeven Cost	$1,529		**Simple Payback (yrs)**	4	**Energy Savings (MMBTU/yr)**	0.0 MMBTU
			Savings-to-Investment Ratio	3.1		
Auditors Notes: The leaks in the hydronic system bleed the pressure out throughout the day and require the pressure pumps to run more often to keep the system pressurized. This also requires the system to be filled with water on a daily basis. Repairing this leak will improve the efficiency and preserve the life of the motor.						

4.5.3 Other Measures

Rank	Location		Description of Existing		Efficiency Recommendation	
9			Clothes Dryers		Repair dryer ducting to eliminate heated air loss and improve air quality.	
Installation Cost	$1,000		**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$148
Breakeven Cost	$1,967		**Simple Payback (yrs)**	7	**Energy Savings (MMBTU/yr)**	5.1 MMBTU
			Savings-to-Investment Ratio	2.0		
Auditors Notes: The ducting in the back of the dryers are old and should be replaced in order to prevent the exhaust air from entering the washeteria space and causing potential health problems. This should also slightly improve the efficiency of the dryers by reducing heat loss through the air.						

Rank	Location	Description of Existing		Efficiency Recommendation	
16		Electric Space Heating		Eliminate use of electric heater when unit heater is repaired.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings ($/yr)**	$60
Breakeven Cost	$856	**Simple Payback (yrs)**	33	**Energy Savings (MMBTU/yr)**	3.9 MMBTU
		Savings-to-Investment Ratio	0.4		
Auditors Notes: When the unit heater is repaired, the electric heater that is currently used to heat the washeteria space on occasion will not be needed to heat the space.					

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.

In the near future, a representative of ANTHC will be contacting the Circle Native Community to follow up on the recommendations made in this report. Funding has been provided to ANTHC through a Rural Alaska Village Grant and the Denali Commission to provide the community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations in the 2017.

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	**AUDITOR INFORMATION**
Building: Circle Washeteria	**Auditor Company:** ANTHC-DEHE
Address: PO Box 89	**Auditor Name:** Kevin Ulrich
City: Circle **Client Name:** Lawrence Crow	**Auditor Address:** 4500 Diplomacy Dr. Anchorage, AK 99508
Client Address: PO Box 89 Circle, AK 99733	**Auditor Phone:** (907) 729-3237 **Auditor FAX:**
Client Phone: (907) 773-2825 **Client FAX:**	**Auditor Comment:**
Design Data	
Building Area: 1,296 square feet	**Design Space Heating Load:** Design Loss at Space: 32,942 Btu/hour with Distribution Losses: 34,675 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 52,859 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 0 people	**Design Indoor Temperature:** 65 deg F (building average)
Actual City: Circle	**Design Outdoor Temperature:** -58.3 deg F
Weather/Fuel City: Circle	**Heating Degree Days:** 16,349 deg F-days
Utility Information	
Electric Utility: Circle Native Community	**Average Annual Cost/kWh:** $0.58/kWh

Annual Energy Cost Estimate							
Description	**Space Heating**	**Water Heating**	**Clothes Drying**	**Lighting**	**Other Electrical**	**Raw Water Heat Add**	**Total Cost**
Existing Building	$5,330	$654	$3,553	$1,571	$16,907	$2,891	**$30,907**
With Proposed Retrofits	$4,722	$646	$3,406	$1,270	$3,205	$2,873	**$16,122**
Savings	$608	$8	$148	$301	$13,703	$18	**$14,785**

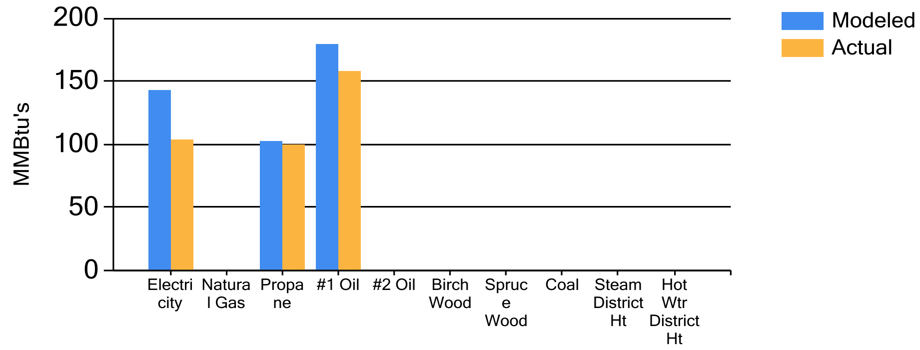
Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	326.8	19.99	$23.84
With Proposed Retrofits	238.4	14.58	$12.44

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.

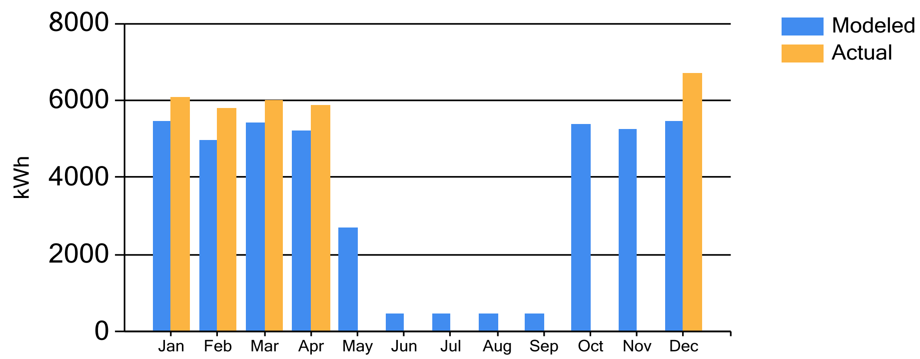
Appendix B – Actual Fuel Use versus Modeled Fuel Use

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.

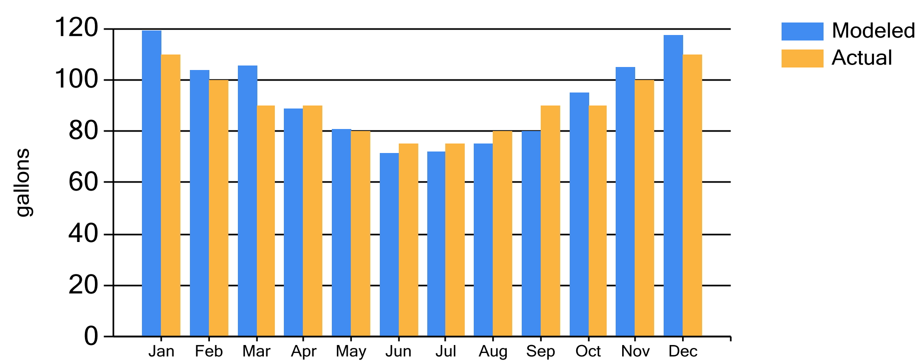
Annual Energy Use



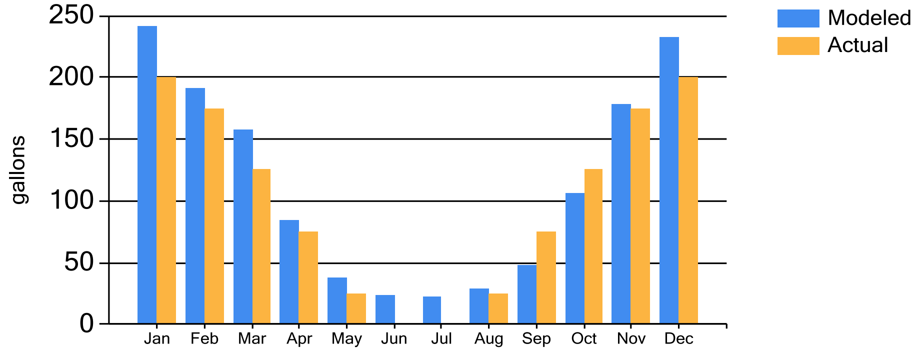
Electricity Use



Propane Use



#1 Fuel Oil Use



Appendix C - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	10.3	10.3	10.3	10.2	6.6	3.7	3.7	3.7	3.7	10.3	10.3	10.3
As Proposed	5.7	5.7	5.7	5.7	4.4	3.4	3.4	3.4	3.4	5.7	5.7	5.7

AkWarmCalc Ver 2.6.1.0, Energy Lib 8/9/2016