



Comprehensive Energy Audit For Nulato New Town Water Plant



Prepared For
City of Nulato

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PREFACE

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

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

ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of Mr. Greg Patsy Water Treatment Plant Operator for the City of Nulato.

1. EXECUTIVE SUMMARY

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

Based on electricity and fuel oil prices in effect at the time of the audit, the annual predicted energy costs for the buildings analyzed are \$6,529 for Electricity, \$19,701 for #1 Oil and total energy costs of \$26,231 per year.

It should be noted that these facilities received the power cost equalization (PCE) subsidy from the state of Alaska. If the facilities had not received the PCE subsidy, total electrical costs would be \$23,875, fuel costs would be \$19,701, and total energy costs would be \$43,576.

Currently the water plant is operating at peak efficiency due to the close attention to detail and timely manual operation of operator Greg Patsy. This precise operational concern is critical to the reduced fuel and electrical usages of the facility, and cannot be guaranteed during other operational scenarios. A more advanced controls retrofit is recommended, but currently would not yield any payback, as automated controls would not increase efficiency over current manual operation.

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

Table 1.1 PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR ¹	Simple Payback (Years) ²
1	Cooking and Clothes Drying – Clothes Dryer	Cutting the Laundromat hours to just a few days a week would reduce the demand on the dryers as well as reduce the demand on the building heating and lighting systems. This would be combined with a setback in temperature for the facility when not in use.	\$2,530	\$500	75.94	0.2

Table 1.1
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR ¹	Simple Payback (Years) ²
2	HVAC And DHW	Using smaller nozzles in the summer, and in non peak demand seasons (late spring, early fall), could substantially increase the efficiency of the boilers by increasing burn time and reducing cycling. Isolating the lag boiler could create additional savings by reducing unnecessary heating losses.	\$2,177	\$2,000	21.01	0.9
3	Setback Thermostat: Laundromat	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Laundromat space.	\$757	\$600	18.93	0.8
4	Setback Thermostat: Water Plant Cold Roof	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant Cold Roof space.	\$315	\$600	7.88	1.9
5	Setback Thermostat: Water Plant with Hot Roof	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant with Hot Roof space.	\$292	\$600	7.31	2.1
6	Lighting: Exterior Lighting	Replace with 2 LED 20W Module Electronic	\$130	\$500	2.28	3.8
7	Other Electrical: Generator Shed Electric Heating	Improve Other Controls	\$2,797	\$14,750	1.66	5.3
	TOTAL, all measures		\$8,999	\$19,550	6.45	2.2

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 \$8,999 per year, or 34.3% of the buildings' total energy costs. These measures are estimated to cost \$19,550, for an overall simple payback period of 2.2 years.

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

Table 1.2 Annual Energy Cost Estimate										
Description	Space Heating	Space Cooling	Water Heating	Lighting	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	\$6,148	\$0	\$4,220	\$583	\$4,990	\$0	\$10,290	\$0	\$0	\$26,231
With All Proposed Retrofits	\$6,316	\$0	\$511	\$452	\$2,193	\$0	\$7,760	\$0	\$0	\$17,232
SAVINGS	-\$168	\$0	\$3,709	\$130	\$2,797	\$0	\$2,530	\$0	\$0	\$8,999

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

2.2 Audit Description

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

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

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs

provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from Nulato New Town Water Plant 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.

Nulato New Town Water Plant is classified as being made up of the following activity areas:

- 1) Water Plant with Hot Roof: 342 square feet
- 2) Laundromat: 1,190 square feet
- 3) Water Plant Cold Roof: 366 square feet

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

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

2.3. Method of Analysis

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

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

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

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

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

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

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

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

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

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

2.4 Limitations of Study

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

3. Nulato New Town Water Plant

3.1. Building Description

The 1,899 square foot Nulato New Town Water Plant was constructed in 1970, with a normal occupancy of one person. The number of hours of operation for this building average 8.1 hours per day, considering all seven days of the week.

Description of Building Shell

The exterior walls are 2x6 construction with fewer than six inches of fiberglass insulation.

The roof of the building is a cold roof with six inches of fiberglass insulation. The structures addition over the water circulation pumps and connection to the water storage tank is a warm roof, with six inches of fiberglass insulation.

The foundation and floor of the building is a concrete pad.

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

Doors are metal urethane with no thermal breaks.

Description of Heating and Cooling Plants

The Heating Plants used in the building are:

Weil McClain #1

Nameplate Information:	Weil McClain BL-488-WS
Fuel Type:	#1 Oil
Input Rating:	924,000 BTU/hr
Steady State Efficiency:	70 %
Idle Loss:	1.5 %
Heat Distribution Type:	Water
Boiler Operation:	Oct - Jun
Notes:	Carlin Model 702CRD 1/2 hp burner

Weil McLain #2

Nameplate Information:	Weil McLain BL-488- WS
Fuel Type:	#1 Oil
Input Rating:	924,000 BTU/hr
Steady State Efficiency:	70 %
Idle Loss:	1.5 %
Heat Distribution Type:	Water
Boiler Operation:	All Year
Notes:	Carlin Model 702CRD 1/2 HP Burner

Space Heating and Cooling Distribution Systems

There are a set of unit heaters which rarely run on the water treatment side of the facility. Baseboard heating in the Laundromat is turned on and off manually, usually at night, so that the Laundromat is warm when people come in the morning. The rest of the time the facility is heated primarily by preheat for the dryers and jacket losses off the boilers.

Domestic Hot Water System

A well insulated 50 gallon hot water tank is kept above the bathrooms, and is manually operated to provide for hot water for washing machines and showers in the facility. The facility uses an average of about 25 gallons of hot water per day.

Lighting

The lighting in the building is made up primarily of electronic T8 fixtures with two to three four foot 32 watt bulbs each. Outside lighting is made up of a pair of 100 watt metal halide fixtures.

Plug Loads

Plug loads are minimal in the building and consist primarily of phones and battery chargers for power tools.

Major Equipment

The following major equipment is in use in the Nulato Newtown water plant:

Pressure Pump 3B- Uptown: Grundfos CR8-50 U-G-A, operated 24/7, 365 days a year.
Uptown Water Circulation Grundfos UPC 65-100, operated 24/7 in the winter time.
Water Tank Circulation Loop: Grundfos UMC50-80, operated 24/7 in the winter time.
4 Speed Queen Washing Machines, averaging 10-15 hours of operating per week each.

Additionally there are various heat exchangers and circulation pumps for glycol and adding heat to the water circulation lines that are essentially never used.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour.

The fuel oil usage profile shows the fuel oil usage for the building. Fuel oil consumption is measured in gallons. One gallon of #1 Fuel Oil provides approximately 132,000 BTUs of energy.

The following is a list of the utility companies providing energy to the building and the class of service provided:

Electricity: AVEC-Nulato - Commercial - Sm

The average cost for each type of fuel used in this building is shown below in Table 3.1. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.1 – Average Energy Cost	
Description	Average Energy Cost
Electricity	\$ 0.13/kWh
#1 Oil	\$ 4.00/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Nulato pays approximately \$26,231 annually for electricity and other fuel costs for the Nulato New Town Water Plant.

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

Figure 3.1
Annual Energy Costs by End Use

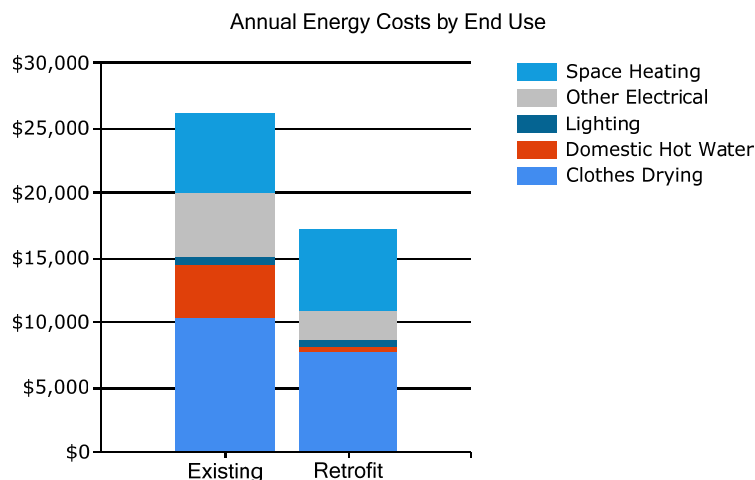


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

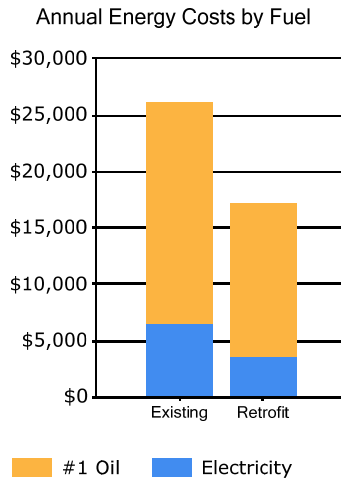
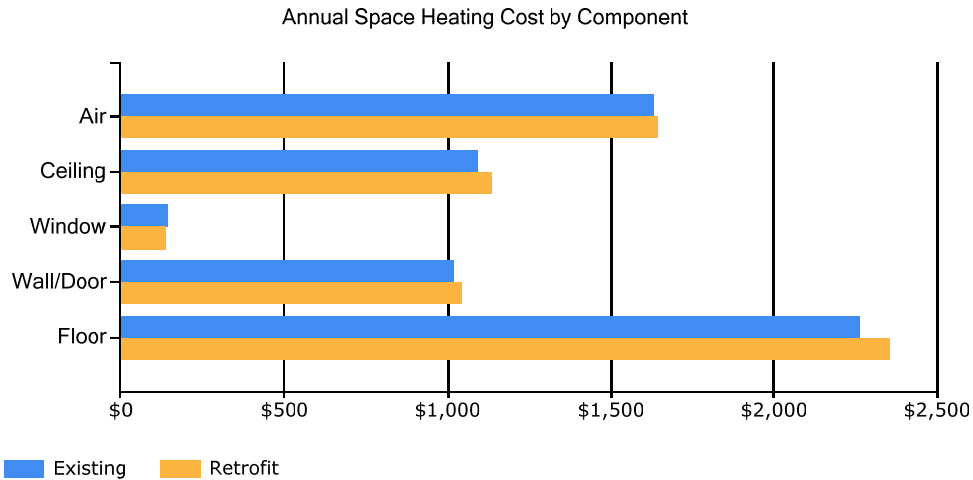


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing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

Figure 3.3
Annual Space Heating Cost by Component



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

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	369	336	369	357	369	357	369	369	357	369	357	369
Other Electrical	4796	4371	4796	1484	1456	988	1021	1021	2936	3711	5242	5416
Clothes Drying	589	537	589	570	589	570	589	589	570	589	570	589
Ventilation Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	8	7	8	8	9	8	8	8	8	9	8	8
Space Heating	14	13	13	12	8	3	2	3	3	8	11	14

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Clothes Drying	199	181	199	192	199	192	199	199	192	199	192	199
DHW	88	80	89	86	99	83	85	85	83	98	87	88
Space Heating	209	198	196	174	92	58	42	47	56	94	155	213

3.2.2 Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (Btu) or kBtu, and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.

The site and source EUIs for this building are calculated as follows. (See Table 3.4 for details):

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

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

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

**Table 3.4
Nulato New Town Water Plant 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	48,726 kWh	166,303	3.340	555,451
#1 Oil	4,925 gallons	650,142	1.010	656,643
Total		816,444		1,212,094
BUILDING AREA 1,899 Square Feet				
BUILDING SITE EUI 430 kBTU/Ft ² /Yr				
BUILDING SOURCE EUI 638 kBTU/Ft ² /Yr				
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

3.3 AkWarm© Building Simulation

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

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

For the purposes of this study, the Nulato New Town Water Plant was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Nulato was used for analysis. From this, the model was 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 Nulato. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.
- The heating and cooling load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in cooling/heating loads across different parts of the building.

- The model does not model HVAC systems that simultaneously provide both heating and cooling to the same building space (typically done as a means of providing temperature control in the space).

The energy balances shown in Section 3.1 were derived from the output generated by the AkWarm© simulations.

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

The energy saving measures are summarized in Table 4.1. Please refer to the individual measure descriptions later in this report for more detail. Calculations and cost estimates for analyzed measures are provided in Appendix C.

Table 4.1 Nulato New Town Water Plant, Nulato, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Cooking and Clothes Drying - Clothes Dryer	Cutting the Laundromat hours to just a few days a week would reduce the demand on the dryers as well as reduce the demand on the building heating and lighting systems. This would be combined with a setback in temperature for the facility when not in use.	\$2,530	\$500	75.94	0.2
2	HVAC And DHW	Using smaller nozzles in the summer, and in non peak demand seasons (late spring, early fall), could substantially increase the efficiency of the boilers by increasing burn time and reducing cycling. Isolating the lag boiler could create additional savings by reducing unnecessary heating losses.	\$2,177	\$2,000	21.01	0.9
3	Setback Thermostat: Laundromat	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Laundromat space.	\$757	\$600	18.93	0.8
4	Setback Thermostat: Water Plant Cold Roof	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant Cold Roof space.	\$315	\$600	7.88	1.9
5	Setback Thermostat: Water Plant with Hot Roof	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant with Hot Roof space.	\$292	\$600	7.31	2.1

**Table 4.1
Nulato New Town Water Plant, Nulato, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES**

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
6	Lighting: Exterior Lighting	Replace with 2 LED 20W Module Electronic	\$130	\$500	2.28	3.8
7	Other Electrical: Generator Shed Electric Heating	Improve Other Controls	\$2,797	\$14,750	1.66	5.3
	TOTAL, all measures		\$8,999	\$19,550	6.45	2.2

4.2 Interactive Effects of Projects

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

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

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

4.3 Mechanical Equipment Measures

4.3.1 Heating/Cooling/Domestic Hot Water Measure

Rank	Recommendation					
2	Using smaller nozzles in the summer, and in non peak demand seasons (late spring, early fall), could substantially increase the efficiency of the boilers by increasing burn time and reducing cycling losses. Isolating the lag boiler could create additional savings by reducing unnecessary heating losses.					
	Installation Cost	\$2,000	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$2,177
	Breakeven Cost	\$42,015	Savings-to-Investment Ratio	21.0	Simple Payback yrs	1
Auditors Notes:						

4.4.3 Night Setback Thermostat Measures

Rank	Building Space	Recommendation
------	----------------	----------------

5	Water Plant with Hot Roof	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant with Hot Roof space.			
Installation Cost	\$600	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$292
Breakeven Cost	\$4,386	Savings-to-Investment Ratio	7.3	Simple Payback yrs	2
Auditors Notes: Implementing a nighttime and weekends or unoccupied setback in the facility would reduce heating costs. Keeping the temperature at 55 degrees Fahrenheit when the facility is not occupied, and then having the temperature brought up to 70 degrees when the facility is occupied could be accomplished through a setback thermostat. This would eliminate the need to manually heat the Laundromat, and allow for significant savings since the Laundromat area would not be heated in the middle of the night beyond 55 degrees.					

Rank	Building Space	Recommendation			
4	Water Plant Cold Roof	Implement a Heating Temperature Unoccupied Setback to 55.0 deg F for the Water Plant Cold Roof space.			
Installation Cost	\$600	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$315
Breakeven Cost	\$4,726	Savings-to-Investment Ratio	7.9	Simple Payback yrs	2
Auditors Notes: Implementing a nighttime and weekends or unoccupied setback in the facility would reduce heating costs. Keeping the temperature at 55 degrees Fahrenheit when the facility is not occupied, and then having the temperature brought up to 70 degrees when the facility is occupied could be accomplished through a setback thermostat. This would eliminate the need to manually heat the Laundromat, and allow for significant savings since the Laundromat area would not be heated in the middle of the night beyond 55 degrees.					

Rank	Building Space	Recommendation			
3	Laundromat	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Laundromat space.			
Installation Cost	\$600	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$757
Breakeven Cost	\$11,361	Savings-to-Investment Ratio	18.9	Simple Payback yrs	1
Auditors Notes: Implementing a nighttime and weekends or unoccupied setback in the facility would reduce heating costs. Keeping the temperature at 55 degrees Fahrenheit when the facility is not occupied, and then having the temperature brought up to 70 degrees when the facility is occupied could be accomplished through a setback thermostat. This would eliminate the need to manually heat the Laundromat, and allow for significant savings since the Laundromat area would not be heated in the middle of the night beyond 55 degrees.					

4.4 Electrical & Appliance Measures

4.4.1 Lighting Measures

The goal of this section is to present any lighting energy conservation measures that may also be cost beneficial. It should be noted that replacing current bulbs with more energy-efficient equivalents will have a small effect on the building heating and cooling loads. The building cooling load will see a small decrease from an upgrade to more efficient bulbs and the heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.4.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition	Recommendation		
6	Exterior Lighting	2 MH 100 Watt Magnetic with Manual Switching	Replace with 2 LED 20W Module Electronic		
Installation Cost	\$500	Estimated Life of Measure (yrs)	10	Energy Savings (/yr)	\$130
Breakeven Cost	\$1,140	Savings-to-Investment Ratio	2.3	Simple Payback yrs	4

Auditors Notes: Replacing current metal halide exterior fixtures with LED wall packs would significantly reduce electricity usage, reduce the need to replace light bulbs, and improve lighting performance in cold weather.

4.4.2 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
7	Generator Shed Electric Heating	Baseboard Electric Heater with Manual Switching, Other Controls	Improve Other Controls		
Installation Cost	\$14,750	Estimated Life of Measure (yrs)	10	Energy Savings (/yr)	\$2,797
Breakeven Cost	\$24,450	Savings-to-Investment Ratio	1.7	Simple Payback yrs	5
Auditors Notes: Installing a setback thermostat and insulating the roof and walls of the generator shed would significantly reduce electricity costs. Currently the building is poorly insulated and has electric heat heating the facility more than necessary during winter months. The generator only needs to be kept slightly above freezing to ensure operation in times of need. The building would benefit greatly from increased insulation especially on the roof.					

4.4.3 Clothes Drying Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
1			Cutting the Laundromat hours to just a few days a week would reduce the demand on the dryers as well as reduce the demand on the building heating and lighting systems. This would be combined with a setback in temperature for the facility when not in use.		
Installation Cost	\$500	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$2,530
Breakeven Cost	\$37,969	Savings-to-Investment Ratio	75.9	Simple Payback yrs	0
Auditors Notes: Operating the Laundromat only on the weekends would significantly reduce the demand of the washing and drying machines, decrease space heating demands for the facility, and reduce run time on the boilers. This facility would be used only to circulate water when the washetera is closed and thus would need very little heat.					

5. ENERGY EFFICIENCY ACTION PLAN

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

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

APPENDICES

Appendix A – Listing of Energy Conservation and Renewable Energy Websites

Lighting

Illumination Engineering Society - <http://www.iesna.org/>

Energy Star Compact Fluorescent Lighting Program - www.energystar.gov/index.cfm?c=cfls.pr_cfls

DOE Solid State Lighting Program - <http://www1.eere.energy.gov/buildings/ssl/>

DOE office of Energy Efficiency and Renewable Energy - http://apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?c=lighting.pr_lighting

Hot Water Heaters

Heat Pump Water Heaters -

http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12840

Solar Water Heating

FEMP Federal Technology Alerts – http://www.eere.energy.gov/femp/pdfs/FTA_solwat_heat.pdf

Solar Radiation Data Manual – <http://rredc.nrel.gov/solar/pubs/redbook>

Plug Loads

DOE office of Energy Efficiency and Renewable Energy – http://apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?fuseaction=find_a_product

The Greenest Desktop Computers of 2008 - <http://www.metaefficient.com/computers/the-greenest-pcs-of-2008.html>

Wind

AWEA Web Site – <http://www.awea.org>

National Wind Coordinating Collaborative – <http://www.nationalwind.org>

Utility Wind Interest Group site: <http://www.uwig.org>

WPA Web Site – <http://www.windpoweringamerica.gov>

Homepower Web Site: <http://homepower.com>

Windustry Project: <http://www.windustry.com>

Solar

NREL – <http://www.nrel.gov/rredc/>

Firstlook – <http://firstlook.3tiergroup.com>

TMY or Weather Data – http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/

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