



# Investigative Energy Audit For

## Gulkana Teen Center



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Prepared For  
**Gulkana Village**

**November 22, 2017**

**Prepared By: Kevin Ulrich, CEM**

**ANTHC-DEHE  
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Anchorage, AK 99508**

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## PREFACE

The purpose of this report is to provide guidance in reducing facility operating costs and enhance the sustainability of this community. The report assesses the current energy usage of the facility, provide options for reducing the amount of energy used, and evaluate the cost vs. benefit of each option.

Discussions of site specific concerns, financing options, general facility information, and an Energy Efficiency Action Plan are also included in this report.

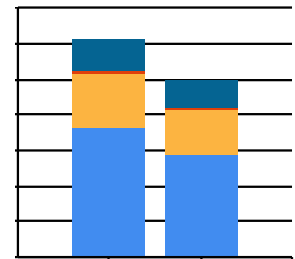
## ACKNOWLEDGMENTS

The Rural Energy Initiative gratefully acknowledges the assistance of Gulkana Tribal Administrator Angela Vermillion, Tribal Clerk Amanda Maxim, and Village Maintenance Person Ray Spear.

## OVERVIEW

This report was prepared for Gulkana Village. The scope of the audit focused on the Gulkana Teen Center and includes an analysis of building occupancy schedules, building shell, heating systems, heating and ventilations systems, domestic hot water, lighting, and other electrical loads. The Gulkana Teen Center has an area of approximately 1,100 square feet and serves as a recreational center for youth after school and during the weekends. There is also guest housing on the western side of the building that was under renovation at the time of the site visit.

Annual Energy Costs by Fuel Type



## ENERGY BASELINE

Based on unsubsidized electricity and fuel oil prices in effect at the time of the audit, the total predicted energy costs are \$3,064 per year. This includes \$1,835 for electricity, \$437 for #1 fuel oil, \$57 for propane, and \$741 for wood.

Table 1 lists the predicted annual energy usage before and after the proposed retrofits for the Gulkana Teen Center.

Table 1: Predicted Annual Energy Use for the Gulkana Teen Center

Predicted Annual Fuel Use				
Fuel Use	Existing Building	With Proposed Retrofits	Total Energy Savings	Total Cost Savings
Electricity	6,915 kWh	5,224 kWh	1,691 kWh	\$430
Spruce Wood	2.96 cords	2.46 cords	0.50 cords	\$125
Propane	15 gallons	15 gallons	0 gallons	0
#1 Oil	185 gallons	154 gallons	31 gallons	\$73

## PROPOSED ENERGY EFFICIENCY MEASURES (EEM)

Table 2 below summarizes the energy efficiency measures analyzed for the Gulkana Teen Center. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return. All costs assume that local labor will be used with no additional cost associated for travel or administrative tasks.

Table 2: Priority List – Energy Efficiency Measures

Priority	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>	CO <sub>2</sub> Savings
High	Setback Thermostat: Gulkana Teen Center	Install a programmable thermostat and implement an unoccupied setback temperature of 60 deg. F.	\$493	\$200	29.86	0.4	2,588.7
Low	Refrigerator	Remove refrigerator that is not being fully used.	\$55	\$1,000	0.63	18.1	445.0

Priority	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>	CO <sub>2</sub> Savings
Low	Standing Freezer	Remove chest freezer that is not being fully used.	\$41	\$1,000	0.47	24.4	331.4
Low	Lighting: Restroom	Replace with new energy-efficient direct-wire LED equivalent lamps.	\$0	\$50	0.08	141.8	2.9
<b>TOTAL</b>			<b>\$589</b>	<b>\$2,250</b>	<b>3.15</b>	<b>3.8</b>	<b>3,368.1</b>

## FACILITY DESCRIPTION

### Building Occupancy Schedules

The building is occupied each afternoon during the school year by students for approximately four hours each day from 3:00 PM – 7:00 PM. The buildings are also occupied approximately five hours per day from 11:00 AM – 4:00PM on the weekends during the same time period. The school year runs from August through May.

### Building Shell

The building is constructed with 2 x 6 lumber construction with fiberglass batt insulation. It is constructed above the ground with a leaky crawlspace insulating the space between the floor and the ground.

There are three entrances into the building, each with a single wood door. The west entrance has a solid wood door with no window and an arctic entry. The library entrance and pool room entrance both have solid wood doors with half-lite windows.

There are eight total windows in the building, each of which has double-pane glass with aluminum framing. Three of the windows are south facing.

### Heating Systems

The heating systems used in the building are:

#### **Biomass Heat**

Fuel Type: Spruce Wood  
 Input Rating: 177,000 BTU/hr  
 Steady State Efficiency: 75 %  
 Idle Loss: 0 %  
 Heat Distribution Type: Glycol  
 Boiler Operation: All Year

#### **Jacuzzi Propane Hot Water Heater**

Fuel Type: Propane  
 Input Rating: 180,000 BTU/hr

Steady State Efficiency: 80 %  
 Idle Loss: 0 %  
 Heat Distribution Type: Water  
 Boiler Operation: All Year

**Toyo Laser 73**

Fuel Type: #1 Oil  
 Input Rating: 40,000 BTU/hr  
 Steady State Efficiency: 80 %  
 Idle Loss: 0 %  
 Heat Distribution Type: Air

**Plug-In Electric Heater**

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

**Domestic Hot Water System**

There is a 3-gallon Jacuzzi model hot water heater that uses propane as its fuel source. The hot water heater provides hot water for the teen center restroom and for the future guest housing.

**Lighting**

**Table 3: Lighting Information in the Gulkana Teen Center**

Room	Lamp Type	Fixtures	Lamps per Fixture	Annual Usage (kWh)
Pool Room	LED 4 ft. Strip	4	1	104
Library	LED 4 ft. Strip	4	1	104
Restroom	Incandescent A Lamp 25 Watt	2	1	7
Guest Housing	Led 4 ft. Strip	4	1	124

**Electrical Equipment**

**Table 4: Major Electrical Equipment in the Gulkana Teen Center**

Equipment	Rating (Watts)	Annual Usage (kWh)
Refrigerator	46	400
Chest Freezer	34	300
Plug-In Fan	45	28

## PROJECT FINANCING

The total estimated cost of the recommended EEM's is \$2,250. The payback for the implemented EEM's is approximately 3.8 years. ANTHC is willing to assist the community with acquiring funds to complete the scope of work recommended in this energy audit.

There are several options for financing energy efficiency projects within the State of Alaska. These include the use of grants, loans, and other funding opportunities. Below is some information on potential funding opportunities.

**Energy Efficiency Revolving Loan Program** – This is a loan administered by the Alaska Housing Finance Corporation (AHFC) for use by any applicant who is also the owner of the building where the work will take place. It provides a loan for permanent energy-efficiency projects with a completion window of one year.

**Sustainable Energy Transmission and Supply Program** – This is a loan administered by the Alaska Energy Authority (AEA) for a government, business, or other organized body of people. It provides a loan for energy-efficiency or power transmission or distribution projects.

**USDA-RD Communities Facilities Direct Loan & Grant Program** - This is a loan or grant provided by the US Department of Agriculture – Rural Development (USDA-RD) for any essential community facility in a rural area. It provides a loan or grant to develop essential community facilities with upgrades or equipment for improvement.

## MEASUREMENT AND VERIFICATION

The results of these recommended measures can be measured through the collection of energy use data through the monthly bills provided by the local electric utility and the local fuel oil supplier. Collecting data and performing a historical comparison is the simplest method of validating the energy and cost savings seen by the measures. Additionally, active remote monitoring systems are available that can collect and store data regarding energy and fuel usage. These systems allow the user to track the usage in real time and can be shared more easily with partners across the state.

# APPENDICES

## Appendix A –Energy Billing Data

The table below shows the fuel and electricity data used during the energy modeling process to confirm the accuracy of the energy distribution.

Month	Fuel Oil Use (gallons)	Electricity Use (kWh)
January	42	942
February	34	800
March	26	1,026
April	15	1,340
May	5	1,117
June	0	383
July	0	86
August	0	130
September	9	103
October	17	92
November	35	94
December	41	144

# Appendix B – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	AUDITOR INFORMATION
<b>Building:</b> Gulkana Teen Center	<b>Auditor Company:</b> ANTHC-DEHE
<b>Address:</b> PO Box 254	<b>Auditor Name:</b> Kevin Ulrich
<b>City:</b> Gulkana	<b>Auditor Address:</b> 4500 Diplomacy Drive
<b>Client Name:</b> Ray Spear	Anchorage, AK 99508
<b>Client Address:</b> P.O. Box 254 Gulkana, AK 99586	<b>Auditor Phone:</b> (907) 729-3237
<b>Client Phone:</b> (907) 259-3740	<b>Auditor FAX:</b>
<b>Client FAX:</b>	<b>Auditor Comment:</b>
Design Data	
<b>Building Area:</b> 1,099 square feet	<b>Design Space Heating Load:</b> Design Loss at Space: 28,453 Btu/hour with Distribution Losses: 28,453 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 43,374 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
<b>Typical Occupancy:</b> 0 people	<b>Design Indoor Temperature:</b> 70 deg F (building average)
<b>Actual City:</b> Gulkana	<b>Design Outdoor Temperature:</b> -39.4 deg F
<b>Weather/Fuel City:</b> Gulkana	<b>Heating Degree Days:</b> 13,439 deg F-days
Utility Information	
<b>Electric Utility:</b> Copper Valley Electric Association	<b>Average Annual Cost/kWh:</b> \$0.29/kWh

Annual Energy Cost Estimate						
Description	Space Heating	Water Heating	Lighting	Refrigeration	Other Electrical	Total Cost
<b>Existing Building</b>	\$2,527	\$51	\$78	\$161	\$6	<b>\$3,064</b>
<b>With Proposed Retrofits</b>	\$2,099	\$51	\$78	\$0	\$6	<b>\$2,474</b>
<b>Savings</b>	\$428	\$0	\$1	\$161	\$0	<b>\$589</b>

Building Benchmarks			
Description	EUI (kBtu/Sq.Ft.)	EUI/HDD (Btu/Sq.Ft./HDD)	ECI (\$/Sq.Ft.)
<b>Existing Building</b>	93.8	6.98	\$2.79
<b>With Proposed Retrofits</b>	76.5	5.69	\$2.25

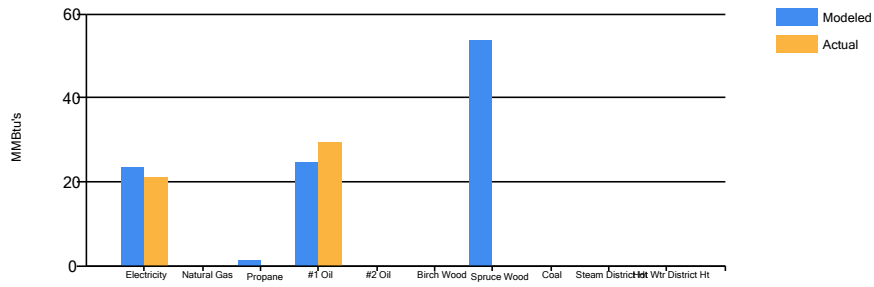
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area.  
 EUI/HDD: Energy Use Intensity per Heating Degree Day.  
 ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.



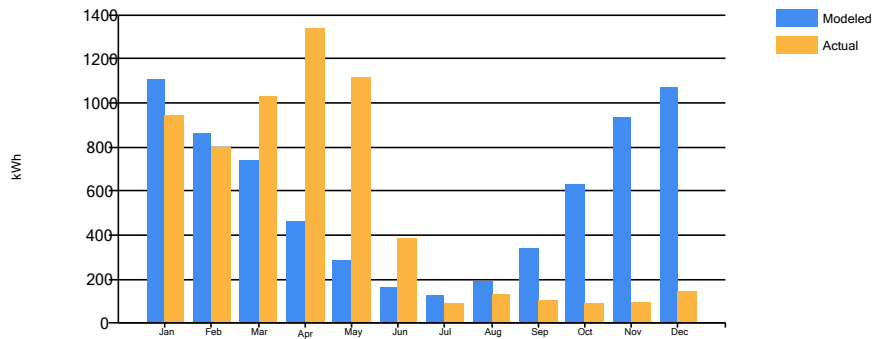
# Appendix C – Actual Fuel Use versus Modeled Fuel Use

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.

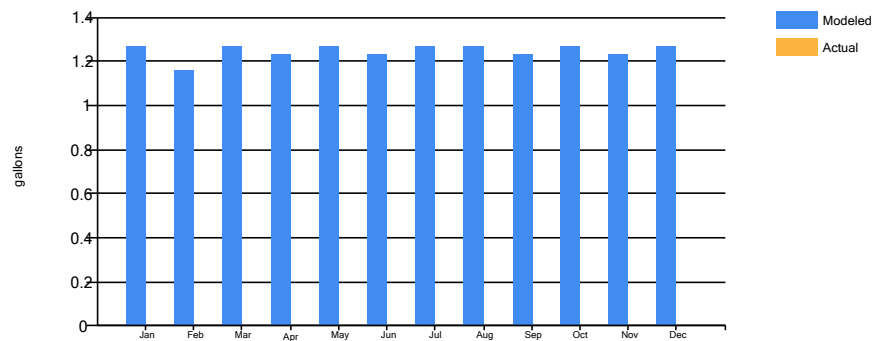
### Annual Energy Use



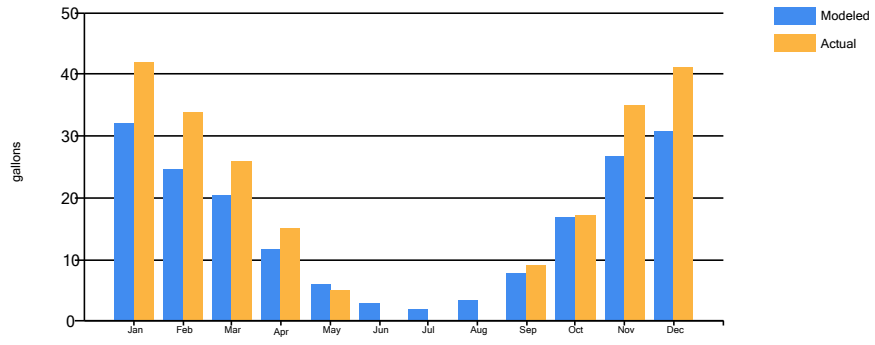
### Electricity Use



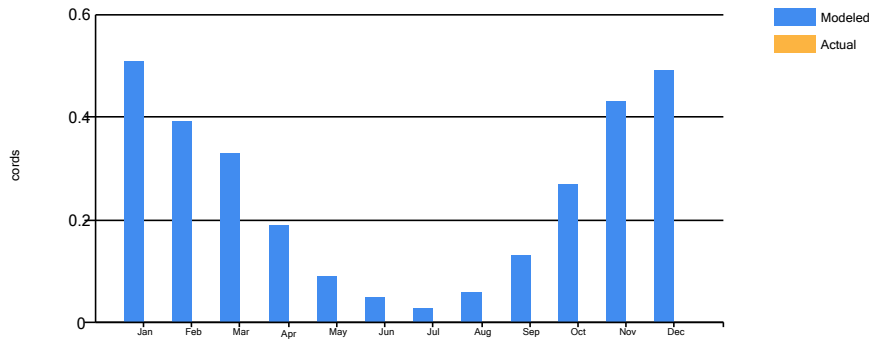
### Propane Use



### #1 Fuel Oil Use



### Spruce Wood Use



## Appendix D - EUI Calculation Details

Electricity for the residential, commercial, and public facilities is provided by the Copper Valley Electric Association.

The average cost for each type of fuel used in this building is shown below in Table 5. This figure includes all surcharges, subsidies, and utility customer charges:

**Table 5: Energy Cost Rates for each Fuel Type.**

Average Energy Cost	
Description	Average Energy Cost
Electricity	\$ 0.29/kWh
Spruce Wood	\$ 250/cords
Propane	\$ 3.44/gallons
#1 Oil	\$ 2.36/gallons

Table 6 shows the calculated results for the building Energy Use Index (EUI), which determines the total energy usage for a type of building for comparison with other buildings of the same type. This allows the user to determine the relative energy use of a building in relation to others of the same type or use.

**Table 6: EUI Building Calculations for the Gulkana Teen Center**

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	6,915 kWh	23,602	3.340	78,829
Spruce Wood	2.96 cords	53,613	1.000	53,613
Propane	15 gallons	1,372	1.010	1,385
#1 Oil	185 gallons	24,456	1.010	24,701
<b>Total</b>		<b>103,043</b>		<b>158,529</b>
BUILDING AREA		1,099	Square Feet	
BUILDING SITE EUI		94	kBTU/Ft <sup>2</sup> /Yr	
<b>BUILDING SOURCE EUI</b>		<b>144</b>	<b>kBTU/Ft<sup>2</sup>/Yr</b>	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

Table 7 shows information on common energy use benchmarks used to characterize the efficiency of a building.

**Table 7: Building Benchmarks for the Gulkana Teen Center**

<b>Building Benchmarks</b>			
<b>Description</b>	<b>EUI (kBtu/Sq.Ft.)</b>	<b>EUI/HDD (Btu/Sq.Ft./HDD)</b>	<b>ECI (\$/Sq.Ft.)</b>
<b>Existing Building</b>	93.8	6.98	\$2.79
<b>With Proposed Retrofits</b>	76.5	5.69	\$2.25
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 E – Materials List and Labor Estimation

Table 8 & 9: Materials List and Cost Estimation for Gulkana Teen Center

Energy Retrofit	Required Materials	Quantity	Cost per Item	Total Materials Cost
Lighting	Incandescent A Lamp LED equivalents	2	\$15	\$30

Category	Cost (\$)
Labor	1,642
Travel	250
Materials	30
Freight	35
Indirect	216
<b>Total</b>	<b>\$2,172</b>

# Appendix F – Materials Specifications

EarthLED Total Product Insight	
Performance Specifications	
REPLACEMENT FOR:	E12 CANDELABRA
BRIGHTNESS (LUMENS):	500
COLOR TEMPERATURE:	3000K   5000K
COLOR ACCURACY (CRI):	>80
TRADITIONAL WATTAGE EQUIVALENT:	60 WATTS
POWER CONSUMPTION:	7 WATTS
VOLTAGE:	120 VOLTS
DIMMABLE:	YES
MOISTURE RATING:	DAMP
FIXTURE RATING:	OPEN FIXTURES
BASE TYPE:	E12
ENERGYSTAR QUALIFIED:	YES (TKUCA38S01-7W-D-830-E12)
Dimensions / Additional Data	
BULB DIAMETER:	1.6 IN
MAXIMUM OVERALL LENGTH:	4.9 IN
PRODUCT WEIGHT:	6.7 OUNCES
CERTIFICATIONS:	UL
PRODUCT/ORDER CODE:	3000K - TKUCA38S01-7W-D-830-E12 5000K - TKUCA38S01-7W-D-850-E12
Lifespan / Cost To Run	
PROJECTED LIFE: @3 HRS/DAY	25,000 HRS
YEARLY ENERGY COST: 3 HRS/DAY @ .11 KWH	\$0.84
<b>WARRANTY</b>	3 YEAR THINKLUX LIMITED WARRANTY EARTHLED PRODUCT PROTECTION PLAN IS AVAILABLE

