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ENERGY AUDIT
POST INSTALLATION REPORT

Results and Recommendations from Energy Audit of Akiachak

For VEEP Grants

Village of Akiachak, Alaska

June 20, 2012

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EXECUTIVE SUMMARY AND PREFACE

This Post Installation Report summarizes the results of an Ameresco Energy Audit of the Village of Akiachak, the initial energy savings measures identified and proposed, and any changes that may have occurred throughout the installation process. The Village of Akiachak is a recipient of an Alaska Energy Authority (AEA) Village Energy Efficiency Program (VEEP) grant of $150,000.

Ameresco engineers conducted an energy audit of the Village of Akiachak on December 14-15, 2010. The table below shows the buildings audited and their respective square footages.

City of Akiachak - Building Summary

Building	Category	Square Footage
Clinic	Public Facility	1,536
Community Hall	Public Building	720
Day Care	Public Facility	1,440
ELCP	Public Facility	400
IRA New Office	Public Building	1,400
Washeteria	Public Facility	2,400
Police Station	Public Building	576
Tribal Council Office	Public Building	2,304
Water Treatment	Public Facility	9,216
Elder and Youth Center	Public Building	1,680
School	School	20,000

The audit identified existing types, conditions, operating modes, and energy consumption profiles for a variety of buildings, facilities and systems. The audit also identified all cost-effective system and facility modifications, adjustments, alterations, additions, and retrofits. Systems investigated during the audit included heating, ventilation, interior and exterior lighting, process exhaust, domestic hot water, motors, building envelopes, utility metering systems, and energy management control systems (EMCS).

The table below shows the results of Ameresco's audit and potential calculation savings, allocated by grant. See *Appendix A* for more detailed calculation results. Project costs include costs incurred from the site visit, engineering time, materials cost, and labor cost, as well as Ameresco's markup. It is important to note that the simple paybacks (SPBs) have been determined according to ECO type. For example, the SPB for an electrical ECO is calculated using only the annual kWh savings, even though the equivalent annual fuel gallon monetary savings is reported.

VEEP ECOS - PROJECT COSTS & EXPECTED SAVINGS - AKIACHAK			
ECO	**Cost**	**Savings**	**SPB**
C01 - THERMOSTAT UPGRADE	$ 3,201.97	*N/A*	*N/A*
E01 - INSTALL OCCUPANCY SENSORS	$ 21,238.10	$ 2,167.07	9.80
E02 - PREMIUM EFFICIENCY MOTORS UPGRADE	$ 30,838.20	$ 704.34	43.78
E03 - CFL LIGHTING UPGRADE	$ 2,588.84	$ 857.49	3.02
M01 - BOILER TUNE-UP	$ 10,061.31	$ 23,482.58	0.43
M02 - BOILER UPGRADE	$ 74,611.28	$ 16,484.75	4.53
AVAILABLE FUNDING	$ 7,460.31		
** Available funding allocated to the village of Kotlik*			
TOTAL GRANT	**$150,000.00**		
VILLAGE TOTAL	**$142,539.69**	**$ 43,696.23**	**3.26**

1.0 BUILDING DESCRIPTIONS

1.1 AKIACHAK CLINIC

Description: The Akiachak Clinic is where village residents come to treat minor ailments and injuries. For life-threatening diseases and illnesses, villagers must visit a hospital in a larger community. The building was constructed in 1994 and is still holding up well. Building operating hours are typically 0900 – 1700, Monday through Friday, with staff on call during the weekend.

General Conditions: The building is in good condition overall. No serious faults or defects were noticed during the walkthrough, though there are many opportunities for improvement. The building, however, has been continuously shifting over the years, and this has made an impact on the floor and plastic tiles.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: The building structure overall appears to be in good condition. The metal standing seam roof is in good condition with no evidence of water leakage. Exterior walls are in good condition, although a new coat of paint is recommended. Interior walls are in good condition, but the many penetrations are not well sealed and insulated. Weather-stripping is in fair condition and in need of replacement. Due to the building movement over the years, the floor insulation is no longer adequate, as occupants complain of cold air coming through the breaks in floor tiles.

Heating: One Weil-McLain Gold Oil boiler (model WGO-3) provides the building with space heating. A combustion analysis showed this boiler to be function at 84.7% combustion efficiency. The boiler is rated as 85% thermally efficient.

Controls: Building heating zones are controlled by a series of mechanical thermostats. A local contractor has already been hired to upgrade the heating controls system.

Lighting: Interior lighting consists primarily of T8 fluorescent lamps with electronic ballasts. Several rooms are lit by T9 fluorescent lamps with electromagnetic ballast fixtures.

Domestic Water: The building contains 2 toilets and 1 shower, but only 1 of the toilets is currently operational. This toilet runs water constantly and has to be manually shut off after flushing.

Building Photos: Akiachak Clinic

Mechanical Thermostat

Mechanical Room and Weil-McLain Boiler

T8 Fluorescent Fixtures in Excellent Condition

Defunct Radiant Heat System

Exposed Piping

Circulating Pump

1.2 AKIACHAK COMMUNITY CENTER

Description: The Community Center building in Akiachak is a common meeting place for village residents and is used for a wide variety of activities throughout the week. Building operating hours are typically in the evenings, 1730 to 2230 hours.

General Conditions: The building was built in the early 1970's and is in fair condition overall, showing many signs of weathering and age. The building structure and envelope in particular are in poor condition and need many improvements.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: The roof is in poor condition, and the drop ceiling shows some evidence of water leakage. The exterior walls are in fair condition and show signs of age and weathering, and the interior walls are also in fair condition. The windows are in fair condition with double pane glass and wood frames instead of typical vinyl frames. Exterior doors are in poor condition and no longer seal well.

Heating: Heating for the Community Center is provided by a fuel-oil fired Monitor M2400 forced air heater. This heater was installed to replace the old furnace, which is still housed in the building but is no longer operational.

Controls: There is not a controls system present at the Akiachak Community Center.

Lighting: Interior lighting fixtures are mostly T8 fluorescent with electronic ballasts. There are a few 90 watt incandescent fixtures throughout the facility as well. There are no occupancy sensors in the building.

Domestic Water: The Community Center does not have a domestic hot water system.

Building Photos: Akiachak Community Center

Old, Worn Window

Run Down Monitor Heater

T8 Lighting Retrofit

Worn, Un-Weather-stripped Door

1.3 AKIACHAK DAY CARE

Description: The Akiachak Day Care provides childcare services to village residents. Typical building operating hours are 0800 to 1700 hours, Monday through Friday.

General Conditions: The building was built in 1999 and appears to be in good condition overall, with no major faults or defects noticed during the walkthrough. The heating system, however, is not operating at optimum efficiency and is in need of a tune-up or upgrade.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: The metal standing seam roof is in good condition and shows no signs of weathering or damage. Exterior walls and windows are in good condition. Exterior doors are in good condition, but have poor weatherstripping.

Heating: The Day Care is heated by a Burnham V8 model hot water boiler, rated 85% efficient. A combustion analysis showed this boiler to be operating at 76.5% combustion efficiency. A new Honeywell controller was installed in December of 2010.

Controls: Building heating is controlled by mechanical thermostats.

Lighting: Interior lighting is primarily T8 fluorescent with electronic ballasts. There are a few 90 watt incandescent fixtures throughout the facility. Exterior lighting consists of 90 watt incandescent fixtures as well.

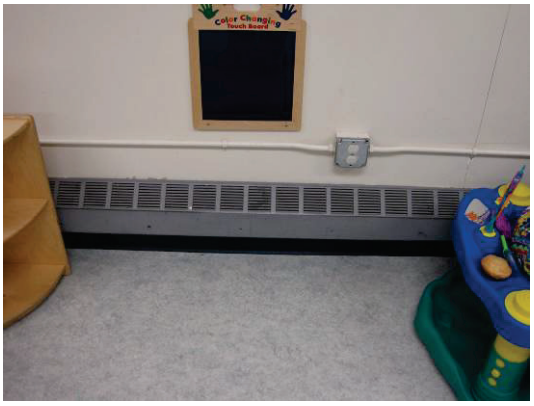
Domestic Water: Domestic hot water is provided by an Amtrol Boilermate indirect-fired water heater.

Building Photos: Akiachak Daycare

Deteriorating Weather-stripping

Windows in Need of Caulking

Make-shift Door Weather-stripping



Radiant Heat System

Burnham Boiler and Amtrol Boilermate Water Heater

Exposed Wiring

1.4 AKIACHAK EARLY LEARNING CHILDHOOD PROGRAM (ELCP) BUILDING

Description: The Akiachak Early Learning Childhood Program (ELCP) building is a school for young children in the village which teaches native traditions such as language, dance, crafts, and history. Building operating hours are 0900 to 1700, Monday through Friday.

General Conditions: The building was built in the early 1980's and is fairly run down. The building has seen a great deal of weathering and wear and is in need of many improvements.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: Exterior walls are in fair condition and show many signs of weathering and age. The roof is in fair condition but appears to be leaking due to evidence of warped and drooping dropped ceiling tiles. Doors are in fair condition and are in need of new weather-stripping. There are several broken windows that have either been boarded up or not yet replaced. One window in particular had only a plastic sheet covering with no insulation over it to prevent the escape of warm air.

Heating: Space heating is provided by a Monitor 441 oil fueled forced air heater.

Controls: There are no separate building controls.

Lighting: Interior lighting mainly consists of T12 fluorescent fixtures with magnetic ballasts as well as several 90 watt incandescent fixtures. There are no occupancy sensors in the building.

Building Photos: Akiachak Early School Building

Broken Window

CFL Fixture

Monitor 441 Heater

Boarded-up Window

1.5 AKIACHAK INDIAN REORGANIZATION ACT OFFICE

Description: The Indian Reorganization Act (IRA) Office handles most of the village facility, maintenance, accounting, and day-to-day issues. The building was constructed in 2008 and is in good condition. Building operating hours are 0900 to 1700, Monday through Friday.

General Conditions: This facility is a new building and, therefore, is in excellent condition compared with the other village buildings.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: Due to the newness of the building, exterior and interior walls are in good condition. Windows and doors are in good condition as well, but an exterior door weather-stripping upgrade would be beneficial.

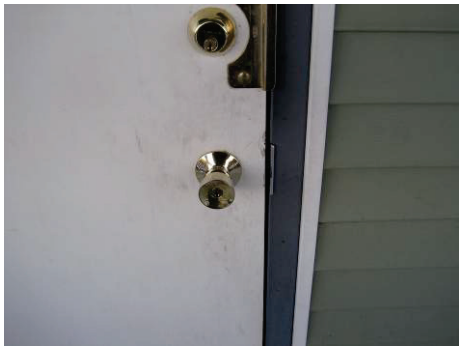
Heating: An oil-fired Burnham boiler installed in 2007 provides the building with space heating. A combustion analysis at the time of the audit showed the boiler to be running at 81.7% combustion efficiency. The boiler is rated at 86.1% thermal efficiency and 127 MBH.

Controls: Building zones are controlled by a series of mechanical thermostats throughout the facility.

Lighting: Interior lighting is primarily T8 fluorescent fixtures with electronic ballasts. There are no occupancy sensors in the building.

Domestic Water: Domestic water heating is provided by a 10-gallon electric Rheem Ruud water heater.

Building Photos: Akiachak IRA Office

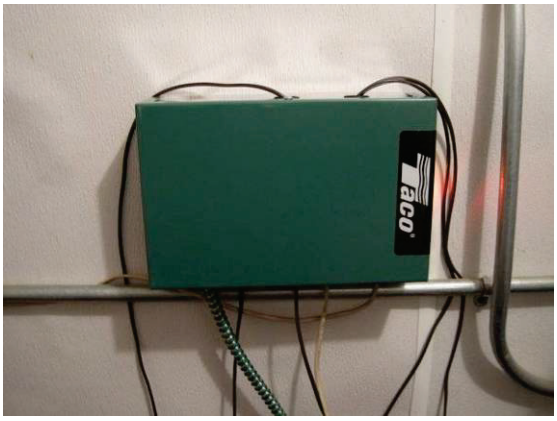


Missing Weather-stripping

Exterior and Windows in Excellent Condition

Burnham Boiler

Rheem Water Heater



Taco Controller

Attic Insulation

1.6 AKIACHAK WASHETERIA

Description: The Akiachak Washeteria is used by most of the villagers for their laundering needs. Typical operating hours are 1000 to 2200 hours, 7 days a week.

General Conditions: The building was built in the 1970's and overall is in fair condition, with much room for improvement. The basement of the facility is currently a hazardous area, and methane gas detection equipment is needed to inspect the area before anyone may enter. Only one of the boilers is currently operational.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: The building is in fair condition, with evidence of aging and weathering on exterior walls. The metal roof is in fair condition, but shows no signs of leakage. Interior walls are in fair condition. Exterior doors are in poor condition and are in need of replacement. Exterior windows are in fair condition, and several are damaged.

Heating: Two Weil-McLain fuel oil Model 976 boilers provide heating to the building. These boilers are discontinued and are listed as 81% thermally efficient. At the time of the audit, only one boiler was functional. The ignition switch of one boiler failed and was replaced with the ignition switch of the second boiler, rendering the second boiler inoperable. A combustion analysis found the functional boiler to be performing at 83.7% combustion efficiency.

Controls: Building heating is controlled by mechanical thermostats.

Lighting: Interior lighting consists mainly of T12 fluorescent fixtures with magnetic ballasts, though some fixtures have been retrofit to T8 fixtures.

Building Photos: Akiachak Washeteria

Building Exterior and Windows

Circulating Pump

Interior Lighting

Functioning Weil-McLain Boiler

Old Forced Air Heater

Washing Machines

1.7 AKIACHAK TEMPORARY POLICE STATION

Description: The current Akiachak Police Station was originally built in 1947 and was the old jail building. This building remains operational 24 hours a day, 7 days a week.

General Conditions: The building is in poor condition overall, mostly due to its age and the effects of weathering over the years. Lighting has already been upgraded, but there are still opportunities for improvement.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: The building is in poor condition due to aging and weathering. Both interior and exterior walls are in need of paint to avoid further damage. Exterior windows and doors are all in poor condition and need to be upgraded.

Heating: Building heating is provided by a Monitor 2400 oil-fired force air heater.

Controls: There are no separate building controls.

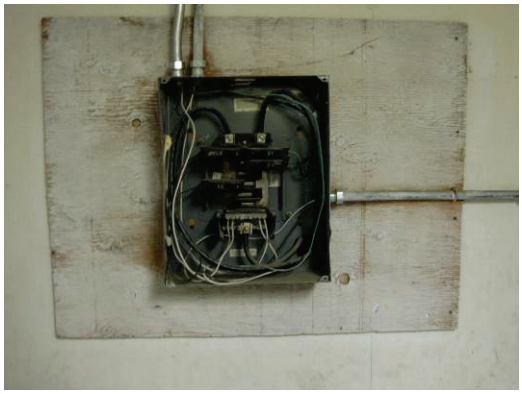
Lighting: Interior lighting is a mixture of T8 fluorescent fixtures with electronic ballasts and 90 watt incandescent fixtures. There are no occupancy sensors in the building.

Domestic Water: There is not a domestic hot water system in place at the Akiachak Police Station.

Building Photos: Akiachak Police Station

Bldg Interior – Lighting Retrofit, Monitor Heater

Monitor 2400 Heater



Exposed Wiring

Poor Door Seal and Make-shift Weather-stripping

Window Replaced With Board

Poorly Fitted Window

1.8 AKIACHAK SCHOOL

Description: The Akiachak School is a combination elementary, middle school, and high school building with 198 students and 44 staff members. The building space is a combination of classroom, office, library, gymnasium, and cafeteria space. The school is one of the best maintained buildings in the village and is relatively new, constructed in 2005. Typical operational hours are from 0730 to 1700, Monday through Friday, but can sometimes run longer due to after school activities.

General Conditions: As expected with a relatively new facility, the building is in good condition overall. No major faults or defects were found during the course of the walkthrough. The school has its own agreement with the Akiachak Community Electrical Company (see *Section 2.0*), but also houses its own backup generators with automatic changeover to be used during black outs or emergencies.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: The building structure overall appears to be in good condition. The double-pane clear glass windows are in good condition, although there are a few damaged fixtures with cracks in the exterior panes. Doors are in good condition and have adequate weather-stripping. The roof is in good condition, but there appears to be some water leakage in one spot by the front entrance.

Air Distribution: Two McQuay air handling units (AHUs) provide the school with its air distribution needs. Both AHUs are unit size 014 Vision models, rated at 4200 to 11,200 cubic feet per minute (cfm) each of airflow. At the time of the audit, these AHUs were well-maintained with clean air filters.

Heating: Three Weil-McLain fuel oil Model 88 boilers provide heating to the building, all assumed to be identically sized model 888. At the time of the audit, one of these boilers was not operational, but has since been fixed and is now running. These boilers are listed as 82% thermally efficient and 84% combustion efficiency, using fuel oil #2. A combustion analysis found the functional boilers to be operating at 85.6% and 86.4% combustion efficiency. These higher efficiency ratings are due to the use of fuel oil #1 in Akiachak, which burns cleaner than fuel oil #2.

Controls: Building zones are controlled by individual mechanical thermostats. At the time of the audit, one of these thermostats was set to 85°F. Energy savings could be realized by reducing this zone to a more reasonable set point.

Lighting: Interior lighting consists primarily of T8 fluorescent lamps with electronic ballasts. Some areas are lit by T5 fixtures. All classrooms have motion sensors set up to turn off lights after 15 to 30 minutes of no activity.

Domestic Water: Two 119 gallon Superstor ULTRA indirect fired water heaters provide the school with domestic hot water.

Building Photos: Akiachak School

Weil-McLain Boiler

CAT Generator

Insulated Piping

Door Missing Weather-stripping

Broken Boiler Controller

Thermostat

1.9 AKIACHAK TRIBAL COURT OFFICE

Description: The Akiachak Tribal Council Office also functions as the Akiachak court system. Building operating hours are from 0900 to 1700, Monday through Friday.

General Conditions: The building was originally constructed in 1955. Due to its age and weathering, the building has become quite run down. The structure has also shifted over the years so much so that many of the interior doors no longer shut properly.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: Building insulation is in poor condition; occupants can feel cold air coming into the building from the attic space and dropped ceiling. One occupant also mentioned cold air can be felt near the windows as well. There is also evidence of water leaking from the roof into the dropped ceiling.

Heating: The original boilers of this building have been shut down because they were consuming a great deal of fuel. A Monitor 2400 oil stove heater now supplies the building with space heating. This oil stove, however, is not able to meet the space heating requirements of the facility, and many areas remain frigid all day. Some areas of the building have been closed off due to the cold conditions.

Controls: The old mechanical thermostats that previously controlled space heating remain in the facility but no longer function due to the boilers being out of commission.

Lighting: Interior lighting consists primarily of T8 fluorescent lamps with electronic ballasts.

Building Photos: Akiachak Tribal Council Office

Non-Weather-stripped Door

Lighting Fixtures

Mechanical Thermostat

Monitor Heater

Old Boiler

Water Damage

1.10 AKIACHAK WATER TREATMENT PLANT

Description: The Akiachak Water Treatment Plant provides clean water to the entire city. The plant has two operators, but receives extra maintenance help when needed. The building is in good condition. Most of the equipment housed at the facility has been well-maintained, though there are several outdated pumps and motors that could be replaced with more efficient models. Typical operating hours are 0900 to 1700.

General Conditions: The facility was constructed in 2000 and is in good condition overall. The plant has one well and two pumps for raw sewage. The water is then treated and distributed to the village through two loops.

> Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: The building structure overall appears to be in good condition. The standing seam metal roof appears to be in good condition. Doors are in good condition with adequate weather-stripping. The double-pane windows are in good condition.

Heating: Two Weil-McLain fuel oil Model 88 boilers provide heating to the building; one boiler is Model 1088, while the other is Model 1188. These boilers are listed as 82% thermally efficient with 84% combustion efficiency, using fuel oil #2. Combustion analyses were performed on these boilers at the time of the audit and found the 1088 boiler to be functioning at 87.7% combustion efficiency, while the 1188 model was functioning at 83.7% combustion efficiency. These high efficiency ratings are due to the use of fuel oil #1 in Akiachak. There is also a XeteX Heat-X-Changer energy recovery unit in service at the facility.

Controls: Building heating is controlled by mechanical thermostats.

Lighting: Interior lighting consists of T8 fluorescent fixtures with electronic ballasts. During the audit, there was not sufficient time to verify the lamp types and wattages of the high bay fixtures.

Domestic Water: Two 41-gallon Amtrol Boilermate indirect-fired water heaters provide the facility with domestic hot water. At the time of the audit, one heater was set to 98°F, while the other was set to 125°F.

Vacuum System: Vacuum sewage systems are installed in bush Alaska due to permafrost and lack of available pitch. The system originates at the treatment facility and is in good operational condition. The vacuum pump motor runs 24/7 to meet village requirements. A higher efficiency motor will result in measurable savings for this system.

Heat Trace System: To prevent system freeze ups, hot water heat trace pumps that run throughout the water and sewer distribution system originate from this facility. The system is manually controlled and runs at all times or at operators' discretion. Limiting the operation of the heat trace based on outside air or ground temperatures will provide significant savings to the village.

Building Photos: Akiachak Water Treatment Plant

Fuel System

Exterior Window

Weil-McLain Boilers

Treated Water System

Treated Water Tanks

Amtrol Boilermate Indirect-Fired Water Heaters

1.11 AKIACHAK ELDER AND YOUTH CENTER

Description: The Akiachak Elder and Youth Center is a facility that is only used for special occasions like racing funds or ceremonies such as marriages or funerals. The building also contains a sauna, kitchen, and several bathrooms.

General Conditions: The building was constructed in 1995 and was empty at the time of the audit. Because the building is only used for special occasions, the operator shuts down the furnace when there are no activities planned. The operator also believes that this furnace is using far more fuel than it should be.

Pictures of general conditions found during the field audit immediately follow this building description.

Building Envelope: The building structure overall appears to be in fair condition. The building exterior shows signs of weathering and age, and the interior walls have no paint. Several of the exterior windows are broken. The building is also poorly insulated.

Heating: An oil-fired Olsen furnace rated 82.7% efficient provides the building with space heating. At the time of the audit, the building was quite cold with temperatures ranging from 40-50°F even though the furnace was operational. This is most likely due to several broken windows in the facility which allow air to escape. This may also be the reason that the furnace is consuming so much fuel, in conjunction with the poor insulation.

Controls: Mechanical thermostats control building heating.

Lighting: Interior lighting consists primarily of T8 fluorescent lamps with electronic ballasts. There are also several 90 watt incandescent fixtures.

Domestic Water: A 50 gallon Bock water heater provides the building with domestic hot water.

Building Photos: Akiachak Youth and Elder Center

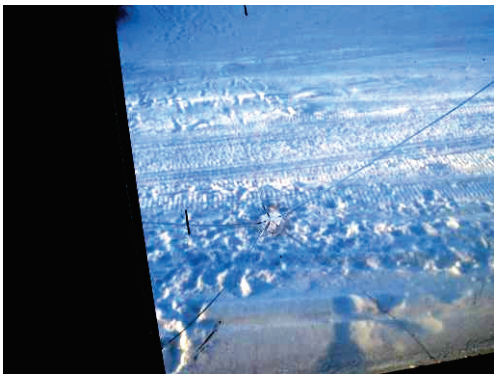
Fuel Tank

Exterior Windows

Bock Water Heater

Building Interior Space

Kitchen Area



Broken Window

2.0 UTILITIES

2.1 ELECTRICITY

The Village of Akiachak produces its own electricity via the Akiachak Native Community Company (ANCC). If a customer consumes less than 100 kWh per billing period, the ANCC charges a flat rate of $60. If a customer consumes more than 100 kWh per billing period, they pay the consumption rate listed below.

Rate Per kWh (ANCC)	$ 0.60
PCE Rate Per kWh	$ 0.3539

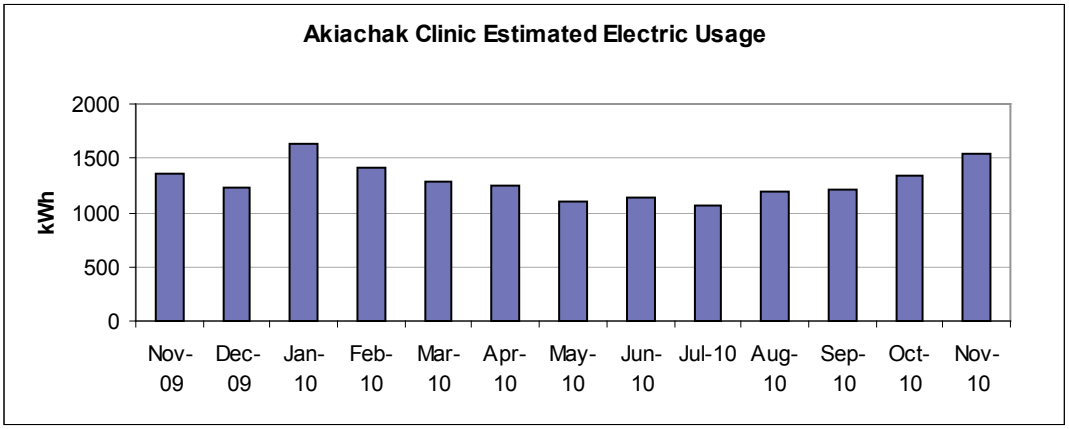
The following buildings currently receive PCE funding:

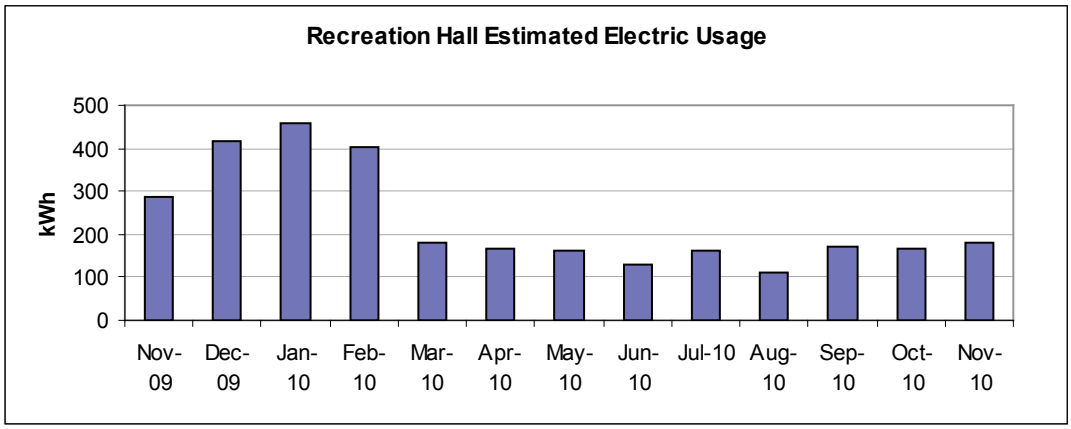
- Akiachak HUD Clinic
- Akiachak Community Center
- Akiachak Washeteria
- Tribal Court Offices
- Akiachak Water Treatment Plant
- Akiachak Elder and Youth Center

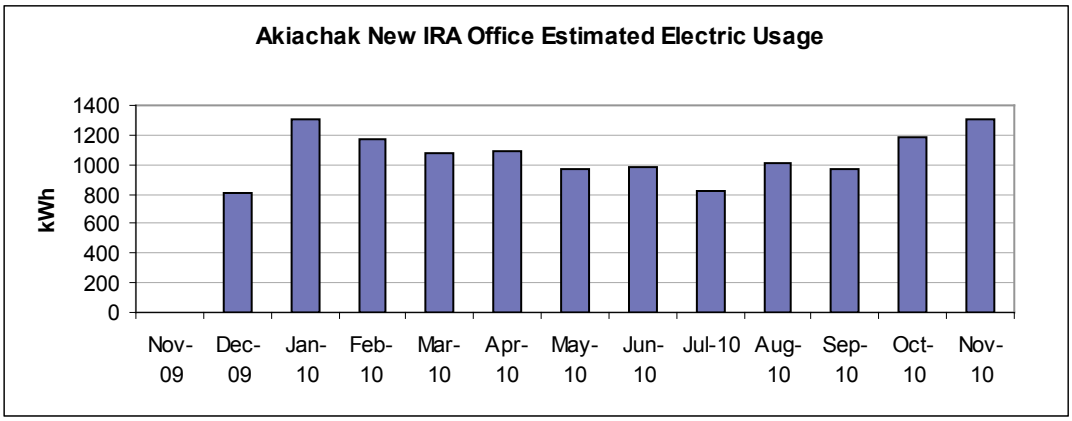
The Akiachak IRA Office and Jail and the Akiachak School buildings do not receive PCE funding at this time.

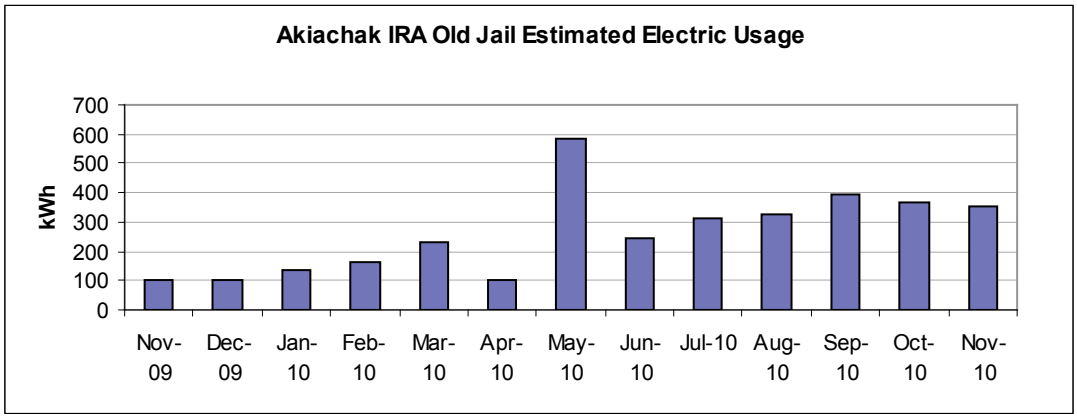
The Yupiit School District (YSD) has a contract with the ANCC to provide electricity to the school at an annual cost of $275,000. The YSD, therefore, does not have an electric bill based on consumption. For calculations, Ameresco has assumed a consumption rate of $0.60 based on bills provided to Ameresco by the ANCC. Schools in the Alaskan bush normally do not receive PCE assistance, and this is also confirmed by the bills provided by the ANCC.

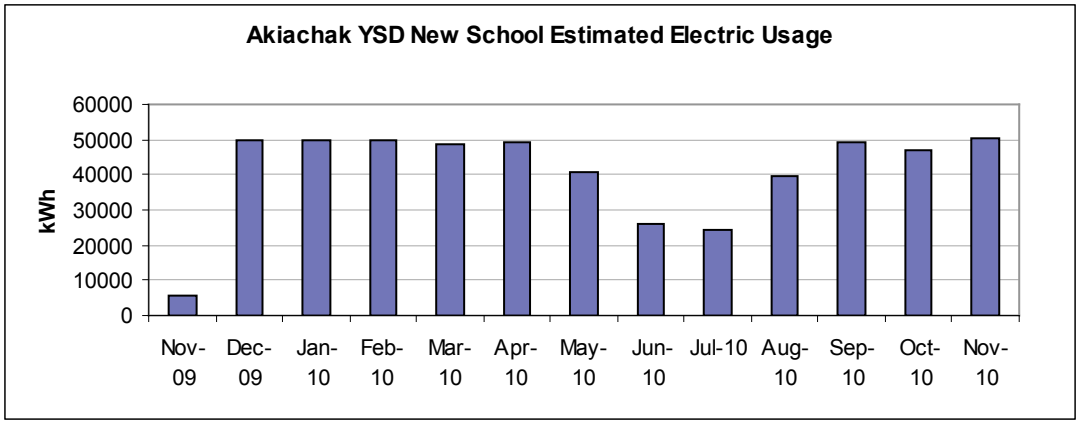
2.1.1 Electricity Usage Profiles

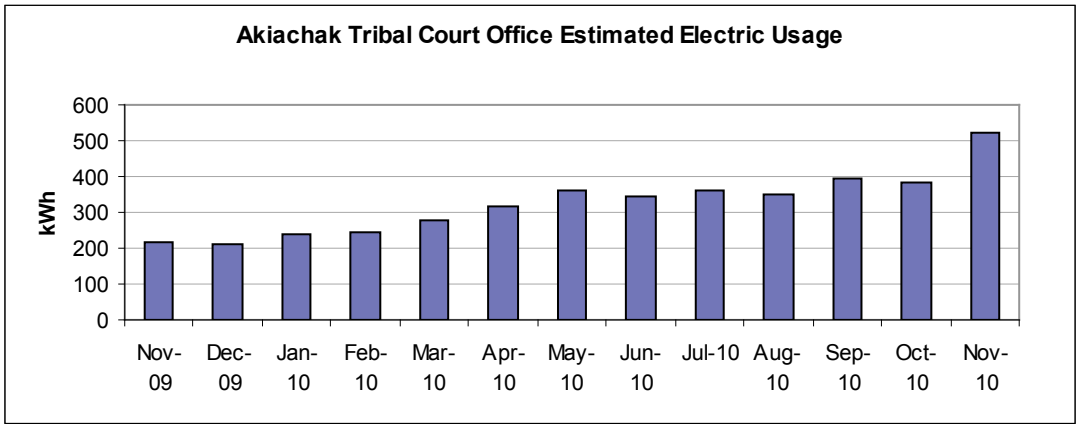


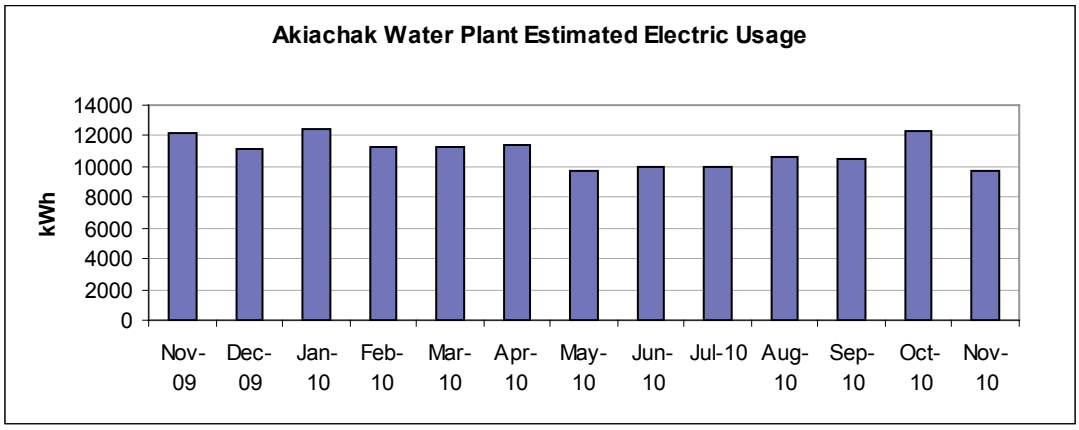


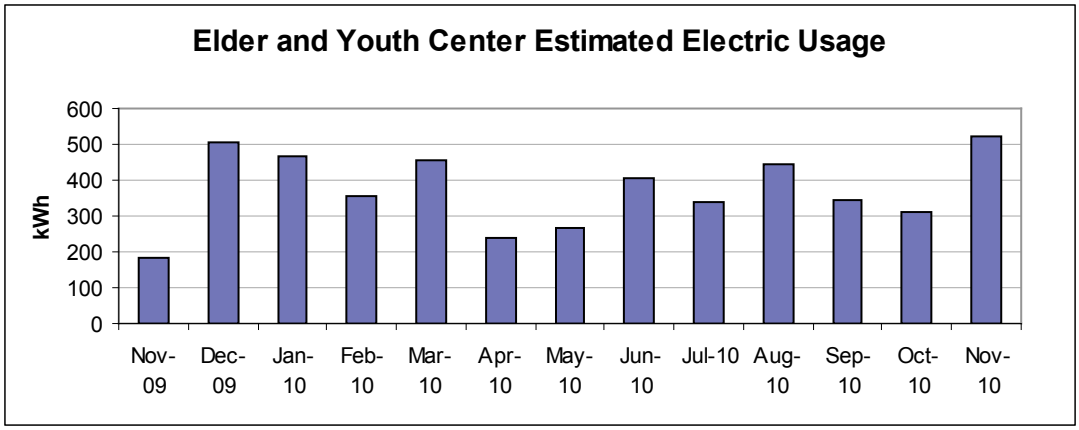



Akiachak IRA Old Jail Estimated Electric Usage
kWh
700
600
500
400
300
200
100
0
Nov-09
Dec-09
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10


Akiachak YSD New School Estimated Electric Usage
kWh
60000
50000
40000
30000
20000
10000
0
Nov-09
Dec-09
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10


Akiachak Tribal Court Office Estimated Electric Usage
kWh
600
500
400
300
200
100
0
Nov-09
Dec-09
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10





2.2 FUEL

The Village of Akiachak purchases its fuel (Fuel Oil #1) from Crowley at a rate of $3.5402/gallon.

The Akiachak School has its own fuel contract with Crowley Petroleum Distribution, Inc. The school purchases its fuel from Crowley at a rate of $3.7300/gallon.

3.0 OPERATIONS/MAINTENANCE PRACTICES

The village has a number of designated maintenance personnel that seem to possess the basic skills required to clean and maintain selected equipment. From Ameresco's observations, if the equipment should fall into disrepair, the staff does not have the training or experience to repair the equipment per the manufacturer's requirements and tends to piece together the equipment to maintain operation. Over time, the systems no longer function as required, which currently appears to be the case of most equipment and systems with in the village.

Operations and maintenance is one area in energy services where improvement and training costs are lower than equipment replacement costs, and the energy efficiency return is high. During the site audit, Ameresco found that outside of general cleaning, most of the equipment is not maintained to meet standard manufacturers' recommendations. Dirty filters, boilers in disrepair, systems altered, and control systems disconnected are a result of limited funding and lack of system training. This results in excessive energy use, premature equipment failure, and employee and resident discomfort. An annual system check by a qualified burner service technician to perform services such as boiler cleaning, boiler tune ups, system check out, and control system reviews will not only extend the overall life of the equipment, but improve occupant comfort as well as increase and maintain long term energy efficiency.

4.0 ENERGY CONSERVATION OPPORTUNITIES

The ECO matrix below summarizes the energy conservation opportunities identified and proposed during the site survey and baseline analysis. A description of each energy conservation opportunity follows the matrix. ***Please Note:*** This matrix applies to the initial proposal and the ECOs identified during that stage of the Akiachak project. There are some ECOs included in this section that were not performed, or the scope of work may have changed. *Section 4* is for reference only. See *Section 5* for updated project information.

ECO No.	ECO Description B=Building Envelope; C=Controls; E=Electrical; M=Mechanical; W=Water/Wastewater; R=Renewable	ECO MATRIX AKIACHAK Clinic	Community Hall	Day Care	Early Education	IRA New Office	Washeteria	Police Station	School	Tribal Council Office	Water Treatment	Youth Center
Controls												
C01	Thermostat Upgrade	X				X						
Electrical												
E01	Occupancy Sensors	X	X	X	X	X	X	X		X	X	X
E02	Premium Efficiency Motors										X	
E03	CFL Lighting Upgrade	X	X	X	X	X	X	X	X	X	X	X
Mechanical												
M01	Boiler Tune-Up	X				X			X		X	
M02	Boiler Upgrade			X			X			X		

VEEP – INITIAL PROPOSAL (FINAL AUDIT REPORT)			
ECO	**Cost**	**Savings**	**SPB**
C01 - THERMOSTAT UPGRADE	$ 2,842.00	$ 10,190.55	0.28
E01 - INSTALL OCCUPANCY SENSORS	$ 22,220.00	$ 3,623.87	6.13
E02 - PREMIUM EFFICIENCY MOTORS UPGRADE	$ 38,612.00	$ 4,930.40	7.83
E03 - CFL LIGHTING UPGRADE	$ 189.00	$ 857.49	0.22
M01 - BOILER TUNE-UP	$ 14,700.00	$ 84,418.14	0.17
M02 - BOILER UPGRADE	$ 61,320.00	$ 16,484.75	3.72
DESIGN/AUDIT	$ 2,500.00		
AVAILABLE FUNDING	$ 7,617.00		
** Available funding allocated for travel expenses, shipping, additional labor, etc*			
TOTAL	**$ 150,000.00**	**$ 120,505.21**	**1.24**

4.1 ECO DESCRIPTIONS - PROPOSED

Below are the descriptions of the Energy Conservation Opportunities (ECOs) that Ameresco analyzed for the Village of Akiachak. These include Ameresco's initial project recommendations for the village.

4.1.1 Controls Opportunities

C01 – Thermostat Upgrade

This ECO proposes replacing the outdated mechanical thermostats with 7-day programmable thermostats. The programmable thermostats would allow a building's HVAC system to be scheduled to operate in comfortable conditions while occupied and allow for night set-backs.

4.1.2 Electrical Opportunities

E01 – Occupancy Sensors

Lighting systems are often left energized in unoccupied areas. This ECO proposes to install sensors to shut off lighting in unoccupied spaces. Common sensing technologies include infrared, ultrasonic, and audible sound, often combining multiple types of sensing in one unit to avoid shutting off lights in an occupied area.

E02 – Premium Efficiency Motors

This ECO proposes installing National Electrical Manufacturers Association (NEMA) premium efficiency motors to replace standard and high efficiency motors. There are various mechanical systems operating with inefficient motors throughout the base. Premium efficiency motors typically increase energy efficiency by 2-3%.

E03 – CFL Lighting Upgrade

This ECO proposes replacing the existing 90-watt incandescent lamps with 23-watt compact fluorescent (CFL) lamps. Most village facilities have several incandescent fixtures in need of replacement. This is a simple ECO with a relatively fast payback rate.

4.1.3 Mechanical Opportunities

M01 – Boiler Tune-Up

This ECO proposes a comprehensive re-commissioning of the boilers in each building to optimize system operations. Such efforts include:

- Replace, repair, calibrate or install sensors or switches
- Repair air linkages
- Conduct combustion efficiency test services

- Clean combustion chambers and stacks

M02 – Boiler Upgrade

This ECO proposes replacing existing hot-water heating boilers with more energy efficient units. Many of the existing units in the village are original to the buildings they serve and have reached the end of their useful service life. Boilers employing modern technology can be installed to reduce energy consumption, improve system operations, and reduce maintenance costs. In some cases, this ECO proposes adding a storage tank to replace a building's domestic water heater.

4.2 ECO DESCRIPTIONS – NOT PROPOSED

Below are the descriptions of the Energy Conservation Opportunities (ECOs) that Ameresco analyzed for the Village of Akiachak. The ECOs in Section 5.2 are those that did not pay back as quickly as in Section 5.1. For the results of the calculations, refer to *Appendix B*.

4.2.1 Building Envelope Opportunities

B01 – Door Weather-stripping Upgrade

This ECO proposes applying weather stripping to exterior door perimeters to reduce air infiltration into the buildings. Many building doors have existing weather stripping material which is worn or missing.

B02 – Thermal Insulation Upgrade

This ECO proposes installing blown-in roof insulation on existing building envelopes to reduce energy consumption. Insulation can be added to roofs to increase or renew their insulating ratings (R-value).

4.2.2 Electrical Opportunities

E01 – T8 Lighting Upgrade

This ECO proposes replacing current T-12 fluorescent lighting and magnetic ballast with T-8 lamps and electronic ballasts. Post-light levels will be nearly equal or better to that of the existing lighting systems,

5.0 FINAL COSTING AND CHANGES FROM INITIAL REPORTING

Due to the brief nature of these contracts and the high cost of travel to and from the villages, audits were conducted a quickly and efficiently as possible. Once engineers have left the villages, communication is strained at best, and gathering additional information is difficult. Because of this, assumptions must be made during the initial ECO assessments and project cost estimates. Occasionally, Ameresco engineers have found that previously identified projects have been externally funded from another source, but this information usually comes too late in the process. As a result of all these factors, some previously identified projects have been modified or abandoned. Final project costs and expected annual savings can be found in *Appendix A*. ECOs that were categorized as "Not Funded," whether in the initial stages of the proposal or during construction, can be found in *Appendix B*.

5.1 CHANGES FROM INITIAL REPORTING

C01 – Programmable Thermostat Upgrade

This ECO was delivered to the village but not installed. After the installation materials were delivered, they could not be located during the construction phase for installation.

E01 – Occupancy Sensors

Installed as planned in the Clinic, Community Hall, Day Care, IRA New Office, Police Station, and Youth Center. The Tribal Council, Water Treatment Plant, and Early Education buildings did not receive upgrades due to grounding issues. A total of 45 of 75 of the initially identified occupancy sensor locations were installed.

E02 – Premium Efficiency Motors Upgrade

Two of the 7 identified premium efficiency motor upgrades were installed as planned at the Water Treatment Plant. The remaining pumps were not installed due to the seizure of their internal components.

E03 – CFL Lighting Upgrade

Installed as planned.

M01 – Boiler Tune-Up

Installed as planned at the IRA New Office, School, and Water Treatment Plant. This ECO was not performed at the Clinic due to the installation of a new boiler. A boiler burner replacement at the Washeteria was added to the scope and performed by Ameresco technicians.

M02 – Boiler Upgrade

Installed as planned in the Day Care and Clinic buildings. The Tribal Council building was removed from the scope of this project because the building was planned to be demolished in the summer of 2012. The AEA approved this project change when Ameresco learned of the planned demolition.

5.2 FUNDING ALLOCATION SUMMARY TABLES

VEEP ECOS - PROJECT COSTS & EXPECTED SAVINGS - AKIACHAK			
ECO	**Cost**	**Savings**	**SPB**
C01 - THERMOSTAT UPGRADE	$ 3,201.97	*N/A*	*N/A*
E01 - INSTALL OCCUPANCY SENSORS	$ 21,238.10	$ 2,167.07	9.80
E02 - PREMIUM EFFICIENCY MOTORS UPGRADE	$ 30,838.20	$ 704.34	43.78
E03 - CFL LIGHTING UPGRADE	$ 2,588.84	$ 857.49	3.02
M01 - BOILER TUNE-UP	$ 10,061.31	$ 23,482.58	0.43
M02 - BOILER UPGRADE	$ 74,611.28	$ 16,484.75	4.53
AVAILABLE FUNDING	$ 7,460.31		
** Available funding allocated to the village of Kotlik*			
TOTAL GRANT	**$150,000.00**		
VILLAGE TOTAL	**$142,539.69**	**$ 43,696.23**	**3.26**

APPENDIX A

VEEP PROJECT COSTS & EXPECTED SAVINGS

APPENDIX A - VEEP PROJECT COSTS & EXPECTED SAVINGS - AKIACHAK

Note: The reported simple paybacks are based on the type of ECO listed. For example, electrical ECOs only use the Annual kWh Cost Savings column to calculate the SPB, even though the Annual Equivalent Fuel Cost Savings is still reported.

C01 - THERMOSTAT UPGRADE

Building	# of Thermostats Installed	Cost Per Thermostat	Total Cost	Electric kWh Savings	Fuel mmBtu Savings	Total mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Total Annual Savings	Simple Payback
Clinic	2	$457.42	$914.85	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Day Care	1	$457.42	$457.42	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
IRA New Office	2	$457.42	$914.85	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Washeteria	2	$457.42	$914.85	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

E01 - INSTALL OCCUPANCY SENSORS

Building	# of Fixtures	Price Per Fixture	Total Cost	Electric kWh Savings	Electric kW Savings	Equivalent mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Total Annual Savings	Simple Payback
Clinic	17	$283.17	$4,813.97	1,289.60	0.00	4.40	93.58	$456.39	$331.29	$787.68	10.55
Community Hall	3	$283.17	$849.52	781.24	0.00	2.67	56.69	$276.48	$200.69	$477.17	3.07
Day Care	10	$283.17	$2,831.75	1,670.14	0.00	5.70	121.20	$591.06	$429.05	$1,020.11	4.79
Early Education*	2	$283.17	$566.35	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
IRA New Office	9	$283.17	$2,548.57	1,923.69	0.00	6.57	139.60	$680.79	$494.18	$1,174.98	3.74
Washeteria*	12	$283.17	$3,398.10	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Police Station	1	$283.17	$283.17	218.40	0.00	0.75	15.85	$77.29	$56.11	$133.40	3.66
Tribal Council Office*	9	$283.17	$2,548.57	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Water Treatment*	7	$283.17	$1,982.22	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Youth Center	5	$283.17	$1,415.87	240.34	0.00	0.82	17.44	$85.06	$61.74	$146.80	16.65

**Material delivered to these buildings but not installed by Ameresco.*

E02 - PREMIUM EFFICIENCY MOTORS UPGRADE

Building	# of Motors	Price Per Motor	Total Cost	Electric kWh Savings	Electric kW Savings	Equivalent mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Total Annual Savings	Simple Payback
Water Treatment	2	Varies w/HP	$30,838.20	1,990.23	0.51	6.79	144.43	$704.34	$511.28	$1,215.62	43.78

E03 - CFL LIGHTING UPGRADE (90w Incandescent to 23w CFL)

Building	Existing Lamp Wattage	Number of Lamps	Total Cost	Electric kWh Savings	Electric kW Savings	Equivalent mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Total Annual Savings	Simple Payback
All Over Village	90	18	$2,588.84	2,422.96	1.21	8.27	175.83	$857.49	$655.85	$1,513.34	3.02

M01 - BOILER TUNE-UP

Building	Number of Boilers	Increase in Efficiency	Total Cost	Electric kWh Savings	Fuel mmBtu Savings	Total mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Total Annual Savings	Simple Payback
IRA New Office	1	3%	$1,676.88	0.00	37.61	37.61	268.61	$0.00	$950.87	$950.87	1.76
School	3	3%	$5,030.65	0.00	474.42	474.42	3,388.70	$0.00	$12,639.87	$12,639.87	0.40
Water Treatment	2	2%	$3,353.77	0.00	391.20	391.20	2,794.30	$0.00	$9,891.84	$9,891.84	0.34

M02 - BOILER UPGRADE

Building	# of Boilers to Replace	New Boiler Efficiency (AFUE)	Total Cost	Electric kWh Savings	Fuel mmBtu Savings	Total mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Total Annual Savings	Simple Payback
Day Care	1	88.00%	$32,110.94	0.00	146.88	146.88	1,049.17	$0.00	$3,714.04	$3,714.04	8.65
Washeteria	1	88.00%	$10,389.40	0.00	351.65	351.65	2,511.76	$0.00	$8,891.65	$8,891.65	1.17
Clinic	1	88.00%	$32,110.94	0.00	153.41	153.41	1,095.78	$0.00	$3,879.06	$3,879.06	8.28

APPENDIX B

ECO CALCULATION RESULTS – NOT FUNDED

APPENDIX B - ECO CALCULATION RESULTS - NOT FUNDED - AKIACHAK

Note: The reported simple paybacks are based on the type of ECO listed. For example, electrical ECOs only use the Annual kWh Cost Savings column to calculate the SPB, even though the Annual Equivalent Fuel Cost Savings is still reported.

B01 - WEATHERSTRIPPING

Building	# of Doors	Price Per Door	Total Cost	Electric kWh Savings	Fuel mmBtu Savings	Total mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Simple Payback
Clinic	3	$560.00	$2,352.00	0.00	6.11	6.11	43.61	$0.00	$154.40	15.23
Day Care	3	$560.00	$2,352.00	0.00	6.76	6.76	48.29	$0.00	$170.95	13.76
IRA New Office	1	$560.00	$784.00	0.00	2.05	2.05	14.65	$0.00	$51.85	15.12
School	6	Varies w/Size	$4,704.00	0.00	19.70	19.70	140.73	$0.00	$498.19	9.44
Water Treatment	7	Varies w/Size	$5,488.00	0.00	51.42	51.42	367.29	$0.00	$1,300.19	4.22
Youth Center	1	$560.00	$784.00	0.00	2.05	2.05	14.67	$0.00	$51.94	15.09

B02 - THERMAL INSULATION UPGRADE

Building	Current Insulation	Proposed Insulation	Total Cost	Electric kWh Savings	Fuel mmBtu Savings	Total mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Simple Payback
Clinic	R-20	R-39	$6,666.24	0.00	9.64	9.64	68.84	$0.00	$243.70	27.35
Community Hall	R-20	R-39	$3,124.80	0.00	4.30	4.30	30.69	$0.00	$108.66	28.76
Day Care	R-20	R-39	$1,736.00	0.00	2.78	2.78	19.85	$0.00	$70.27	24.71
Early Education	R-20	R-39	$1,736.00	0.00	2.44	2.44	17.45	$0.00	$61.79	28.10
IRA New Office	R-20	R-39	$6,076.00	0.00	8.78	8.78	62.75	$0.00	$222.13	27.35
Washeteria	R-20	R-39	$10,416.00	0.00	15.24	15.24	108.85	$0.00	$385.34	27.03
Police Station	R-20	R-39	$2,499.84	0.00	3.52	3.52	25.13	$0.00	$88.97	28.10
Tribal Council Office	R-20	R-39	$9,999.36	0.00	14.07	14.07	100.53	$0.00	$355.89	28.10

E01 - T8 LIGHTING UPGRADE

Building	# of Fixtures	Price Per Fixture	Total Cost	Electric kWh Savings	Electric kW Savings	Equivalent mmBtu Savings	Equivalent Fuel Gallons Savings	Annual kWh Cost Savings	Annual Equivalent Fuel Cost Savings	Simple Payback
Early Education	4	Varies w/# of lamps	$1,153.60	128.13	1.06	0.44	9.30	$45.34	$32.92	25.44
Washeteria	30	Varies w/# of lamps	$8,622.60	564.35	7.75	1.93	40.95	$199.72	$144.98	43.17

APPENDIX C

EQUATIONS USED IN CALCULATIONS

APPENDIX C - EQUATIONS USED IN CALCULATIONS - AKIACHAK

ECO ***Equations***

B01 1. Door Leakage Area (in2) = Door Area x Door Leakage Factor
2. Specific Infiltration (CFM/in2) = [(Stack Coefficient x ΔT) + (Wind Coefficient x [Wind Speed]2)]1/2
3. ΔT = Heating Setpoint Temp - Bin Temp
4. Air Infiltration (CFM) = Specific Infiltration x Door Leakage Area
5. Heat Loss Rate (Btu/hr) = 1.08 x Air Infiltration x ΔT
6. Heating Load (mmBtu) = Heat Loss Rate x Bin Hours / 1,000,000
7. Energy Savings = Baseline - Proposed

Note: This ECO was completed using the RETscreen program.

B02 *Note: This ECO was completed using the RETscreen program.*
Inputs are R-values reported in the appendices as well as the insulation square footage.

C01 *Note: This ECO is based on bin data, occupancy, heating peak loads, boiler efficiency, and an assumed night setback.*
Baseline Usage = (Peak Load x Occupied Load Profile x All Hours) / Boiler Eff.
ECM Usage = [(Peak Load x Occupied Load Profile x Occupied Hours)
+ (Peak Load x Unoccupied Load Profile x Unoccupied Hours)] / Boiler Eff.
mmBtu Saved = Baseline Usage - ECM Usage
Space Heating Savings (MMBtu/yr) = (Baseline Space Heating) x [(Occupied Bin Hours)/(Total Bin Hours)] x (8% savings)

E01 1. Baseline Usage (kWh) = (Existing Fixture Wattage) x (Qty) x (Existing Hours) / (1,000)
2. Proposed Usage (kWh) = (Existing Fixture Wattage) x (Qty) x [(Existing Hours) - (Hours Reduced)] / (1,000)
3. Annual Energy Savings = (Baseline Energy Usage) - (Proposed Energy Usage)
4. Annual Cost Savings = (Energy Savings) x (Energy Cost)

E02 1. Existing/Proposed Motor Demand (kW) = (Motor HP) x (Load Factor) x (0.746 kW/HP)/ Motor Efficiency
2. Existing/Proposed Motor Consumption (kWh) = (Motor Demand) x (Diversity Factor) x (Annual Hours)
3. kW Savings = [(Baseline kW) - (Proposed kW)] x (12 Months)
4. kWh Savings = (Baseline kWh) - (Proposed kWh)
5. Energy Cost Savings = Energy Savings (kW or kWh) x (Energy Unit Cost)

E03 1. Baseline Demand (kW) = (Existing Fixture Wattage) x (Qty) X (12 Months) / (1,000)
2. Baseline Usage (kWh) = (Baseline Demand) x (Fixture Hours)
3. Proposed Demand (kW) = (Proposed Fixture Wattage) x (Qty) X (12 Months) / (1,000)
4. Proposed Usage (kWh) = (Proposed Demand) x (Fixture Hours)
5. Annual Energy Savings = (Baseline Energy Usage) - (Proposed Energy Usage)
6. Annual Cost Savings = (Energy Savings) x (Energy Cost)

M01 Savings (MBtu) = (Boiler Input Rating) x ((1/Tested Efficiency)-(1/Desired Efficiency)) x (Hours per Year)
Savings ($) = (MBtu Savings) x (Energy Cost)

M02 Savings (MBtu) = (Boiler Input Rating) x ((1/Old Boiler Efficiency)-(1/New Boiler Efficiency)) x (Hours per Year)
Savings ($) = (MBtu Savings) x (Energy Cost)

FOR E01 - Hours Reduced

From the Energy Management Handbook, Turner

4th Edition Table 13.8 p361

Savings from installing occupancy sensors are as follows:

Offices (Private)	25-50%
Offices (Open Spaces)	20-25%
Rest Rooms	30-75%
Corridors	30-40%
Storage Areas	45-65%
Meeting Rooms	45-65%
Conference Rooms	45-65%
Warehouses	50-75%

For E02

Load factor assumed to be 80% except in some cases. Vacuum pumps assumed 100% load factor.
Diversity factor assumed to be 95%.

Tables 2A and 2B - 1995 Commercial Building Energy Consumption
2003 ASHRAE Applications Handbook, Chapter 35

	Energy End-Use (1,000 Btu/ft^2-yr)		
Building Characteristics	**Space Heat**	**Cool**	**Ventilation**
Education	32.8	4.8	1.6
Food sales	27.5	13.4	4.4
Food service	30.9	19.5	5.3
Health care	55.2	9.9	7.2
Lodging	22.7	8.1	1.7
Mercantile and service	30.6	5.8	2.5
Office	24.3	9.1	5.2
Public assembly	53.6	6.3	3.5
Public order and safety	27.8	6.1	2.3
Religious worship	23.7	1.9	0.9
Storage/Warehouse	15.7	0.9	0.3
Vacant	11.9	0.6	0.3

APPENDIX D

POST INSTALLATION PHOTOS

APPENDIX D – POST INSTALLATION PHOTOS - AKIACHAK

New Boiler Installation at the Day Care

Boiler Installation at the Clinic

Installed Occupancy Sensor