AMERESCO
Green • Clean • Sustainable

ENERGY AUDIT FINAL REPORT

Results and Recommendations from Energy Audit of Newtok

For VEEP Grants

City of Newtok, Alaska

June 20, 2012

Prepared By:
Ameresco, Inc.
6643 Brayton Drive
Anchorage, AK 99507

Prepared For:
Alaska Energy Authority
City of Newtok

TABLE OF CONTENTS

APPENDICES

EXECUTIVE SUMMARY AND PREFACE

This Post Installation Report summarizes the results of an Ameresco Energy Audit of the City of Newtok, the initial energy savings measures identified and proposed, and any changes that may have occurred throughout the installation process. The City of Newtok 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 City of Newtok on October 23, 2010. The table below shows the buildings audited and their respective square footages.

City of Newtok - Building Summary

Building	Category	Square Footage
Tribal Council Office	Public Building	875
Power Plant Building	Public Building	400
Washeteria	Public Facility	1,100
Power Company Office	Public Building	750
Community Center	Public Facility	1,000
School	School	20,000
Post Office	Public Building	400
Community Store	Public Building	1,600
Tom's Store	Public Building	800

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 - NEWTOK			
ECO	**Cost**	**Savings**	**SPB**
B01 - WEATHER-STRIPPING	$ 602.84	$ 156.11	3.86
B02 - THERMAL INSULATION UPGRADE	$ 13,462.44	$ 249.45	53.97
B03 - ENERGY EFFICIENT WINDOW UPGRADE	$ 12,025.47	$ 18.62	646.01
B04 - ENERGY EFFICIENT DOOR UPGRADE	$ 12,211.72	$ 43.35	281.70
E01 - T8 LIGHTING UPGRADE	$ 8,073.71	$ 1,762.50	4.58
E02 - T5 LIGHTING UPGRADE	$ 5,106.74	*N/A*	*N/A*
E03 - INSTALL OCCUPANCY SENSORS	$ 3,759.84	$ 92.41	40.68
E05 - CFL LIGHTING UPGRADE	$ 642.56	$ 50.20	12.80
E06 - STREET LIGHTING UPGRADE	$ 44,832.15	$ 4,017.69	11.16
M02 - BURNER REPLACEMENT	$ 38,613.76	$ 5,678.44	6.80
AVAILABLE FUNDING	$ 10,668.75		
** Available funding applied to Kotlik*			
GRANT TOTAL	**$150,000.00**		
VILLAGE TOTAL	**$139,331.25**	**$12,068.76**	**11.54**

1.0 BUILDING DESCRIPTIONS

1.1 NEWTOK TRIBAL COUNCIL OFFICE

Description: The Newtok Tribal Council building houses the Tribal Council and City offices.

General Conditions: The building appears to be in good condition overall. The wood exterior and roof are in good condition. Windows are double-pane clear glass and are in good condition. The building could use some envelope upgrades, but is holding up well.

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

Building Envelope: The standing wood exterior and roof are in good condition and do not appear to have any major faults. Most windows are in good condition, though some could use caulking. Insulation is fair, but there is adequate space to add more. Most access points to the attic appear to have been sealed adequately.

Heating: Building heating is provided by a single Monitor 2400 electric heater. This heater was set to 88 degrees Fahrenheit at the time of the audit.

Lighting: Interior lighting consists of T12 fluorescent fixtures with magnetic ballasts as well as several 60 watt incandescent fixtures.

Building Photos: Newtok Tribal Council Office

Monitor Heater

Typical Window

Attic Access

Sealed Penetration

1.2 POWER PLANT (UNUSRAQ POWER COMPANY)

Description: The Newtok Power Plant is independently owned by the City.

General Conditions: The building is in poor condition overall. There is no heating or insulation. Excess heat is being lost at the exhaust fan in the small building addition. This addition has been somewhat enclosed, but it does not currently contain or reuse the heat that is being lost.

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

Equipment: The power company building houses 3 generators, but only one of these is functioning. If this last generator were to fail, the village would be without power. Many of the village buildings do not have functional back-up generators, including the village clinic which lost medicine that spoiled the last time the power failed. Two of the generators are 100 kW MagnaPlus models made by Marathon Electric; one of these is the remaining functional generator. There is also a failed 125 kW Stamford model made by NewAge, LLC (now owned by Cummins).

Loading: At the time of the audit, demand loading was about 125 kW.

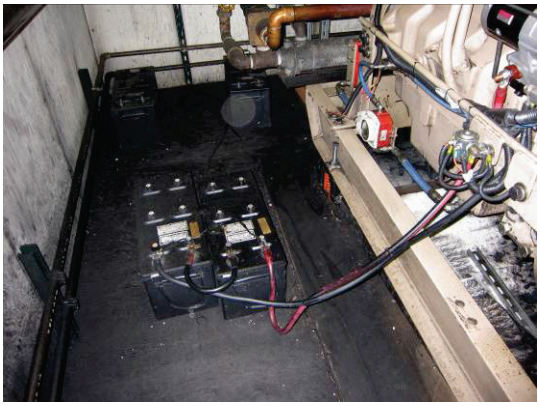
Building Photos: Newtok Power Plant

Damaged Generator

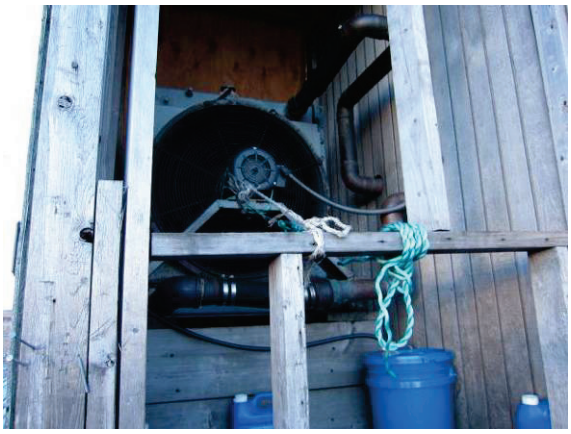
Damaged Generator

Damaged Generator

Damaged Generator



Generator Battery Packs



Radiator for Generators

1.3 NEWTOK WASHETERIA

Description: The Newtok Washeteria is used by most of the villagers for their laundering needs.

General Conditions: The building is in fair condition. There have been some problems with the hot water system, but this could be easily fixed with a Superstor or Amtrol system. Another issue is the loss of heating if power is lost to the building.

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

Building Envelope: The building appears to be in good condition. Exterior and interior walls do not have any major faults. Windows and doors are in good condition, but door weatherstripping is in need of an upgrade. Currently, the only form of weatherization on the building is make-shift weatherstripping from towels and other fabric.

Heating: Building heating is provided by two Trane hot water unit heaters. A Nordyne furnace is also in the facility but does not appear to be operating. As stated in the general conditions of the building, if power is lost to the building, however, none of the heating equipment functions. This could be remedied with 2 Toyostove fuel oil heaters or equivalent.

Lighting: Interior lighting mainly consists of T12 fluorescent fixtures with magnetic ballasts.

Domestic Water: The domestic hot water system is currently out of order. An old A.O. Smith water heater that is no longer operational still resides in the mechanical room.

Laundry Equipment: There are 3 Alliance SpeedQueen electric dryers as well as 6 SpeedQueen washers located in the Newtok Washeteria. The washers do not meet current ENERGY STAR requirements,

which changed in January 2011. All laundry equipment at the facility, however, appears to be functioning properly and in good condition.

Building Photos: Newtok Washeteria

SpeedQueen Washers

SpeedQueen Dryers

Old Furnace

Trane Unit Heater

Make-shift Weather-stripping

Defunct A.O. Smith Water Heater

1.4 NEWTOK POWER COMPANY OFFICE (UNUSRAQ POWER COMPANY)

Description: The Power Company Office houses the administrative offices of the Unusraq Power Company. This building is where residents come to pay their electric bills, and all customer service issues are handled here.

General Conditions: The building is in fair condition. The exterior shows many signs of wear and age, but appears to be holding up well. No major faults or defects were found during the course of the audit.

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

Building Envelope: The building envelope is in good condition overall. The windows are doors could be upgraded to be more energy efficient. The attic has some areas that are missing insulation.

Heating: Building heating is provided by 2 Monitor 441 oil fired forced air heaters. A Marvin quartz radiant heater is also used from time to time when the heating needs of the building are not met by the 2 Monitors.

Controls: There are no additional building controls.

Lighting: Interior lighting consists mainly of T12 fluorescent fixtures with magnetic ballasts.

Building Photos: Power Company Office (Unusraq Power Company)

Office Interior

Missing Insulation in Attic

Monitor Heaters

Marvin Quartz Heater

1.5 NEWTOK COMMUNITY CENTER

Description: The Newtok Community Center is a common gathering place for the village residents. The building is used 7 days a week for a wide variety of activities including traditional dancing and game nights.

General Conditions: The building is in fair condition overall. The structure has seen some wear, and the building itself is shifting. The exterior is fairly weathered but appears to be holding up well.

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

Building Envelope: The building exterior has seen quite a bit of wear and is faded and somewhat dilapidated, but the roof appears to be in good condition. The doors do not seal properly due to the amount the building has shifted, and there is no weather-stripping present.

Heating: Building heating is provided by a Monitor 41 fuel oil forced air heater. There is also a waste oil burner in the facility, but was not operational at the time of the audit.

Controls: There are no additional building controls.

Lighting: Interior lighting consists mainly of T12 fluorescent fixtures with magnetic ballasts.

Building Photos: Newtok Community Center

Worn Doorframe

Building Interior

Monitor Heater

Waste Oil Heater

1.6 NEWTOK SCHOOL

Description: The Newtok School houses elementary through high school age students. The school is divided into wings – a high school section, and an elementary and middle school section. The building also contains a gym, which functions as the school cafeteria as well.

General Conditions: The building is in good condition and is well-maintained. No major faults of defects were found during the course of the audit.

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

Building Envelope: The standing seam exterior and roof are in good condition and do not appear to have any major faults. Windows are doors are in good condition and seal properly. The building also appears to be well-insulated.

Heating: Building heating is provided by 2 Weil-McLain fuel oil fired boilers rated at 643 MBH out each and 82% thermal efficiency.

Controls: Zone temperatures are controlled by mechanical thermostats.

Lighting: Interior lighting consists mainly of T8 fluorescent fixtures with electronic ballasts. The gym area is lit by mercury vapor (MV) fixtures.

Domestic Water: A 90 gallon Bock fuel oil water heater provides the building with domestic hot water. The Newtok School also houses its own water treatment center for building-wide domestic water and wastewater handling.

Building Photos: Newtok School

Gym Lighting

Weil-McLain Boiler

Bock Water Heater

Circulating Pumps

1.7 OTHER NEWTOK BUILDINGS SURVEYED

Newtok Post Office: The Newtok Post Office is a very small facility that appears relatively well-maintained. Lighting fixtures have already been retrofit to CFL lamps, and all doors appear to seal well. There are few opportunities for improvement here.

Community Store: The Community Store is in good condition. Doors all seal well and the facility appears to be well-maintained. Interior lighting fixtures are primary T12 fluorescent fixtures with magnetic ballasts, and there are no occupancy sensors in the building. Heating is provided by 2 Monitor 2400 fuel oil forced air heaters.

Tom's Store: Tom's store is a second retail facility that competes with the Newtok Community Store. This store is in fair condition overall, and has no insulation in the attic area. Interior lighting consists of T12 fluorescent fixtures with magnetic ballasts. Heating is provided by an older Monitor fuel oil forced air heater.

1.8 MISCELLANEOUS OBSERVATIONS

Transformer Issues: The existing power poles are being utilized by multiple overhead services and have become heavily congested. Villagers have to coordinate on power usage to prevent outages because of this congestion.

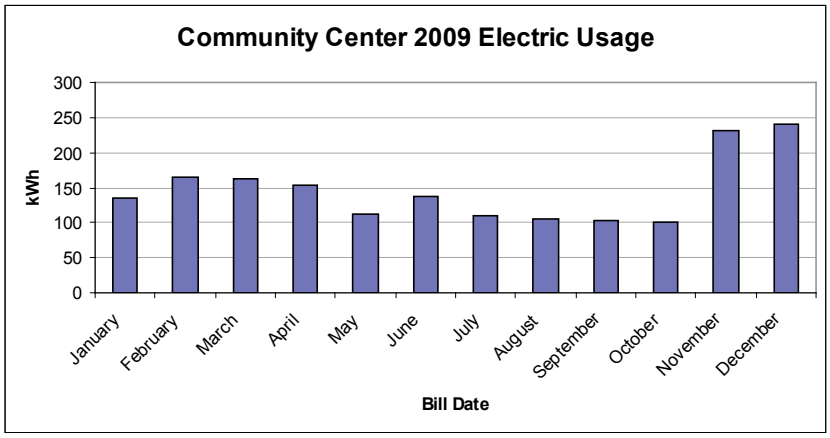
2.0 UTILITIES

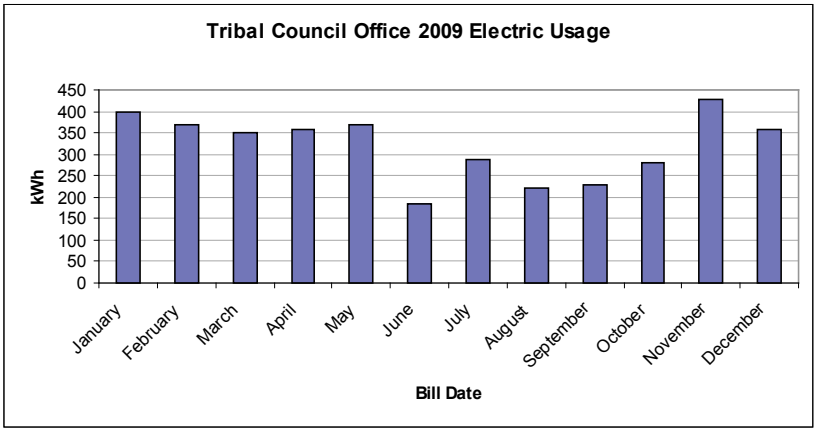
2.1 ELECTRICITY

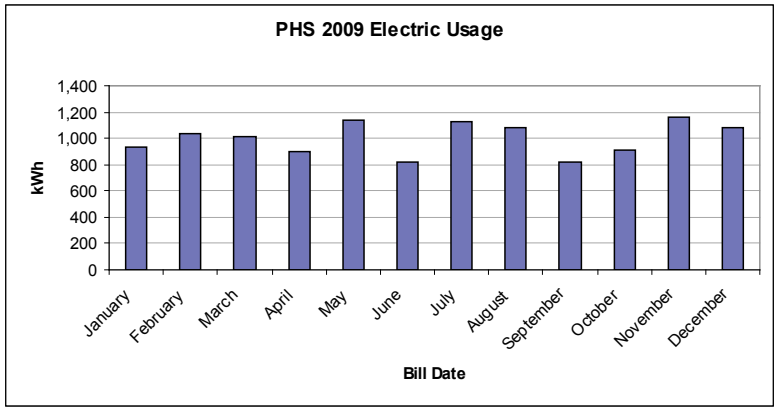
The City of Newtok purchases its electricity from the Unusraq Power Company. The Newtok Community Center (Quyurrvik) is the only building audited to receive power cost assistance.

Unusraq Power Company kWh Rate	$	0.80
Power Cost Assistance Rate (Credited to Some Accounts)	$	0.3960 – 0.4082

2.1.1 Electricity Usage Profiles







2.2 FUEL

Newtok purchases its few in bulk shipments that equal 30-35,000 gallons each year at a current rate of $3.57/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 skill 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 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 Newtok 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 NEWTOK						
		Tribal Council	Washeteria	Power Company	Community Center	Community Store	Tom's Store	School
Building Envelope								
B01	Door Weather-stripping Upgrade	X	X					
B02	Insulation Upgrade	X					X	
B03	Energy Efficient Window Upgrade			X				
B04	Energy Efficient Door Upgrade		X					
Electrical								
E01	T-8 Lighting Upgrade	X	X	X	X	X	X	
E02	T-5 Lighting Upgrade							X
E03	Occupancy Sensors	X	X	X	X	X	X	
E04	Premium Efficiency Motors Upgrade		X					
E05	CFL Lighting Upgrade	X						
E06	Street Lighting Upgrade*							
Mechanical								
M01	Boiler Tune-Up							X

** E06 is a village-wide initiative and does not apply to a specific building in the matrix*

VEEP – INITIAL PROPOSAL (FINAL AUDIT REPORT)			
ECO	**Cost**	**Savings**	**SPB**
B01 - WEATHER-STRIPPING UPGRADE	$ 3,500.00	$ 156.11	22.42
B02 - THERMAL INSULATION UPGRADE	$ 8,000.00	$ 249.45	32.07
B03 - ENERGY EFFICIENT WINDOW UPGRADE	$ 5,000.00	$ 18.62	268.60
B04 - ENERGY EFFICIENT DOOR UPGRADE	$ 10,000.00	$ 43.35	230.68
E01 - T8 LIGHTING UPGRADE	$ 20,000.00	$ 1,762.50	11.35
E02 - T5 LIGHTING UPGRADE	$ 15,000.00	$ 3,615.18	4.15
E03 - INSTALL OCCUPANCY SENSORS	$ 3,000.00	$ 917.28	3.27
E04 - PREMIUM EFFICIENCY MOTORS UPGRADE	$ 2,000.00	$ 51.30	38.98
E05 - CFL LIGHTING UPGRADE	$ 1,000.00	$ 50.20	19.92
E06 - STREET LIGHTING UPGRADE	$ 40,000.00	$ 5,665.97	7.06
M01 - BOILER TUNE-UP	$ 10,000.00	$ 6,298.66	1.59
DESIGN/AUDIT	$ 2,500.00		
AVAILABLE FUNDING	$ 30,000.00		
TOTAL	**$ 150,000.00**	**$ 18,828.60**	**7.97**

4.1 ECO DESCRIPTIONS

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

4.1.1 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 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).

B03 – Energy Efficient Windows

This ECO proposes installing new windows with improved heat transfer resistivity. This ECO would improve insulating values of the fenestration and reduce the negative energy effects of insolation.

B04 – Energy Efficient Doors

This ECO proposes installing new insulated doors. The installation would improve U-values of the current hollow metal doors, single pane glass doors, and un-insulated bay doors connected to conditioned spaces.

4.1.2 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.

E02 – T5 Lighting Upgrade

This ECO proposes replacing high intensity discharge (HID) lighting systems in the medium and high bay areas such as the water treatment plant, maintenance shops, school, etc., with T5 fluorescent fixtures. HID lighting is often used in areas with high ceilings or roof structures. The fixtures generate high luminous flux, are reasonably energy efficient, and are long lasting. Such systems often remain illuminated continuously since the re-strike times make periodic switching in irregularly occupied spaces a nuisance. Continuous operation of HID fixtures reduces the overall energy efficiency of lighting systems designed around their use. Newer, high output fluorescent sources, characterized by quick warm-up, with instant light output and improved efficiency, are now being used in place of many medium wattage HID fixtures in low and high bay applications. Post-light levels will be nearly equal to that of the existing lighting systems

E03 – 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.

E04 – 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%.

E05 – Compact Fluorescent Lighting (CFL) Upgrade

This ECO proposes replacing current incandescent lighting with compact fluorescent (CFL) bulbs. Post-light levels will be nearly equal or better to that of the existing lighting systems. Typical existing incandescent lamps range from 60 to 150 watts, and the new CFL lamps will use 13 to 26 watts. This is a low-cost retrofit that will result in fast paybacks.

E06 – Street Lighting Upgrade

This ECO proposes upgrading the existing 150-watt high pressure sodium (HPS) street lighting fixtures to more efficient 40-watt light-emitting diode (LED) fixtures. Village demand would be decreased at night, and savings would be realized in fuel savings from electricity generation.

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

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

B01 – Door Weather-stripping Upgrade

Installed as planned.

B02 – Thermal Insulation Upgrade

Installed as planned.

B03 – Energy Efficient Window Upgrade

Installed as planned.

B04 – Energy Efficient Door Upgrade

Installed as planned.

E01 – T8 Lighting Upgrade

Installed as planned.

E02 – T5 Lighting Upgrade

ECO removed from scope. A T5 upgrade was installed via another grant between Ameresco's initial site visit and construction mobilization. This information was not available to Ameresco before materials had been purchased, and therefore VEEP funding was used for this purchase. The T5 fixtures have been handed over to the Alaska Building Science Network per the request of the AEA.

E03 – Occupancy Sensors

Installed as planned in the Tribal Council building. This ECO was not completed at the Washeteria, Power Plant, Community Center, Community Store, or Tom's Store due to grounding and work box sizing issues.

E04 – Premium Efficiency Motor Upgrade

ECO removed from scope. Higher efficiency motors than those previously installed were unavailable for procurement during the construction phase of this audit.

E05 – CFL Lighting Upgrade

Installed as planned.

E06 – Street Lighting Upgrade

Newly identified ECO. Initial audit information on street lighting count proved incorrect, and some existing street lights could not be replaced due to code issues and insufficient available hardware at the village. 17 of the existing 30 street lights have been retrofit.

M01 – Boiler Tune-Up

Removed from scope. This ECO has been replaced by M02.

M02 – Burner Replacement

Newly identified ECO. Additional funding was used for boiler burner replacements at the Newtok School. Installation was performed by Ameresco technicians.

5.2 Funding Allocation Summary Tables

VEEP ECOS - PROJECT COSTS & EXPECTED SAVINGS - NEWTOK			
ECO	**Cost**	**Savings**	**SPB**
B01 - WEATHER-STRIPPING	$ 602.84	$ 156.11	3.86
B02 - THERMAL INSULATION UPGRADE	$ 13,462.44	$ 249.45	53.97
B03 - ENERGY EFFICIENT WINDOW UPGRADE	$ 12,025.47	$ 18.62	646.01
B04 - ENERGY EFFICIENT DOOR UPGRADE	$ 12,211.72	$ 43.35	281.70
E01 - T8 LIGHTING UPGRADE	$ 8,073.71	$ 1,762.50	4.58
E02 - T5 LIGHTING UPGRADE	$ 5,106.74	*N/A*	*N/A*
E03 - INSTALL OCCUPANCY SENSORS	$ 3,759.84	$ 92.41	40.68
E05 - CFL LIGHTING UPGRADE	$ 642.56	$ 50.20	12.80
E06 - STREET LIGHTING UPGRADE	$ 44,832.15	$ 4,017.69	11.16
M02 - BURNER REPLACEMENT	$ 38,613.76	$ 5,678.44	6.80
AVAILABLE FUNDING	$ 10,668.75		
** Available funding applied to Kotlik*			
GRAND TOTAL	**$150,000.00**		
VILLAGE TOTAL	**$139,331.25**	**$12,068.76**	**11.54**

VEEP ECOS - ECOS NOT FUNDED - NEWTOK			
ECO	**Cost**	**Savings**	**SPB**
E04 - PREMIUM EFFICIENCY MOTORS UPGRADE	*N/A*	$ 51.30	*N/A*
M01 - BOILER TUNE-UP	$ 4,000.00	$ 6,298.66	0.64

APPENDIX A

VEEP PROJECT COSTS & EXPECTED SAVINGS

APPENDIX A - VEEP PROJECT COSTS & EXPECTED SAVINGS - NEWTOK

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	Total Annual Savings	Simple Payback
Tribal Council	1	$200.95	$200.95	0.00	1.83	1.83	13.06	$0.00	$46.62	$46.62	4.31
Washeteria	2	$200.95	$401.90	0.00	4.29	4.29	30.67	$0.00	$109.50	$109.50	3.67

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	Total Annual Savings	Simple Payback
Tribal Council	R-20	R-39	$7,032.62	0.00	4.90	4.90	34.97	$0.00	$124.83	$124.83	56.34
Tom's Store	R-20	R-39	$6,429.82	0.00	4.89	4.89	34.91	$0.00	$124.62	$124.62	51.60

B03 - ENERGY EFFICIENT WINDOW UPGRADE

Building	# of Windows	Price Per Window	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
Power Company	5	$525.00	$12,025.47	0.00	0.73	0.73	5.21	$0.00	$18.62	$18.62	646.01

B04 - ENERGY EFFICIENT DOOR UPGRADE

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	Total Annual Savings	Simple Payback
Washeteria	2	Varies w/Size	$12,211.72	0.00	1.70	1.70	12.14	$0.00	$43.35	$43.35	281.70

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	Total Annual Savings	Simple Payback
Tribal Council	7	Varies w/# of Lamps	$926.49	224.22	1.85	0.77	16.27	$87.85	$58.09	$145.94	10.55
Washeteria	4	Varies w/# of Lamps	$529.42	195.10	1.61	0.67	14.16	$76.44	$50.55	$126.99	6.93
Power Co	2	Varies w/# of Lamps	$264.71	64.06	0.53	0.22	4.65	$25.10	$16.60	$41.70	10.55
Community Center	6	Varies w/# of Lamps	$794.14	415.83	4.90	1.42	30.18	$162.92	$107.73	$270.65	4.87
Community Store	34	Varies w/# of Lamps	$4,500.10	3,366.27	27.74	11.49	244.29	$1,318.91	$872.10	$2,191.01	3.41
Tom's Store	8	Varies w/# of Lamps	$1,058.85	232.96	1.92	0.80	16.91	$91.27	$60.35	$151.63	11.60

E02 - T5 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	Total Annual Savings	Simple Payback
School*	27	$237.00	$5,106.74	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

**T5 lights were delivered but not installed. T5s had previously been installed by another grant prior to Ameresco mobilization.*

E03 - INSTALL OCCUPANCY SENSORS											
Building	**# of Sensors**	**Price Per Sensor**	**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**
Tribal Council	1	$537.12	$537.12	235.87	0.00	0.81	17.12	$92.41	$61.11	$153.52	5.81
Washeteria*	2	$537.12	$1,074.24	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Power Co*	1	$537.12	$537.12	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Community Center*	1	$537.12	$537.12	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Community Store*	1	$537.12	$537.12	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Tom's Store*	1	$537.12	$537.12	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

**Sensors were delivered to these buildings, but not installed due to grounding issues.*

E05 - CFL LIGHTING UPGRADE											
Building	**# of Lamps to Change**	**Price Per Lamp**	**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**
Tribal Council	2	$321.28	$642.56	128.128	0.00	0.44	9.30	$50.20	$33.19	$83.39	12.80

E06 - STREET LIGHTING UPGRADE - QTY 17											
Building	**Current Fixture**	**Proposed 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**
Whole Village	150W HPS	72W LED	$44,832.15	10,249.20	28.08	34.98	743.77	$4,017.69	$2,655.27	$6,672.96	11.16

M02 - BURNER REPLACEMENT											
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**
School	2	2.00%	$38,613.76	0.00	222.68	222.68	1,590.60	$0.00	$5,678.44	$5,678.44	6.80

APPENDIX B

ECO CALCULATION RESULTS – NOT FUNDED

APPENDIX B - ECO CALCULATION RESULTS - NOT FUNDED - NEWTOK

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.

E04 - 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
Washeteria	3	Varies w/HP	*N/A*	130.94	0.07	0.45	9.50	$51.30	$33.92	$85.23	*N/A*

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
School	2	2.00%	$4,000.00	0.00	247.01	247.01	1,764.33	$0.00	$6,298.66	$6,298.66	0.64

APPENDIX C

EQUATIONS USED IN CALCULATIONS

APPENDIX C - EQUATIONS USED IN CALCULATIONS - NEWTOK

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.

B03 *Note: This ECO was completed using the eQuest program.*
Two building models were created and compared using pre- and post-install window upgrade data.

B04 *Note: This ECO was completed using the eQuest program.*
Two building models were created and compared using pre- and post-install door upgrade data.

E01 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)

E02 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)

E03 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)

E04 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)

E05 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)

E06 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/Existing Burner Efficiency)-(1/New Efficiency)) x (Hours per Year)
Savings ($) = (MBtu Savings) x (Energy Cost)

FOR E03 - 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 E04

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 – NEWTOK

Completed Window Upgrade

Completed Street Lighting Upgrade

Completed Street Lighting Upgrade - Night