Village End Use Energy Efficiency Measures Program

AEA Grant # 2195234 Administered by Alaska Building Science Network

Crooked Creek Final Report

Community Summary

5 community buildings and 3 teacher housing units received energy efficiency upgrades:

Office Building, Washeteria, School Main Building, School Gym, Generator Shed & Teacher Housing

Retrofits Completed: November 2007 – November 2008

Village-Wide Lighting Retrofit Summary:

- Retrofitted 127 light fixtures with electronic ballasts & T8 lamps
- Installed 64 compact fluorescent light bulbs
- Installed 21 T5 linear fluorescent fixtures in the School Gym
- Pre-retrofit energy use for all lighting: 25.765 Kilowatts
- Post-retrofit energy use for all lighting: 13.085 Kilowatts
- Energy savings projection: 12.680 Kilowatts
- Pre-retrofit to post retrofit energy reduction: 49%

- Estimated Annual Savings:

kWh Rate (as of 11/19/2008): $0.85 Fuel Cost (FY 2007 Ave): $3.19

Hours Per Day/ 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
Locally Estimated	$22,068.1	2257.08	$7,200.08
4 Hours/day	$10,771.10	1101.65	$3,514.27
7 Hours/day	**$18,849.50**	1927.89	$6,149.97
10 Hours/day	$26,927.90	2754.13	$8,785.66

- Total project cost for all measures: $ 37,775
- Simple Payback (lighting measures only, using 7 hours/day lighting use run-time): 2 years
- Total village wide in-kind contribution: $ 7,813.00

Additional Energy Efficiency Measures:

- 2 Programmable thermostats installed in the Water plant / Washeteria and School Bus barn.
- Heat Recovery Project for City Water Plant / Washeteria

Native Village of Crooked Creek Owned Buildings

2 buildings owned by the Native Village of Crooked Creek received energy efficient lighting upgrades as follows:

Office Building, Water Plant / Washeteria,

- Lighting upgrades completed in November 2007
- Retrofitted 42 light fixtures with electronic ballasts & T8 lamps
- Installed 14 compact fluorescent light bulbs
- Pre-retrofit energy use for all lighting: 4.89 Kilowatts
- Post-retrofit energy use for all lighting: 2.532 Kilowatts
- Energy savings projection: 2.358 Kilowatts
- Pre-retrofit to post retrofit energy reduction: 48%
- Estimated Annual Savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
Locally Estimated	$6,689.68	684.21	$2,182.61
4 Hours/day	$2,003.03	204.87	$653.52
7 Hours/day	$3,505.30	358.51	$1,143.66
10 Hours/day	$5,007.58	512.16	$1,633.80

Additional Energy Efficiency Measures:

- Programmable thermostat installed in the Water plant / Washeteria
- Heat Recovery Project for City Water Plant / Washeteria

Programmable Thermostat installed in Water plant / Washeteria provides fuel savings

Native Village of Crooked Creek Office Building

Materials Installed	**Quantity**
2-lamp electronic ballast, (2) 25 watt T8 lamps	14
4-lamp electronic ballast, (3) 25 watt T8 lamps	2
CFL-14 W	11
CFL-20 W	1
CFL-23 W	2

- Pre-retrofit energy use: 1950 watts
- Post-retrofit energy use: 1028 watts
- Energy savings projection: 922 watts
- Pre-retrofit to post retrofit energy reduction: 47%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
2000 Hours/year (Est.)	$1,566.41	160.21	$511.07
4 Hours/day	$783.20	80.10	$255.53
7 Hours/day	$1,370.61	140.18	$447.18
10 Hours/day	$1,958.01	200.26	$638.83

Note: Two 4-lamp fixtures de-lamped to three 25 watt T-8 lamps each for additional savings.

Water Plant / Washeteria

Materials Installed	Quantity
2-lamp electronic ballast, (2) 25 watt T8 lamps	17
4-lamp electronic ballast, (3) 25 watt T8 lamps	7
4-lamp electronic ballast, (4) 25 watt T8 lamps	2

- Pre-retrofit energy use: 2940 watts
- Post-retrofit energy use: 1504 watts
- Energy savings projection: 1436 watts
- Pre-retrofit to post retrofit energy reduction: 49%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4200 Hours/year (Est.)	$5,123.28	524.00	$1,671.55
4 Hours/day	$1,219.83	124.76	$397.99
7 Hours/day	$2,134.70	218.33	$696.48
10 Hours/day	$3,049.57	311.90	$994.97

Note: Seven 4-lamp fixture de-lamped to three 25 watt T-8 lamps each for additional savings.

Heat Recovery - Additional Measure

Materials Installed

Welding black pipe components

- Pre-retrofit energy use: 3500 gallons of fuel
- Projected Post-retrofit energy use: 700 gallons of fuel
- Energy savings projection: 2800 gallons of fuel
- Pre-retrofit to post retrofit energy reduction: 80%
- Estimated annual savings:

	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
3500 gallon usage	2800	$8932.00
3800 gallon usage	3040	$9697.60
4000 gallon usage	3200	$10208.00

- AEA project cost: $ 4,200
- AEA cost payback: .47 years
- Total project cost: $ 42,000
- Total cost payback: 4.70 years

Water Plant / Washeteria – Heat Recovery Project

Heat Recovery lines were in the ground, stubbed-out and ready for hook-up

Heat Exchanger was sitting in the corner feeling out of place

Fans in the power plant were regularly dumping true “waste heat”

This extra measure was a top priority for the Native Village of Crooked Creek. Heat recovery from the power plant to the near by water plant was in the original design for the new power plant. As construction progressed some complications arose, funding ran out and the heat recovery system between the two buildings was never completed. Fuel use and cost for the water plant / washeteria was substantial and with the spiked high costs of fuel in 2008 the cost of fuel was jeopardizing the ability of the Native Village to keep the water plant on-line.

Starting in 2007 and up through September, 2008 when the project was completed, ABSN Project Manager Geoff Butler coordinated with ANTHC Remote Maintenance Worker, Bruce Werba and Senior Power Plant and Water Plant Operator for the Native Village of Crooked Creek, Tom Parent for this retrofit. According to Tom Parent who has been responsible for fueling the operations of the water plant / washeteria for more than a decade, pre-retrofit the water plant used 3,800 - 4,000 gallons of fuel annually on average. From past similar heat recovery projects, Bruce Werba stated he expects to see an 80% fuel savings from the measure. The current fuel use goes to heating water loops circulating around the village for household water/plumbing, as well as all the heat required for the washeteria washers and dryers. Additionally the heat recovery will provide heat to bring up the ground water temperature before water treatment and distribution for a 3,000 gallon water tank. The measure is expected to save the Native Village around 3,000 gallons of fuel annually which at an average of say $3.19/gallon equates to $9,570 in savings annually. At that rate the project will pay for itself in under 5 years. At higher fuel prices, which is likely, the payback will be more rapid. AEA grant funds covered approximately 10% of total project costs, or $4,200 for welding black pipe components of the system. The following two-page report is written by Bruce Werba on the function and results of the system.

Completed heat recovery lines entering the Water Plant

Plumbed and operational heat exchanger harvests hot water from generators and transfers to boiler supply lines

Completed heat recovery lines exiting the Power Plant

September 10, 2008

Mr. Jeff Butler, Program Manger
The Alaska Building Science Network
5401 Cordova Street, Suite 303
Anchorage, Alaska 99518

Subject: Crooked Creek Water Plant Waste Heat Project

Mr. Butler,

I spoke with Mr. Brian Gray, Engineer of Alaska Energy & Engineering, Inc. on the specs' of his design and agreed with his concept of how this project would work after everything is in operation. We both have extensive experience in working with waste heat construction and agreed to get rid of the BTU's calculating instruments that were designed into the system. We also called on the Kuskokwim Power Authority and Mrs. Evelyn Thomas, Tribal Administrator of Crooked Creek and they also agreed to eliminate the BTU calculating instruments. At this time I would like to commend Mrs. Thomas on being the driving force of this project along with the Water Plant Operator, Mr. Tom Parent, who was persistent for this new concept. We put our data together from the past 12 yrs. of the water plant using an average of 4 thousand gallons of fuel oil per year. With the engineering and the direction of construction, the project may be done for approximately $44,250.

What has the waste heat accomplished for the water plant? How does it work? Basically the waste heat system is brought into the return line system with a return and a supply line with a gate between the two. The returning cooler water which is approximately 165 degrees returning to the boiler is now routed to the power plant and is heated to 180 degrees, then, comes back in front of the gate and goes into the boiler. The water is now 180 degrees and does not cause the boiler to come on line because the settings of the boiler system is satisfied. If the demand on the boiler or hydronic system is greater than the BTU's supplied by the power plant, the boiler will come on line and assist with the waste heat to satisfy the 180 degrees. These demands only occur when the outside temperatures are sub-zero degrees. Being mindful, the washeteria is also supplied with the waste heat for operation. If all three dryers are running, it puts a large demand on the BTU's needed to run the water plant. Also, when the water plant is making water, the well water is coming in at 34 degrees and is heated to 48 degrees, putting another large demand on the BTU's. Now that

Now that we know what is needed at the water plant, you can see the demand of BTU's needed to run the plant. Keep in mind, that every gallon of fuel oil used, rounded off, will give off approximately 100,000 BTU's.
The project went very well and as you can see from the pictures taken, it is not over designed; it is very simple and operates efficiently. You can also see the inside of the water plant is all done in copper and outside of the building is welded black iron pipe. This project was engineered to have 2-inch black iron pipe that is insulated with 2-inch foam, and an outside rubber flexible shield to protect the insulation from weather. The waste heat system project ran from the power plant to the water plant, which is approximately 140 ft. apart.
After one months service, the waste heat system seems to be doing quite well. With the school on line, which uses much electricity, the power plant is putting out sufficient BTU's to run the water plant. We have yet to see what happens when the sub-zero temperatures of winter come in. With past experiences, in putting these systems in, we are figuring that it may burn approximately 1,000 gallons of heating fuel. If the water plant purchased the usual 4,000 gallons of heating fuel, it would cost them $29,600 at $7.40 per gallon. If our predictions hold true and they are only going to use ¼ of the fuel, which would be 1,000 gallons at $7.40 per gallon, it would cost $7,400. The village would save $22,200. There is only one unknown factor at this point. What would be the cost of the waste heat from the power plant sold to the water plant? As you can see, the cost of savings is going to be phenomenal year by year. This is not a new concept; it has been used in the past in many areas of bush Alaska. Because of the energy crunch, you are going to see this waste heat concept used much more in the future. It would be very interesting to back track in one to two years to see how much this water plant has saved.
Great appreciation goes to the two entities, ANTHC and The Alaska Building Science Network, that made this project possible by their funding.

Sincerely,

Bruce Werba

Bruce Werba
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Holy Cross, AK. 99602
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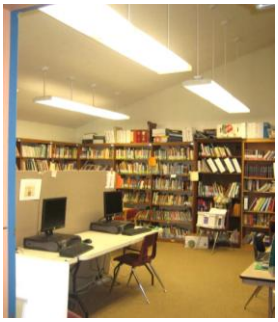
Kuspuk School District Owned Buildings



3 buildings and 3 teacher housing units owned by the Kuspuk School District received energy efficient lighting upgrades as follows: Johnny John Sr. School Main Building, School Gym, Generator Shed, Duplex 3-Bedroom side, Duplex 2-Bedroom side, 2-Bedroom Teacher Housing Unit.

- Lighting upgrades completed in: November 2008
- Retrofitted 85 light fixtures with electronic ballasts & T8 lamps
- Installed 50 compact fluorescent light bulbs
- Installed 21 T5 linear fluorescent fixtures
- Pre-retrofit energy use for all lighting: 20.875 Kilowatts
- Post-retrofit energy use for all lighting: 10.553 Kilowatts
- Energy savings projection: 10.322 Kilowatts
- Pre-retrofit to post retrofit energy reduction: 49%
- Estimated Annual Savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
Locally Estimated	$15,378.4	1572.87	$5,017.464
4 Hours/day	$8,768.15	896.79	$2,860.75
7 Hours/day	$15,344.2	1569.37	$5,006.30
10 Hours/day	$21,920.3	2241.96	$7,151.86

Programmable T-stat installed in school Bus Barn

Additional Energy Efficiency Measures:

- 1 Programmable thermostat was installed in the School Bus barn.

Notes: Since the Bus barn is not classroom or office space that must be maintained at 65 or more degrees during all day-time hours, considerable fuel savings is achievable from programming this heating control to lower temps for longer periods. Ten percent or more fuel savings is expected.

School Main Building


25 watt T-8 lamps save energy while improving over-all light levels in class rooms and hallways for a better learning environment.

Materials Installed	**Quantity**
2-lamp electronic ballast, (1) 25 watt T8 lamp	4
2-lamp electronic ballast, (2) 25 watt T8 lamps	15
4-lamp electronic ballast, (4) 25 watt T8 lamps	5
4-lamp fixture (two)2-lamp ballasts and (4) 25 watt T8 lamps	59
CFL-14 W	2
CFL-20 W	7
CFL-23 W	15
CFL-27 W	4

- Pre-retrofit energy use: 13997 watts
- Post-retrofit energy use: 7308 watts
- Energy savings projection: 6689 watts
- Pre-retrofit to post retrofit energy reduction: 48%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
1800 Hours/year (Est.)	$10,227.6	1046.06	$3,336.95
4 Hours/day	$5,682.05	581.15	$1,853.86
7 Hours/day	$9,943.59	1017.01	$3,244.25
10 Hours/day	$14,205.1	1452.87	$4,634.65

Generator Shed

Materials Installed	**Quantity**
2-lamp electronic ballast, (2) 32 watt T8 lamps	2

- Pre-retrofit energy use: 168 watts
- Post-retrofit energy use: 120 watts
- Energy savings projection: 48 watts
- Pre-retrofit to post retrofit energy reduction: 29%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
1095 Hours/year (Est.)	$44.65	4.57	$14.57
4 Hours/day	$40.77	4.17	$13.30
7 Hours/day	$71.35	7.30	$23.28
10 Hours/day	$101.94	10.43	$33.26

Teacher Housing

Compact fluorescent bulbs greatly reduce wattage in teacher housing.

Duplex, 3-Bedroom side

Materials Installed	**Quantity**
CFL-14 W	6
CFL-20 W	2

- Pre-retrofit energy use: 480 watts
- Post-retrofit energy use: 124 watts
- Energy savings projection: 356 watts
- Pre-retrofit to post retrofit energy reduction: 74%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
1500 Hours/year (Est.)	$453.61	46.39	$148.00
4 Hours/day	$302.41	30.93	$98.67
7 Hours/day	$529.21	54.13	$172.66
10 Hours/day	$756.02	77.32	$246.66

Duplex, 2-Bedroom side

Materials Installed	**Quantity**
CFL-20 W	4
CFL-23 W	3

- Pre-retrofit energy use: 435 watts
- Post-retrofit energy use: 149 watts
- Energy savings projection: 286 watts
- Pre-retrofit to post retrofit energy reduction: 66%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
1500 Hours/year (Est.)	$364.42	37.27	$118.90
4 Hours/day	$242.95	24.85	$79.26
7 Hours/day	$425.16	43.48	$138.71
10 Hours/day	$607.37	62.12	$198.16

Teacher Housing – 2- Bedroom Unit

Materials Installed	Quantity
CFL-14 W	5
CFL-23 W	2
• Pre-retrofit energy use:	525 watts
• Post-retrofit energy use:	116 watts
• Energy savings projection:	409 watts
• Pre-retrofit to post retrofit energy reduction:	78%

• Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
1500 Hours/year (Est.)	$521.14	53.30	$170.03
4 Hours/day	$347.43	35.53	$113.35
7 Hours/day	$608.00	62.19	$198.37
10 Hours/day	$868.57	88.84	$283.39

School Gym

T-5 fluorescent fixtures installed in high school gymnasium.

T-5 fixtures save energy while greatly improving light levels in large spaces.

Materials Installed	Quantity
T5 fixture, electronic ballast, (2) 54 watt T5 HO	15
T5 fixture, electronic ballast, (3) 54 watt T5 HO	6
• Pre-retrofit energy use:	5270 watts
• Post-retrofit energy use:	2736 watts
• Energy savings projection:	2534 watts
• Pre-retrofit to post retrofit energy reduction:	48%

• Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
1750 Hours/year (Est.)	$3,766.94	385.27	$1,229.02
4 Hours/day	$2,152.54	220.16	$702.30
7 Hours/day	$3,766.94	385.27	$1,229.02
10 Hours/day	$5,381.34	550.39	$1,755.75

Crooked Creek – Alaska Building Science Network – T5 Lighting Upgrade Details

These retrofits were completed in November 2008.

School Gym	Length (feet)	Width (feet)	Ceiling Height (feet)	Type of Existing Fixture	# of Existing Fixtures	Existing Fixture Wattage	**Total Existing Wattage**	Existing Foot-candles	New Foot-Candles	# of New Fixtures	New fixtures	New Fixture Wattage	**Total New Wattage**
	52	41	26' av, sloping 21' – 32', peak runs along the length	HPS 150 watt		160	**0**	62-66	52	15	T-5 2 lamps	114	**1710**
				HPS 250 watt		260	**0**			6	T-5 3 lamps	171	**1026**
2132 total sq ft				Other School Gym (A)	20	232	**4,640**				T-5 6 lamps	342	**0**
Existing light fixtures per row: 4, 8' & 1, 4' fixture				Other School Gym (B)	5	126	**630**				Other fixtures (A)		**0**
					Total Existing Watts		5,270				Total New Watts		2736

46 lamps = 230,000 lumins = 52 av fc

Percent Savings Pre to Post Retrofit:	**48.08%**

Savings & Payback Calculation for Gym:

1750

New watts / old watts

neg 1 (New watts / Old watts x 100 – 100) / 100

Assume 1750 hrs / year for 250 days/year of use

Full cost of electricity: $0.85 /kWh

Watts of existing lighting: 5,270

New wattage for T5 fixtures: 2,736

Calculation: (Watts) x (hrs/year) / (1000w/kw) x (cost of electricity) = (cost / year)

Existing Cost: $7,834

Retrofitted Cost: $4,067

Annual Savings: $ $3,767

T5 Materials costs	$3,585
T5 shipping costs	$540

Material & shipping cost of Gym retrofit: $ 4,125

Simple Payback: Materials cost / annual savings = **1.10** years (for retrofit to pay for itself in materials)

Crooked Creek, In-Kind Contribution Tracking Record - ABSN Energy Efficiency Projects:

In-Kind Item	Dates	Hours Contri-buted	Hourly Wage	Value / Amount	Notes
Staff time for project contact, introduction, and reviewof intro materials (Number of entities x 1 hour each)		3	$15.00	$45.00	list number of entities
Staff time for Attending teleconference (TC/IRA)		3	$15.00	$45.00	list # of staff and wages if possible ($15/hr is an average wage designated for village entity staff).
Staff time for Attending teleconference (School)		2	$15.00	$30.00	"
Maint. Staff time to accompany Field Manager on building assessments - 1st site visit		4	$15.00	$60.00	list entity and maint staff, add rows as necessary
Maint. Staff time to attend ABSN training		6	$15.00	$90.00	list entity and maint staff, add rows as necessary
Conservative village office administrative percentage of total project cost less ABSN Admin %. Total project cost = $37,775/village - (our admin percentage , (around 12%) Approx: $4,533) = $33,242 x 5.5% = $1,828 (this 5.5% village admin cost estimate is spread across all entities we work with for the course of the grant for completing all energy efficiency measures. These are primarily for cumulative, otherwise unaccounted time expense for village- based project support.	Feb, '07 through			$1,828.00	Each time we call, email, or fax a village entity, someone has to receive the communication, review and/or foward the information, follow-up on requests, etc. Wether it is to set-up a teleconference, verify maintenance staff participation in lighting or boiler trainings, set-up in-kind lodging and transportation, lighting trainings, track a shipment, verify completion of lighting in a given building, ship lamps and ballasts out of the village, request a labor reimbursement agreement, or invoice etc, etc. Village expenses for phone charges, copying and fax costs, office supplies, etc are part of this ammount.
Lodging for ABSN Field Managers - 1st assessment site visit	Oct 29 & 30, '07	2	$60.00	$120.00	Two nights for assessment and stayed with a friend for 2nd visit.
Kuspuk SD maint labor for T8 and cfl retrofits in school facilities	Dec. '07	73	$15.00	$1,095.00	Our tally sheet labor estimate for retrofitting 85 linear fluorescent and 50 cfl light fixtures is 73 hours @ $15/hr
Kuspuk SD cert. electriciain maint labor for T5 retrofits.				$4,500.00	Comparable estimate - In-kind labor, provided by school district - includes airfare & per diem and lodging.
Native Village of Crooked Creek – Heat Recovery project	2007-2008			$5,700	Total Project cost to NVCC was approx $42,000. VEUEEM grant funds covered roughly 10% at $4,200, plus $1,500 coordination time, We are listing a full match of $5,700 inkind for this measure.
	TOTAL			$13,513.00	