Village End Use Energy Efficiency Measures Program

AEA Grant # 2195225 Administered by Alaska Building Science Network

Ekwok Final Report



Community Summary

11 community buildings received energy efficiency upgrades as follows:

City Offices, City Shop, Gas Station, VPSO Building, ENL Tribal Office, EPA Building, Clinic, Boys & Girls Club, Russian Church, William "Sonny" Nelson School Shop and Generator Building, School Storage & Furnace Rooms, School Gym

Retrofits Completed: August 2009 – January 2010
ABSN Field Management by: Harry Morgan and Anna Hilbruner.
Trained 5 local maintenance staff who were employed by village entities to complete lighting retrofits

Village-Wide Lighting Retrofit Summary:

- Retrofitted 81 light fixtures with electronic ballasts & T8 lamps
- Installed 54 compact fluorescent light bulbs
- Installed 20 T5 linear fluorescent fixtures
- Pre-retrofit energy use for all lighting: 18.82 Kilowatts
- Post-retrofit energy use for all lighting: 8.35 Kilowatts
- Energy savings projection: 10.47 Kilowatts
- Pre-retrofit to post retrofit energy reduction: 56%

- Estimated Annual Savings:

kWh Rate (FY 2009 Ave): $0.50 Fuel Cost (FY 2009 Ave): $3.66

Hours Per Day/ 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
Locally Estimated Use	$8,303	1,351	$4,945
4 Hours/day	$5,236	852	$3,118
7 Hours/day	**$9,163**	1,491	$5,457
10 Hours/day	$13,090	2,130	$7,796

- Total project cost for all measures: $20,000 (Allocated according to number of lighting retrofits and tracked grant expense)
- Simple Payback (lighting measures only, using 7 hours/day lighting use run-time): 2.18 years
- Total village wide in-kind contribution for lighting projects: $5,813

City of Ekwok Owned Buildings



4 buildings owned by the City of Ekwok received energy efficient lighting upgrades as follows:

City Offices, City Shop, Gas Station, VPSO Building

- Lighting upgrades completed in: January 2010
- Retrofitted 22 light fixtures with electronic ballasts & T8 lamps
- Installed 36 compact fluorescent light bulbs
- Pre-retrofit energy use for all lighting: 6.288 Kilowatts
- Post-retrofit energy use for all lighting: 1.964 Kilowatts
- Energy savings projection: 4.324 Kilowatts
- Pre-retrofit to post retrofit energy reduction: 69%

- Estimated Annual Savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
Locally Estimated	$3,198.73	520.54	$1,905.18
4 Hours/day	$2,162.00	351.83	$1,287.70
7 Hours/day	$3,783.50	615.70	$2,253.48
10 Hours/day	$5,405.00	879.58	$3,219.25

"The lights are nice and bright, just the thing we need here for long winter nights and short days."

~ Ernie Nelson City Administrator

City Offices



Materials Installed	Quantity
2-lamp electronic ballast, (2) 25 watt T8 lamps	10
3-lamp electronic ballast, (3) 25 watt T8 lamps	4
4-lamp electronic ballast, (3) 25 watt T8 lamps	4
CFL-14 W	6
CFL-20 W	3
CFL-27 W	1
Outdoor 23w Flood	4

- Pre-retrofit energy use: 3972 watts
- Post-retrofit energy use: 1319 watts
- Energy savings projection: 2653 watts
- Pre-retrofit to post retrofit energy reduction: 67%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$1,326.50	215.87	$790.07
7 Hours/day	$2,321.38	377.77	$1,382.63
10 Hours/day	$3,316.25	539.67	$1,975.18
1820 Hours/year (Est.)	$2,414.23	392.88	$1,437.93

City Shop

Materials Installed	Quantity
Outdoor 23w Flood	9

- Pre-retrofit energy use: 900 watts
- Post-retrofit energy use: 207 watts
- Energy savings projection: 693 watts
- Pre-retrofit to post retrofit energy reduction: 77%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$346.50	56.39	$206.38
7 Hours/day	$606.38	98.68	$361.16
10 Hours/day	$866.25	140.97	$515.94
1000 Hours/year (Est.)	$346.50	56.39	$206.38

Gas Station

Materials Installed	Quantity
CFL-23 W	5
Outdoor 23w Flood	1

- Pre-retrofit energy use: 600 watts
- Post-retrofit energy use: 138 watts
- Energy savings projection: 462 watts
- Pre-retrofit to post retrofit energy reduction: 77%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$231.00	37.59	$137.59
7 Hours/day	$404.25	65.79	$240.77
10 Hours/day	$577.50	93.98	$343.96
500 Hours/year (Est.)	$115.50	18.80	$68.79

VPSO Building

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

- Pre-retrofit energy use: 816 watts
- Post-retrofit energy use: 300 watts
- Energy savings projection: 516 watts
- Pre-retrofit to post retrofit energy reduction: 63%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$258.00	41.99	$153.67
7 Hours/day	$451.50	73.47	$268.92
10 Hours/day	$645.00	104.96	$384.17
1250 Hours/year (Est.)	$322.50	52.48	$192.08

Ekwok Village Council Owned Buildings



4 buildings owned by the Ekwok Village Council received energy efficient lighting upgrades as follows:

ENL Tribal Office, EPA Building, Clinic, Boys & Girls Club

- Lighting upgrades completed in January 2010
- Retrofitted 37 light fixtures with electronic ballasts & T8 lamps
- Installed 16 compact fluorescent light bulbs
- Pre-retrofit energy use for all lighting: 5.951 Kilowatts
- Post-retrofit energy use for all lighting: 2.605 Kilowatts
- Energy savings projection: 3.346 Kilowatts
- Pre-retrofit to post retrofit energy reduction: 56%

- Estimated Annual Savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
Locally Estimated	$3,178.38	517.23	$1,893.06
4 Hours/day	$1,673.00	272.25	$996.45
7 Hours/day	$2,927.75	476.44	$1,743.79
10 Hours/day	$4,182.50	680.63	$2,491.12

ENL Tribal Office Building



Materials Installed	Quantity
2-lamp electronic ballast, (2) 25 watt T8 lamps	12
CFL-20 W	2
CFL-23 W	2

- Pre-retrofit energy use: 1358 watts
- Post-retrofit energy use: 638 watts
- Energy savings projection: 720 watts
- Pre-retrofit to post retrofit energy reduction: 53%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$360.00	58.58	$214.42
7 Hours/day	$630.00	102.52	$375.23
10 Hours/day	$900.00	146.46	$536.05
2000 Hours/year (Est.)	$720.00	117.17	$428.84

EPA Building

Materials Installed	Quantity
2-lamp electronic ballast, (2) 25 watt T8 lamps	2
3-lamp electronic ballast, (3) 25 watt T8 lamps	4
4-lamp electronic ballast, (3) 25 watt T8 lamps	3
CFL-20 W	2
Outdoor 23w Flood	2

- Pre-retrofit energy use: 1784 watts
- Post-retrofit energy use: 699 watts
- Energy savings projection: 1085 watts
- Pre-retrofit to post retrofit energy reduction: 61%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$542.50	88.28	$323.12
7 Hours/day	$949.38	154.50	$565.45
10 Hours/day	$1,356.25	220.71	$807.79
2000 Hours/year (Est.)	$1,085.00	176.57	$646.23

Clinic

Materials Installed	Quantity	
2-lamp electronic ballast, (2) 25 watt T8 lamps	1	
4-lamp electronic ballast, (3) 25 watt T8 lamps	6	De-lamping from 4 to 3 lamps/fixture saved additional watts.
4-lamp electronic ballast, (4) 25 watt T8 lamps	4	
CFL-20 W	2	
CFL-23 W	5	

- Pre-retrofit energy use: 2289 watts
- Post-retrofit energy use: 1011 watts
- Energy savings projection: 1278 watts
- Pre-retrofit to post retrofit energy reduction: 56%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$639.00	103.99	$380.59
7 Hours/day	$1,118.25	181.98	$666.04
10 Hours/day	$1,597.50	259.97	$951.48
1820 Hours/year (Est.)	$1,162.98	189.26	$692.68

Boys & Girls Club

Materials Installed	Quantity
2-lamp electronic ballast, (2) 25 watt T8 lamps	5
CFL-27 W	1

- Pre-retrofit energy use: 520 watts
- Post-retrofit energy use: 257 watts
- Energy savings projection: 263 watts
- Pre-retrofit to post retrofit energy reduction: 51%
- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$131.50	21.40	$78.32
7 Hours/day	$230.13	37.45	$137.06
10 Hours/day	$328.75	53.50	$195.81
1600 Hours/year (Est.)	$210.40	34.24	$125.32

Russian Orthodox Church Owned Buildings



1 building owned by the community supported Russian Orthodox Church received energy efficient lighting upgrades as follows:

Russian Orthodox Church

Materials Installed	**Quantity**
CFL-27 W	2

- Lighting upgrades completed in January 2010
- Installed 2 compact fluorescent light bulbs
- Pre-retrofit energy use for all lighting: 0.2 Kilowatts
- Post-retrofit energy use for all lighting: 0.054 Kilowatts
- Energy savings projection: 0.146 Kilowatts
- Pre-retrofit to post retrofit energy reduction: 73%

- Estimated Annual Savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$73.00	11.88	$43.48
7 Hours/day	$127.75	20.79	$76.09
10 Hours/day	$182.50	29.70	$108.70
900 Hours/year (Est.)	$65.70	10.69	$39.13

Southwest Region School District Owned Buildings

3 buildings owned by the Southwest Region School District received energy efficient lighting upgrades as follows William "Sonny" Nelson School:

School Shop, School Storage & Back, School Gym

- Lighting upgrades completed in January 2010
- Retrofitted 22 light fixtures with electronic ballasts & T8 lamps
- Installed 20 T5 linear fluorescent fixtures
- Pre-retrofit energy use for all lighting: 6.388 Kilowatts
- Post-retrofit energy use for all lighting: 3.732 Kilowatts
- Energy savings projection: 2.656 Kilowatts
- Pre-retrofit to post retrofit energy reduction: 42%

- Estimated Annual Savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
Locally Estimated	$1,860.50	302.77	$1,108.13
4 Hours/day	$1,328.00	216.11	$790.97
7 Hours/day	$2,324.00	378.19	$1,384.19
10 Hours/day	$3,320.00	540.28	$1,977.41

In-kind Labor: Southwest Region School District generously provided all maintenance staff labor in-kind to the grant to complete school facility, teacher housing and Gym T5 lighting retrofits - resulting in substantial direct cost savings to the grant.

School Shop

Materials Installed	Quantity
2-lamp electronic ballast, (2) 25 watt T8 lamps	3
4-lamp electronic ballast, (4) 25 watt T8 lamps	10

- Pre-retrofit energy use: 1932 watts
- Post-retrofit energy use: 1038 watts
- Energy savings projection: 894 watts
- Pre-retrofit to post retrofit energy reduction: 46%

- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$447.00	72.74	$266.24
7 Hours/day	$782.25	127.30	$465.91
10 Hours/day	$1,117.50	181.86	$665.59
1000 Hours/year (Est.)	$447.00	72.74	$266.24

School Storage & Back Room

Materials Installed	Quantity
2-lamp electronic ballast, (2) 25 watt T8 lamps	9

- Pre-retrofit energy use: 756 watts
- Post-retrofit energy use: 414 watts
- Energy savings projection: 342 watts
- Pre-retrofit to post retrofit energy reduction: 45%

- Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$171.00	27.83	$101.85
7 Hours/day	$299.25	48.70	$178.24
10 Hours/day	$427.50	69.57	$254.62
1000 Hours/year (Est.)	$171.00	27.83	$101.85

School Gym

Yellow / green HID lighting – pre-retrofit,
low color rendering index (CRI) of 60 - 70

New T5 HIF fixtures
high color rendering index (CRI) of 85

"I was able to get up to Ekwok the other day... what a difference the new T-5 lighting makes! We are getting at least twice the light levels as we used to. The difference in light quality and atmosphere for the kids is worth as much as the cost savings to me. Without your help I don't know when we would have had the funding to do that re-lamp."

- 9-16-09 Comments from a phone call with Kim Endicott, Director of Maintenance, Southwest Region School District

Materials Installed	**Quantity**
T5 fixture, electronic ballast, (2) 54 watt T5 HO	20
• Pre-retrofit energy use:	3700 watts
• Post-retrofit energy use:	2280 watts
• Energy savings projection:	1420 watts
• Pre-retrofit to post retrofit energy reduction:	38%

• Estimated annual savings:

Hours Per Day / 250 Days Per Year	Electrical Savings	Comparative Avoided Diesel Use (gal)	Comparative Avoided Diesel Costs
4 Hours/day	$710.00	115.54	$422.88
7 Hours/day	$1,242.50	202.20	$740.04
10 Hours/day	$1,775.00	288.85	$1,057.20
1750 Hours/year (Est.)	$1,242.50	202.20	$740.04

ABSN T5 Lighting plans are designed to increase the average light levels throughout the area when all fixtures are switched on - in comparison with former existing light output. Existing switching controls are normally retained - allowing users to choose the appropriate number of light fixtures / rows of light fixtures needed for various use patterns. In many cases school staff will choose not to use all fixtures available, thereby achieving more electrical savings than is shown above. Considering light quality, ABSN T5 lighting plans employ 54-watt, high output T5 lamps with a color-rendering index (CRI) of 85. Existing light fixtures in rural high ceiling areas typically have a CRI ranging from 30 to 70. With the T5 retrofits, the boost in CRI greatly improves light quality – resulting in objects appearing much closer to their true color as seen under sunlight. This increased light quality can result in less light needed to illuminate a given space - for example fewer rows of fixtures selected to light the space.

Ekwok - Alaska Building Science Network - T5 Lighting Upgrade Details

These retrofits were completed in (August, 2009).

Ekwok 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**
	70	50	20'4"	HPS 150 watt		160	**0**	13-16	35 - 37	20	T-5 2 lamps	114	**2280**
Color shade of walls				HPS 250 watt		260	**0**				T-5 3 lamps	171	**0**
				Multi-Vapor 175 watt	20	185	**3,700**				T-5 6 lamps	342	**0**
					Total Existing Watts		3,700				Total New Watts		2280

Percent Savings Pre to Post Retrofit:	**38.38%**

Savings & Payback Calculation for Gym:

1750 New watts / old watts

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

Full cost of electricity: $ 0.50 /kWh

Watts of existing lighting: 3,700

New wattage for T5 fixtures: 2,280

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

Existing Cost: $ 3,238

Retrofitted Cost: $ 1,995

Annual Savings: $ $ 1,243

T5 Materials costs $ 3,454.00

T5 shipping costs $ 198.58

Material & shipping cost of Gym retrofit: $3,652.58

Simple Payback: Materials cost / annual savings = **2.94** years (for retrofit to pay for itself in materials)

Ekwok, 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 & review of intro materials		3	$ 20.00	$ 60.00	Number of entities x 1 hour each
Staff time for Attending teleconference		2	$ 20.00	$ 40.00	TC/IRA
Staff time for Attending teleconference		2	$ 20.00	$ 40.00	City
Staff time for Attending teleconference		1	$ 20.00	$ 20.00	School
Maint. Staff time to accompany Field Manager on building assessments		8	$ 15.00	$ 120.00	1st site visit - city
Conservative village office administrative percentage of total project cost less ABSN Admin %. Total project cost = $20,000/village - (our admin percentage, (around 12%) Approx: $2,400) = $17,600 x 5.5% = $968 (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			$968	Each time we call, email, or fax a village entity, someone has to receive the communication, review and/or forward the information, follow-up on requests, etc. Whether 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. Village expenses for phone charges, copying and fax costs, office supplies, etc. are part of this amount.
Lodging for ABSN Field Managers		6	$ 75.00	$ 450.00	1st & 2nd site visits - city
School Labor for T8 Upgrades		20	$ 20.00	$ 400.00	Estimated Maint Labor for T8s
School Labor for T5 Gym Upgrades				$ 3,700.00	Conservative estimate for total labor contributed including travel and fringe costs.
Tribe backhaul/Photos Labor		1	$ 15.00	$ 15.00	
	TOTAL			$5,813.00	

The capacity of ABSN's scope of work was greatly increased by the response of local communities to work in partnership with ABSN and provide in-kind services of project coordination, paid labor for lighting retrofits, transportation and lodging for ABSN field staff, and other valuable contributions. This allowed ABSN and the community of Ekwok to deliver 29% more energy savings measures beyond the original grant funding.