

**Village End Use Energy Efficiency Measures Program '05 – '06**  
**AEA Grant # 2195234 Administered by Alaska Building Science Network**

**Kwigillingok Final Report**



**Community Summary**

**10 Community buildings and 5 teacher housing units received energy efficiency upgrades November 2006 – Summer 2007**

Community Hall, Washeteria, Clinic, Public Safety Office, Bunkhouse/Office, Water & Sewer Office, ANTHC Garage, Marina/Store, General Store, Kwigillingok School and 5 teacher housing units

**Village-Wide Lighting Retrofit Summary:**

- Retrofitted 151 light fixtures village-wide with electronic ballasts and T8 lamps
- Installed: 43 compact fluorescent light bulbs village-wide
- T5 Light fixtures were installed in the school gym
- Pre-retrofit energy use for all lighting: 20,011 watts
- Post-retrofit energy use for all lighting: 11,590 watts
- Energy savings projection: 8,421 watts (8.42 kW)
- **Pre-retrofit to post retrofit energy reduction: 42 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$3,958	636 Gallons	\$1,449
7 Hours	\$6,926	1,112 Gallons	\$2,536
10 Hours	\$9,895	1,589 Gallons	\$3,623

- Total project cost for all measures: \$ 37,250
- Simple mean payback\*: 5.38 Years
- Total village wide in-kind contribution: \$ 7,571

\*(All grant funds, but accounting for lighting savings only)

**Additional Energy Efficiency Measures:** (Budget Expense: \$ 4,954)

- 16 hour energy efficiency boiler training for 1 local maintenance staff – at Bethel regional Boiler training in March, 2006 (Classroom hours provided in-kind by ABSN).

## Kwigillingok IRA Owned Buildings

Energy efficient lighting upgrades were completed in four buildings owned by the Kwigillingok IRA Council.

### IRA owned Buildings - Lighting Retrofit Summary:

- Lighting upgrades completed in December 2006
- Retrofitted 73 linear fluorescent fixtures with T8 lamps and electronic ballasts
- Installed: 4 compact fluorescent light bulbs
- Pre-retrofit energy use for all lighting: 6,668 watts
- Post-retrofit energy use for all lighting: 4,762 watts
- Energy savings projection: 1,906 watts (1.91 kW)
- **Pre-retrofit to post retrofit energy reduction: 29 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$896	144 Gallons	\$328
7 Hours	\$1,568	252 Gallons	\$574
10 Hours	\$2,240	360 Gallons	\$820

### Community Hall/Offices



Materials Installed	2-Lamp Ballasts 32w lamps	2-Lamp Fixtures 3-lamp ballasts 32w lamps	4-Lamp Ballasts 25w lamps	13w CFL	20w CFL	25w CFL
<b>Community Hall/Offices</b>	22	0	0	0	0	0

- Pre-retrofit energy use: 1,780 watts
- Post-Retrofit Energy Use: 1,320 watts
- Energy savings projection: 460 watts (.46 Kw)
- **Pre-retrofit to post retrofit energy reduction: 26 %**

• **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$216	35 Gallons	\$79
7 Hours	\$378	61 Gallons	\$139
10 Hours	\$541	87 Gallons	\$198

**Washeteria**



Materials Installed	2-Lamp Ballasts 32w lamps	2-Lamp Fixtures 3-lamp ballasts 32w lamps	2-Lamp Fixtures 3-lamp ballasts 25w lamps	4-Lamp Fixtures 3-lamp ballasts 25w lamps	4-Lamp Ballasts 25w lamps	13w CFL	20w CFL	25w CFL
<b>Washeteria</b>	0	8	3	0	0	0	4	0

- Pre-retrofit energy use: 1,258 watts
- Post-Retrofit Energy Use: 765 watts
- Energy savings projection: 493 watts (.49 Kw)
- **Pre-retrofit to post retrofit energy reduction: 39 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$232	37 Gallons	\$85
7 Hours	\$405	65 Gallons	\$148
10 Hours	\$579	93 Gallons	\$212

## Clinic



Materials Installed	2-Lamp Ballasts 25w lamps	4-Lamp Ballasts 25w lamps	13w CFL	20w CFL	25w CFL
<b>Clinic (New)</b>	11	14	0	0	0

- Pre-retrofit energy use: 2,340 watts
- Post-Retrofit Energy Use: 1,777 watts
- Energy savings projection: 563 watts (.56 Kw)
- **Pre-retrofit to post retrofit energy reduction: 24 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$236	38 Gallons	\$86
7 Hours	\$413	66 Gallons	\$151
10 Hours	\$590	95 Gallons	\$216

Notes: Before the VEUEEM grants, the clinic had previously been retrofitted with electronic ballasts and 32 watt T8s. Local maintenance staff were able to save an additional 24% energy cost by simply replacing all lamps with Phillips 25 watt, high-phosphor T8 lamps. Before lamp replacement we found the clinic to be fairly poorly lit because a good share of the original T8 lamps were burned out. Ceiling height was not beyond 8' and with all new 25 watt T8s light levels increased throughout the clinic following lamp replacement.

## Public Safety Office

Materials Installed	2-Lamp Ballasts 32w lamps	2-Lamp Ballasts 25w lamps	4-Lamp Ballasts 25w lamps	13w CFL	20w CFL	25w CFL
<b>Public Safety Building</b>	15	0	0	0	0	0

- Pre-retrofit energy use: 1,290 watts
- Post-Retrofit Energy Use: 900 watts
- Energy savings projection: 390 watts (.39 Kw)
- **Pre-retrofit to post retrofit energy reduction: 30 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$183	29 Gallons	\$67
7 Hours	\$321	52 Gallons	\$117
10 Hours	\$458	74 Gallons	\$168

## Kwigillingok ANTHC Owned Buildings

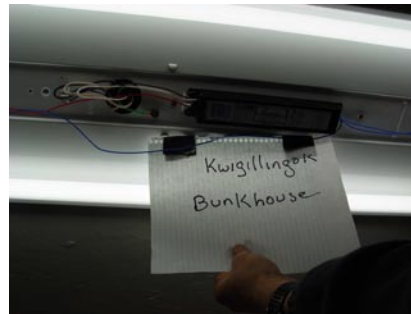
Energy efficient lighting upgrades were completed in two buildings owned by the ANTHC.

### ANTHC owned Buildings - Lighting Retrofit Summary:

- Lighting upgrades completed in December 2006
- Retrofitted 43 linear fluorescent fixtures with T8 lamps and electronic ballasts
- Pre-retrofit energy use for all lighting: 5,433 watts
- Post-retrofit energy use for all lighting: 2,732 watts
- Energy savings projection: 2,701 watts (2.70 kW)
- **Pre-retrofit to post retrofit energy reduction: 50 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$1,269	204 Gallons	\$465
7 Hours	\$2,222	357 Gallons	\$814
10 Hours	\$3,174	510 Gallons	\$1,162

### ANTHC Office and Bunkhouse



Materials Installed	3-Lamp Ballasts 32w lamps	2-Lamp Fixtures 3-lamp ballasts (2) 25w lamps	13w CFL	20w CFL	25w CFL	2-foot 2-lamp T8 fixture
Office and Bunk House	0	20	0	0	0	1

- Pre-retrofit energy use: 3,099 watts
- Post-Retrofit Energy Use: 1,136 watts
- Energy savings projection: 1,936 watts (1.96 Kw)
- **Pre-retrofit to post retrofit energy reduction: 63 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$923	148 Gallons	\$338
7 Hours	\$1,615	259 Gallons	\$591
10 Hours	\$2,307	370 Gallons	\$845



Notes: The ANTHC Bunkhouse saw 63% savings when 20 4-lamp fixtures went from an existing energy use of 150 watts/fixture down to 55 watts each through use of (2) 25-watt T8 lamps and 3-lamp ballasts.

### Water and Sewer Building



Materials Installed	3-Lamp Ballasts 32w lamps	3-Lamp Ballasts (3) 32w lamps	2-Lamp Ballasts 25w lamps	4-Lamp Ballasts 25w lamps	13w CFL	20w CFL	25w CFL	2-foot 2-lamp T8 fixture
<b>Water &amp; Sewer Building</b>	6	10	0	0	0	0	0	6

- Pre-retrofit energy use: 2,334 watts
- Post-Retrofit Energy Use: 1,596 watts
- Energy savings projection: 738 watts (.74 Kw)
- **Pre-retrofit to post retrofit energy reduction: 32 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$347	56 Gallons	\$127
7 Hours	\$607	97 Gallons	\$222
10 Hours	\$867	139 Gallons	\$318

Notes: Strategic de-lamping and various lamp and ballast combinations achieved a balance of good light and energy savings.

## Kwigillingok Village Corporation Owned Buildings

Energy efficient lighting upgrades were completed in two buildings owned by the Kwigillingok Village Corporation

### Village Corporation owned Buildings - Lighting Retrofit Summary:

- Lighting upgrades completed in December 2006
- Retrofitted 30 linear fluorescent fixtures with T8 lamps and electronic ballasts
- Installed: 1 compact fluorescent light bulbs
- Pre-retrofit energy use for all lighting: 2,680 watts
- Post-retrofit energy use for all lighting: 1,690 watts
- Energy savings projection: 990 watts (.99 kW)
- **Pre-retrofit to post retrofit energy reduction: 37 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$465	75 Gallons	\$170
7 Hours	\$814	131 Gallons	\$298
10 Hours	\$1,163	187 Gallons	\$426

### Marina/Store



Materials Installed	2-Lamp Ballasts 32w lamps	4-Lamp Ballasts 32w lamps	2-Lamp Ballasts 25w lamps	4-Lamp Ballasts 25w lamps	13w CFL	20w CFL	25w CFL
Marina / Store	4	0	0	0	0	0	0

- Pre-retrofit energy use: 396 watts
- Post-Retrofit Energy Use: 240 watts
- Energy savings projection: 156 watts (.16 Kw)
- **Pre-retrofit to post retrofit energy reduction: 39 %**

- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$73	12 Gallons	\$27
7 Hours	\$128	21 Gallons	\$47
10 Hours	\$183	29 Gallons	\$67

### General Store

Materials Installed	2-Lamp Ballasts 32w lamps	2-Lamp Fixtures 3-lamp ballasts 25w lamps	4-Lamp Fixtures 3-lamp ballasts 25w lamps	4-Lamp Ballasts 25w lamps	13w CFL	20w CFL	25w CFL
General Store	0	26	0	0	0	1	0

- Pre-retrofit energy use: 2,284 watts
- Post-Retrofit Energy Use: 1,450 watts
- Energy savings projection: 834 watts (.83 Kw)
- **Pre-retrofit to post retrofit energy reduction: 37 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$392	63 Gallons	\$144
7 Hours	\$686	110 Gallons	\$251
10 Hours	\$980	157 Gallons	\$359

Notes: Forty-watt T12 lamps in 2-lamp fixtures were in use in the General Store which has a ceiling height of 10 feet. Maintenance staff retrofitted with 25-watt T8s and 3-lamp ballasts to meet light levels and achieve good energy savings.



## Lower Kuskokwim School District Owned Buildings - Kwigillingok School

Energy efficient lighting upgrades were completed in five teacher housing units owned by LKSD.

### School owned Buildings - Lighting Retrofit Summary:

- Lighting upgrades completed in November 2006
- Retrofitted 5 linear fluorescent fixtures with T8 lamps and electronic ballasts
- Installed: 38 compact fluorescent light bulbs
- Pre-retrofit energy use for all lighting: 5,230 watts
- Post-retrofit energy use for all lighting: 2,406 watts
- Energy savings projection: 2,824 watts (2.82 kW)
- **Pre-retrofit to post retrofit energy reduction: 54 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$1,327	213 Gallons	\$486
7 Hours	\$2,323	373 Gallons	\$851
10 Hours	\$3,318	533 Gallons	\$1,215

### Teacher Housing

School Buildings	2-Lamp Ballasts 32w lamps	13w CFL	20w CFL	25w CFL
<b>Fixture TOTALS</b>	5	11	16	11

- Pre-retrofit energy use: 3,370 watts
- Post-Retrofit Energy Use: 1,038 watts
- Energy savings projection: 2,332 watts (2.33 Kw)
- **Pre-retrofit to post retrofit energy reduction: 69 %**
- **Estimated Annual Savings:**

Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$1,096	176 Gallons	\$401
7 Hours	\$1,918	308 Gallons	\$702
10 Hours	\$2,740	440 Gallons	\$1,003

Notes: Since nearly all lighting retrofits were CFL replacements, comparative energy savings was substantial.

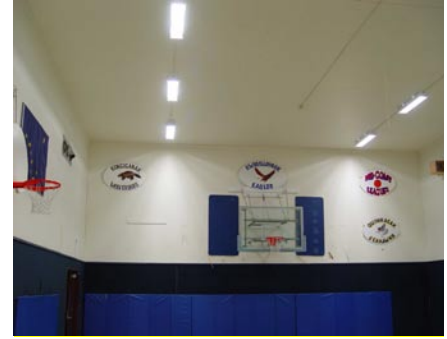
## High Output T5 Lighting Upgrades for the Kwigillingok Gym



Kwigillingok School



T5 light upgrades – all in-kind labor from LKSD.



Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use	Avoided Diesel Costs
4 Hours	\$231	37 Gallons	\$85
7 Hours	\$405	65 Gallons	\$148
10 Hours	\$578	93 Gallons	\$212

Notes: In gyms like Kwigillingok where existing light levels were marginal and energy use was already comparatively low (small number of 157 watt HPS fixtures) savings percentages decrease with use of T5s or any other lighting retrofit plan. LKSD still chose to proceed with upgrading the Kwigillingok school gym lighting with in-kind labor to achieve better light quality, reasonable savings, and standardization of gym lighting materials in their western Alaska schools.

**Kwigillingok School, T5 Lighting Upgrade Details - ABSN Energy Efficiency Projects '05-'06**

These retrofits will be completed during the '07 Summer recess.

Kwigillingok Gym	Length (feet)	Width (feet)	Ceiling Hieght (feet)	# of Existing Fixtures	Existing Fixture Watts	Total Existing Watts	Existing Foot-candles	New Foot-Candles	# of New Fixtures	lamps / fixture	New Fixture Watts	Total New Watts
	61	36	20	12	155	1,860	33	?	12	2	114	1368

Total New wattage for gym = 26 % savings

**Savings & Payback Calculation for Gym:**

26.4516129

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

Full cost of electricity: \$0.47 /kWh

Watts of existing lighting: 1,860

New wattage for T5 fixtures: 1,368

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

Existing Cost: \$1,530

Retrofitted Cost: \$1,125

**Annual Savings: \$** \$405

Est material & shipping cost of Gym retrofit: \$3,024.10

**Simple Payback:** Materials cost / annual savings = **7.473002694** years (for retrofit to pay for itself in materials)

## Bethel Boiler Training at Yuut Elitnaurviat Learning Center, March 24 & 25, 2006



16 hours of classroom time at the Learning Center Shop



Blue plastic cases are Bacharach flu gas analyzer kits – taken back to villages by maintenance staff



Training on oil burner combustion efficiency

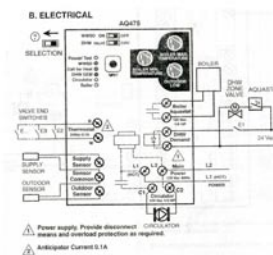
Kwigillingok maintenance staff: Benedict White traveled to Bethel March 24 and 25, 2006 to participate in this training. ABSN partnered with Bethel Community Services Association, YKHC's Yuut Elitnaurviat Learning Center and AVCP Housing Authority to provide ABSN's 16 hour boiler training course to 7 rural maintenance staff. Charlie Deer's training hours were covered by \$2,100 in matching funds from ABSN. AEA VEUEEM grant funds were used to cover air fair and lodging in Bethel for the following maintenance staff from this grant's villages: **Chefornak**: Bernard Mael, **Kongiganak**: John Phillip, **Kwigillingok**: Benedict White, **Mekoryuk**: Alvin David, **Quinhagak**: Norman Cleveland and Adolph Pleasant. Andrew Lind of Port Heiden (NW-SW Region VEUEEM grant) was also brought to Bethel for this class.



Components of a Bacharach Flu Gas Analyzing Kit used in boiler efficiency training and left with capable maint staff in their villages.



Smoke-test kit for analyzing flu gases for boiler efficiency



Schematic of outdoor temperature sensing boiler control

During this 16-hour course ABSN's boiler specialist Charlie Deer instructed maintenance staff in the fundamentals of boiler and fuel energy efficiency. Training topics covered: fuel, proper heating system sizing, testing boiler efficiency with a flu gas analyzer kit, cleaning and tuning boilers for energy efficiency, control options and proper control function, burner and nozzle components and function, outdoor temperature boiler controls, programmable thermostats, etc.

**Kwigillingok, In-Kind Contribution Tracking Record - ABSN Energy Efficiency Projects:**

Village entities worked with: Tribe, City, Village Corp, School District.

In-Kind Item	Dates	Hours Contributed	Hourly Wage	Value / Amount	Notes
Staff time for project contact, introduction, and review of intro materials (Number of entities x 1 hour each)		4	\$15.00	\$60.00	Hrs contributed column indicates # of entities we worked with in the village. \$15 / hr is our estimated average wage for local village staff: Tribal Administrators, City Clerks, Facilities Managers, maintenance staff, etc.
Staff time for Attending teleconference - all entities village-wide		12	\$15.00	\$180.00	Hrs contributed column indicates length of telecon multiplied by # of village telecon participants
Maintenance Labor - Fred Phillip - assist with PCB ballast survey	5/12/06	6	\$12.00	\$72.00	Fred Phillip - accompany FM on building walk-throughs - various entities, and PCB ballast survey
Maintenance Labor - Fred Phillip - assist with PCB ballast survey	10/6/06	8	\$12.00	\$96.00	Fred Phillip lighting counts, calls, receive and count lighting freight
<b>Village office administrative percentage of total project cost less ABSN Admin %.</b> Total project cost = \$37,250/village - (our admin percentage, (around 9%) Approx: \$3,352) = \$33,897 x 5% = \$1,694 (this 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 project support.	Jan '05 - Jan '07			\$1,694.00	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, etc. Village expenses for phone charges, copying and fax costs, office supplies, etc are part of this amount.
Lodging for ABSN Field Managers - all site visits				\$420.00	6 nights @ \$70/night
Transportation and fuel costs - all site visits				\$240.00	6 days 4-wheeler rental @ \$40/day
Payroll and bookkeeping costs		2	22	\$44.00	
LKSD School & teacher housing lighting upgrades	10/25/06	4	24.49	\$97.96	Maint Staff (Steve Evon) for Teacher Housing lighting upgrades. This was for (37) incandescents and (5) 2-lamp linear fluorescents in 5 teacher housing units.
LKSD School & teacher housing lighting upgrades		4	16.32	\$65.28	Maint Staff (Wassilie Andrew) for Teacher Housing lighting upgrades. This was for (37) incandescents and (5) 2-lamp linear fluorescents in 5 teacher housing units.
School T5 Gym lighting upgrades				\$4,500.00	Comparable estimate - In-kind labor, provided by school district - includes airfare & per diem and lodging.
Employer expense for Workman's Comp		2044	0.05	\$102.20	Generic multiplier: .05 x gross payroll of village labor
	TOTAL			\$7,571.44	