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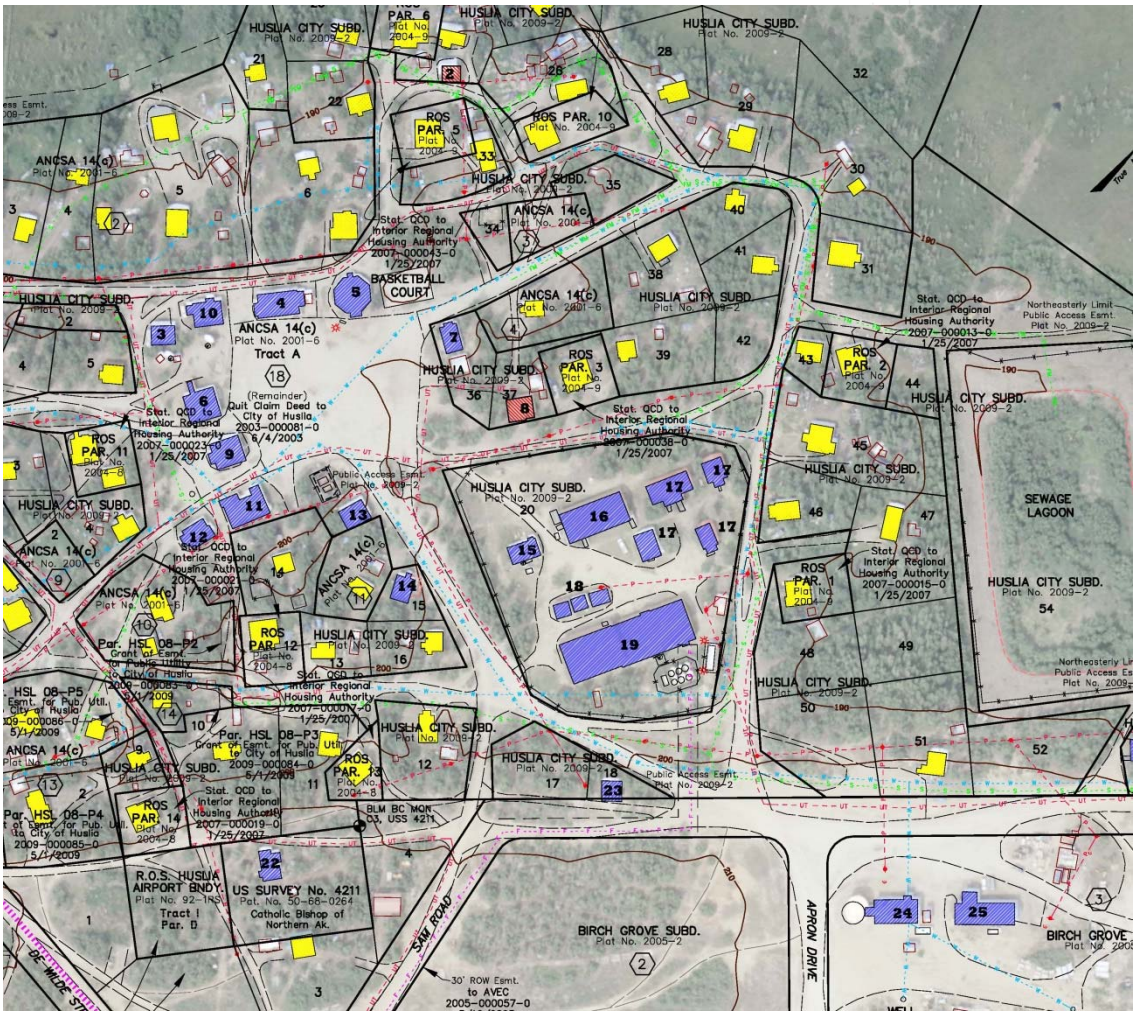

Investment Grade Energy Audit

Tribal Buildings in the Village of Huslia

Owner: The Huslia Village Tribal Council
Client: The Foraker Group/The Denali Commission

June 14, 2013
Project # DC-HSL-001-Tribal

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Energy Audits of Alaska

Project # DC-HSL-001-Tribal

Prepared for:

The Foraker Group
The Denali Commission

Subject Buildings:

Rose Ambrose Health Clinic
Tribal Office Building
Dakli Building
Old Environmental Office
Community Hall

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Disclaimers

This energy audit is intended to identify and recommend potential areas of energy savings, estimate the value of the savings and approximate the costs to implement the recommendations. Any modifications or changes made to a building to realize the savings must be designed and implemented by licensed, experienced professionals in their fields. Lighting recommendations should all be first analyzed through a thorough lighting analysis to assure that the recommended lighting upgrades will comply with State of Alaska Statute as well as Illuminating Engineering Society (IES) recommendations. Energy Audits of Alaska, LLC and Richard S. Armstrong, PE, LLC bear no responsibility for work performed as a result of this report.

Payback periods may vary from those forecasted due to the uncertainty of the final installed design, configuration, equipment selected, and installation costs of recommended EEMs, or the operating schedules and maintenance provided by the owner. Furthermore, EEMs are typically interactive, so implementation of one EEM may impact the cost savings from another EEM. Neither the auditor, Richard S. Armstrong, PE LLC, The Foraker Group, The Denali Commission or any other party involved in preparation of this report accepts liability for financial loss due to EEMs that fail to meet the forecasted payback periods.

This audit meets the criteria of an Investment Grade Audit per the Association of Energy Engineers definition, and is valid for one year. The life of the Investment Grade Audit may be extended on a case-by-case basis.

IGA's are the property of the Denali Commission and the Foraker Group.

AkWarm-C is a building energy modeling software developed under contract by the Alaska Housing Finance Corporation (AHFC).

List of Abbreviations used in this document

AFUE	Annual fuel utilization efficiency
BMG	Biomass generator
CFL	Compact florescent lamp
CFM	Cubic Feet per Minute
CMU	Concrete Masonry Unit (Cinder block)
DHW	Domestic Hot Water
ECI	Energy Cost Index
ECM	Energy Conservation Measure (no or low cost), also called O & M recommendations
EEM	Energy Efficiency Measure
EMCS	Energy Management Control Systems
EOL	End of Life
EUI	Energy utilization (or use) Index
F	degrees Fahrenheit
FC	Foot candles
Gal	Gallons
gpf	Gallons per flush
gpm	Gallons per minute
HID	High Intensity discharge
HPS	High Pressure Sodium
HRV	Heat Recovery Ventilator
HVAC	Heating Ventilation and Air Conditioning
IR	Infra-Red
K	degrees Kelvin
kW	Kilowatt
kWh	Kilowatt-hour
LED	Light emitting diode
MBH	1,000 BTU/hour
MMBTU	1,000,000 BTU
O & M	Operations and Maintenance
OC	On center (joists, studs and rafters)
OSA	Outside Air
PCE	Power Cost Equalization
PIR	Passive Infra-Red
PLMD	Plug Load Management Device
PSO	Public Safety Officer
PV	Photovoltaic
ROI	Return on Investment
SF	Square feet or Square foot
SIR	Savings to Investment Ratio
VPSO	Village Public Safety Officer
W	Watt
WTP	Water Treatment Plant

1.0 Executive Summary

Guidance to the reader:
The Executive Summary is designed to contain all the information the building owner/operator should need to determine how the subject building's energy efficiency compares with other similar use buildings, which energy improvements should be implemented, approximately how much they will cost and their estimated annual savings. The Executive Summary discusses the village as a whole (1.0), then each building (1.1, 1.2, 1.3 etc.), and at the end of the Executive Summary a table summarizes the savings, costs and payback for all recommended EEM's for all of the village buildings covered in this audit.

Sections 2, 3 and 4 of this report and the Appendices, are back-up and provide much more detailed information should the owner/operator, or their staff, desire to investigate further. To assist in navigation, all sections and subsections which appear in the Table of Contents are bold and underlined in the body of this report. Issues that the auditor feels are of particular importance to the reader are underlined.

Background:
This audit was funded by The Denali Commission under a contract issued by the Foraker Group to Richard S. Armstrong, PE, LLC. The Village of Huslia Tribal Council (a federally recognized tribal entity) and City of Huslia are in the process of design and construction of a Cordwood boiler (i.e. Biomass Boiler) using local labor to harvest local timber and generate heat for nearby buildings. They are seeking additional funding from the US Department of Energy to implement energy efficiency measures in the non-residential Tribal buildings included in this audit, prior to implementation of the Biomass Boiler.

This report # DC-HSL-001-Tribal includes the following facilities, which are in consideration for Biomass Heating (see map on next page):

A. Clinic (2657 SF)
B. Tribal Office (1624 SF)
C. Dakli Building (810 SF)
D. Old Environmental Office (775 SF)
E. Community Hall (1374 SF)

In the interest of optimizing the auditor's time, leveraging travel costs and bringing as much value to the village as possible, certain non-tribal buildings were also audited. Findings and the report for these facilities are found in report # DC-HSL-001-City.

F. City office (1336 SF)
G. Washeteria –Water Treatment Plant (2096 SF)
H. Head Start Building (1453 SF)
I. Village Street lights
J. Airport runway lights

Building(s) Owner:
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Huslia, AK 99746
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Grantor funding these audits:
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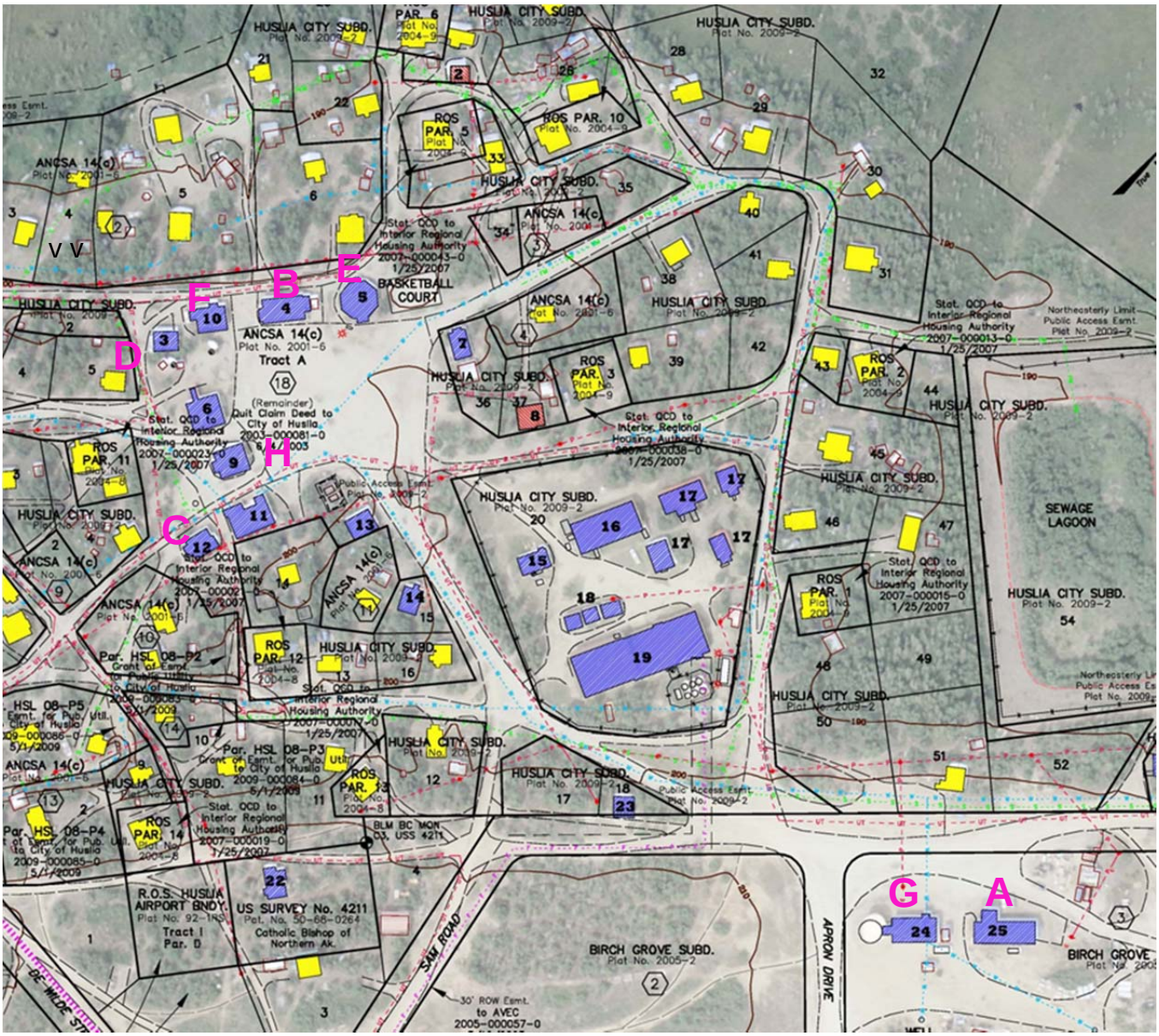
The Huslia Tribal Village



NORTH

Huslia is a remote village of approximately 309 people, located on the west side of the Koyukuk River, about 200 miles east and north of Fairbanks. The older buildings in the village are constructed of logs, while the newer units are generally stud-wall construction.

Water and sewer lines now service most buildings in the village, and both the clinic and water treatment plant, which also houses the washeteria, have been built in the last 5 years.

Purpose and Nature of this Audit:

The purpose of this energy audit is to identify cost-effective system and facility modifications, adjustments, alterations, additions and retrofits. Systems investigated during the audit included HVAC, interior and exterior lighting, motors, building envelope, and energy management control systems.

This is an Investment Grade Audit, also called an IGA. An IGA is defined as a technical and economic analysis of potential energy saving projects in a facility. The analysis must provide information on current energy consuming equipment, identify technically and economically feasible EEMs for existing equipment and provides the client with sufficient information to judge the technical and economic feasibility of the recommended EEMs. The ECM's identified in this audit, although they have the potential to save significant consumption and cost, are not part of the technical and economic analysis; only the EEM's are include in the cost and savings calculations in this audit.

Site Survey conditions:

The site visit to this building occurred on the 29th and 30th of May 2013. The outside ambient temperature varied between 52F in the morning and 76F in the afternoon. The relative humidity varied from 30% to 35%. The weather was clear and sunny.

Other Renewable energy opportunities:

None of the buildings audited have south facing roof orientations which would be suitable for mounting PV panels.

PCE Adjustment

The State of Alaska created a power cost equalization program to provide economic assistance to customers in rural Alaska where the cost per kWh of electricity can be up to 8 times higher than the cost in more urban areas of the state. The PCE adjustment is determined periodically by the Alaska Energy Authority. The PCE discount on a village's electric bill can reduce the cost of electricity by a significant amount, which can vary from 30% to 60% or more each year.

An interesting and somewhat disturbing consequence of the PCE discount is that some EEM's will save kWh of electricity but result in a higher cost to the building owner. Because of the high cost of fuel oil in Huslia, the savings resulting from incorporation of the recommended EEM's, using the PCE-discounted electric

cost, is less than the savings using the higher, true cost of electricity. This counter-intuitive situation is explained in more detail following Figure 17 below.

For an investment grade audit in Alaska, the auditor must determine which kWh cost to use in savings calculations. The non-discounted electric rate reflects the true cost of electricity, while the PCE-discounted rate reflects the actual cost to the building owner, with the State of Alaska contributing the difference. In this audit, after discussion with the Denali Commission, the true cost of electricity is used to calculate savings, i.e. the non-PCE-discounted rate per kWh. All cost per kWh figures and all savings figures in this document have been calculated based on the true cost of power.

There is one instance (for each building) in this document where EEM savings are shown using both the true cost and the PCE-discounted cost of power. For each building, a comparison table is provided immediately after the EEM Summary table at the end of Sections 1.1, 1.2, 1.3, etc. These tables show the total building savings for EEM's using both the true cost and the PCE discounted rate for a kWh of power.

Overall Energy Consumption of Tribal Buildings

These buildings utilize either fuel oil and/or wood for heating. Electricity is generated by the village power plant. Fuel oil is either barged or flown in.

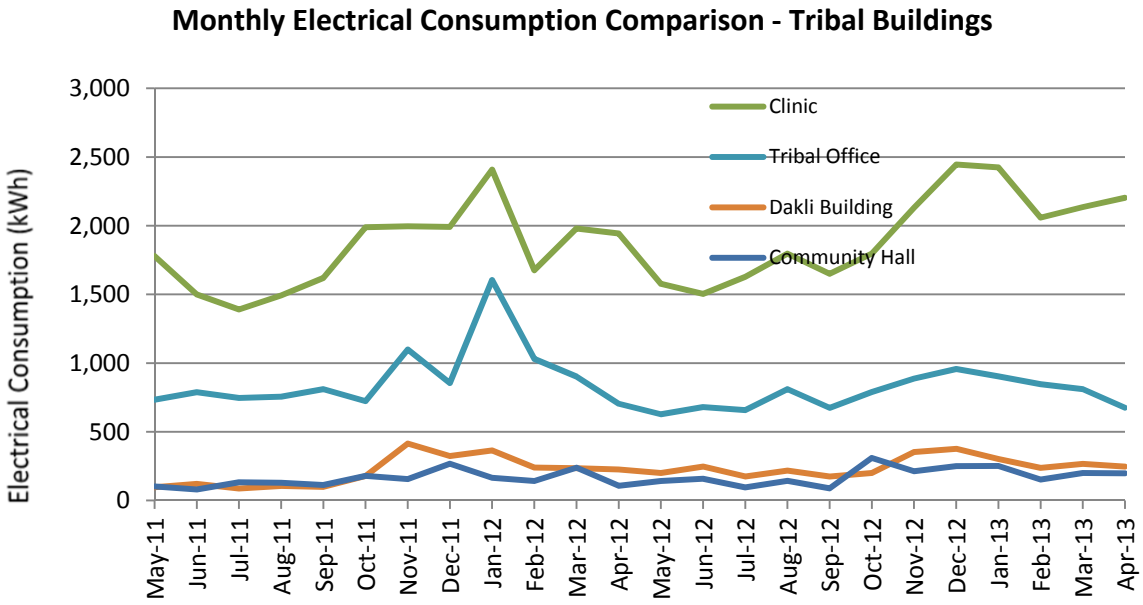
24 months of fuel oil and electrical consumption data was provided by the City of Huslia and tribal personnel. The benchmark period is from May 2011 through April 2013. This raw data is found in Appendix F.

Figure 1 – Average annual consumption & costs by building

2 year average			
		Consumption	Cost
Clinic	Electricity (kWh)	22,560	$13,563
	Fuel Oil (gallons)	11,690	$81,832
	Building total		$95,395
Tribal Office	Electricity (kWh)	10,037	$6,034
	Fuel Oil (gallons)	1,508	$10,555
	Building total		$16,589
Dakli Building	Electricity (kWh)	2,745	$1,650
	Fuel Oil (gallons)	1,908	$13,355
	Building total		$15,005
Old Environmental Office	Electricity (kWh)	Under Construction since mid-2011	
	Fuel Oil (gallons)		
	Building total		$0
Community Center	Electricity (kWh)	2,008	$1,207
	Fuel Oil (gallons)	est 515	$3,605
	Building total		$4,812

Source: Tribal staff and the City of Huslia

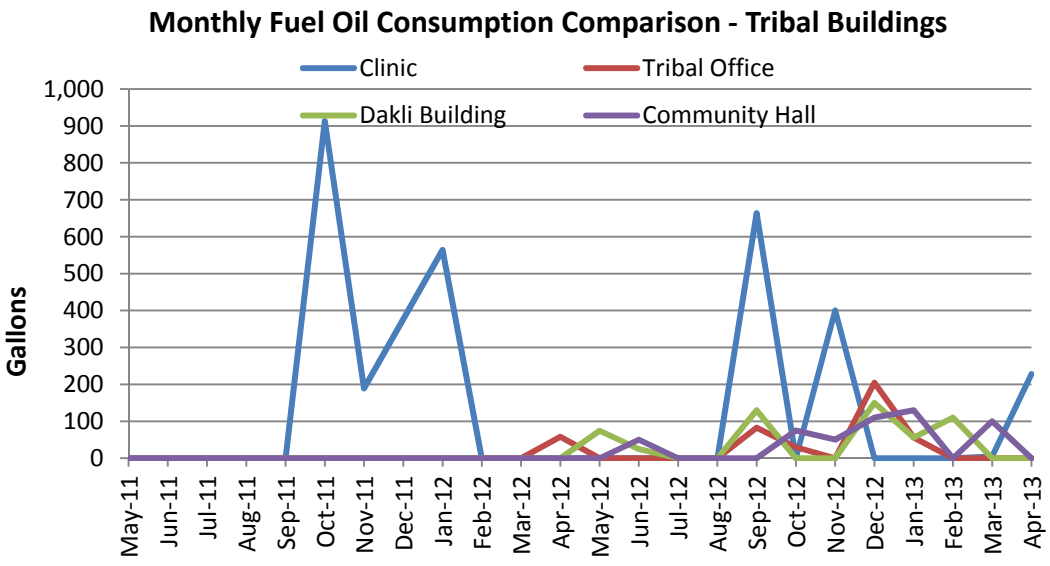
Figure 2 – Electric Consumption



The electrical data for the Dakli building and community hall appears to be consistent and reasonable, as would be expected when electricity is not used for heating or DHW. The Tribal office and Clinic have notable anomalies in January of 2012 and the Clinic more so than the Tribal office, in December of 2012 and January of 2013.

All the buildings increase slightly in the winter months, most likely attributed to longer hours of darkness and more use of lighting. But the Tribal office and Clinic are exceptional, and the Clinic repeats the following year. On-site personnel did not know why these spikes occurred. The auditor is presuming that there is an event(s) in January each year occurring at the Clinic, but has no explanation for the single peak in the Tribal office consumption.

Figure 3 – Fuel Oil consumption



Typically, fuel oil data is less reliable, as it depends on a person's recording accuracy and precision during fuel deliveries, and requires that the tank be filled each time. This does not occur in Huslia (or almost any other community) and unless there is a cumulative flow meter which is consistently read each month, actual monthly consumption is impossible to determine. What this auditor normally does is to normalize the annual fuel amount into a reasonable seasonal curve in order to determine monthly consumption.

In the case of the Community center, there is no tracking of fuel oil usage at all, the Clinic's fuel oil EUI is on par with the other villages with average EUI's and well below the outliers (Hughes and Shaktoolik). The Huslia washeteria has the lowest EUI among all the villages – this makes sense as it is almost a brand new building, with state of the art systems. issues are explored in more detail in Sections 1.1 and 1.5 below. The extremely high Clinic consumption will skew the EUI comparison charts below.

When an annual amount is estimated, or there are only a few deliveries, the auditor normalizes the annual amount into the seasonal curves shown in Sections 1.1 through 1.5 below.

Figure 4

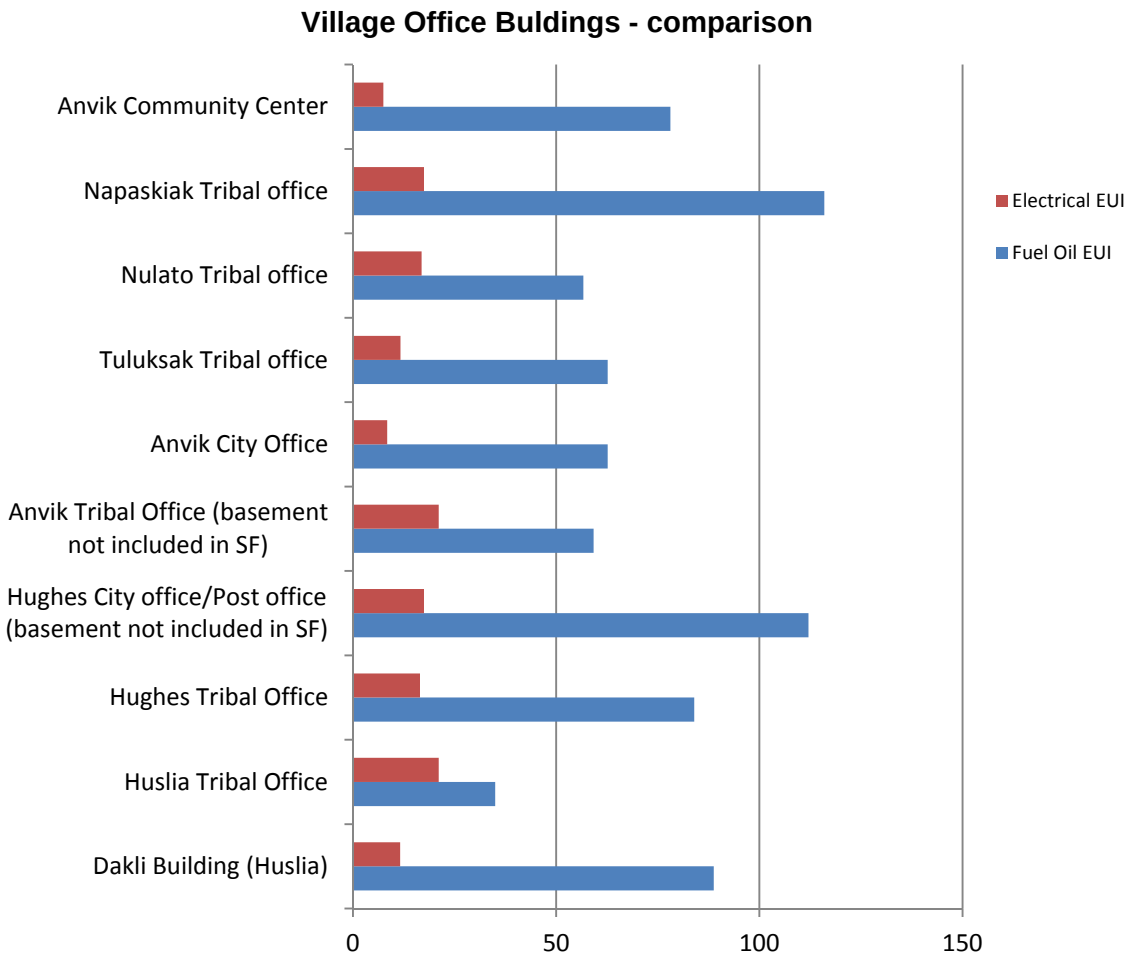


Figure 5 - Clinics

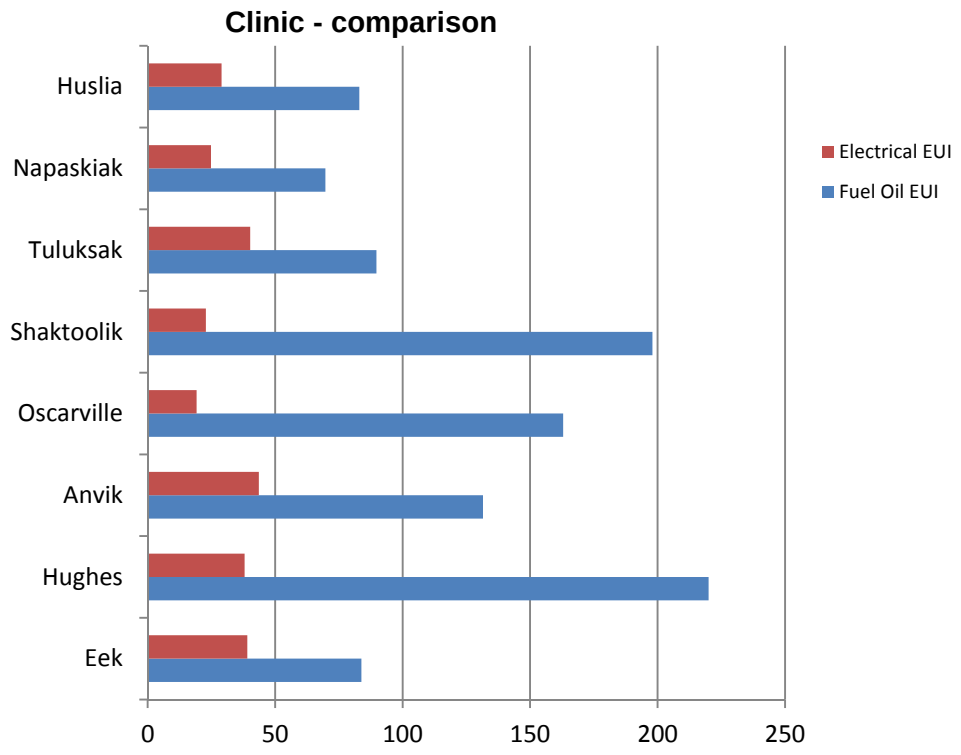
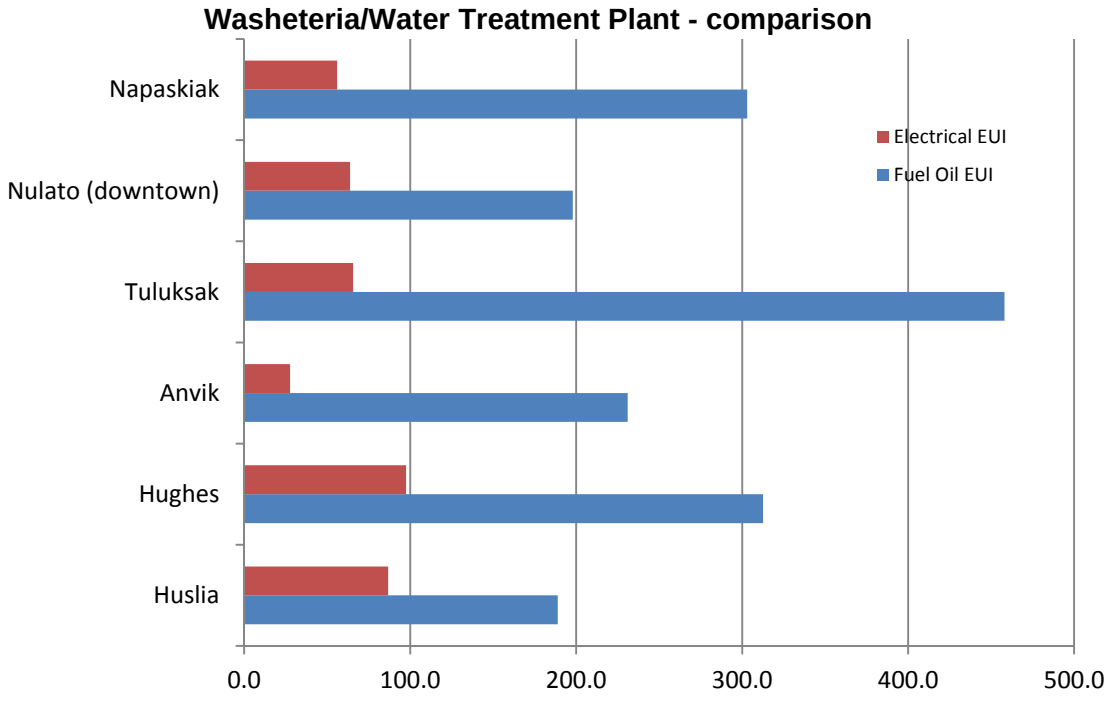


Figure 6 – Washeterias/Water Treatment Plants



Benchmarking

A benchmark measure of energy use relative to other similar function buildings in the area is the Energy Use Index (EUI), which takes the total annual energy used by the facility divided by the square footage area of the building, for a value expressed in terms of kBTU/square foot (SF). This number can then be compared to other buildings to see if it is average, higher or lower than similar-use buildings in the area. Likewise, the Energy Cost Index (ECI) is the cost of all energy used by the building expressed in $/SF of building area.

Figure 7 – Electric EUI and ECI

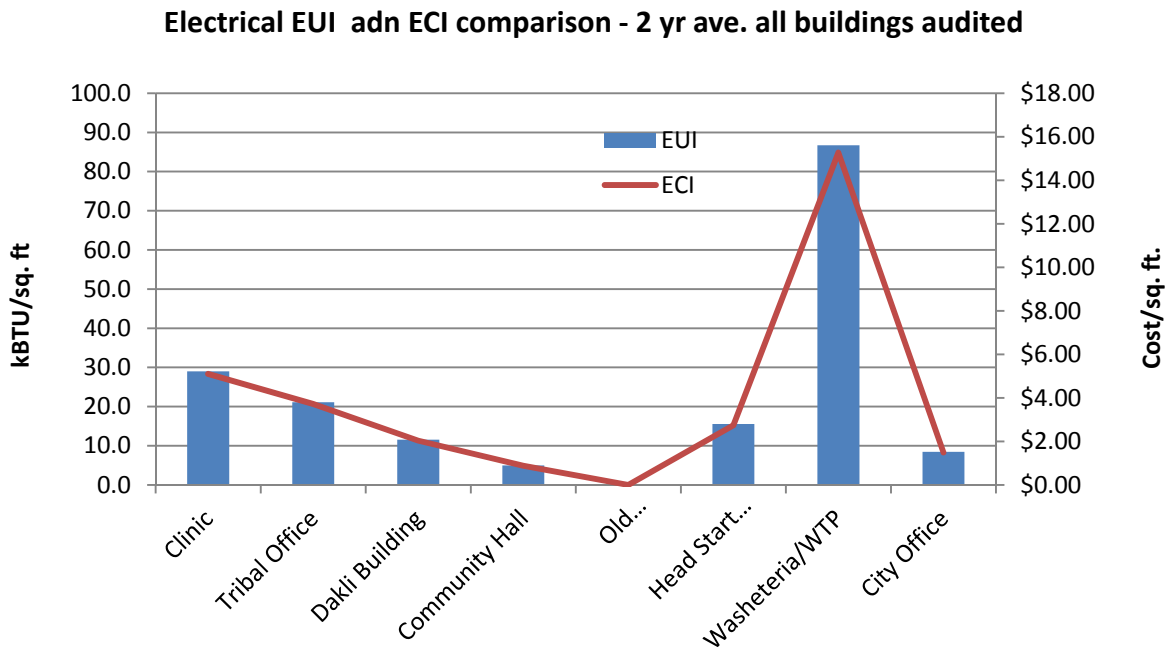


Figure 8 – Fuel oil EUI and ECI

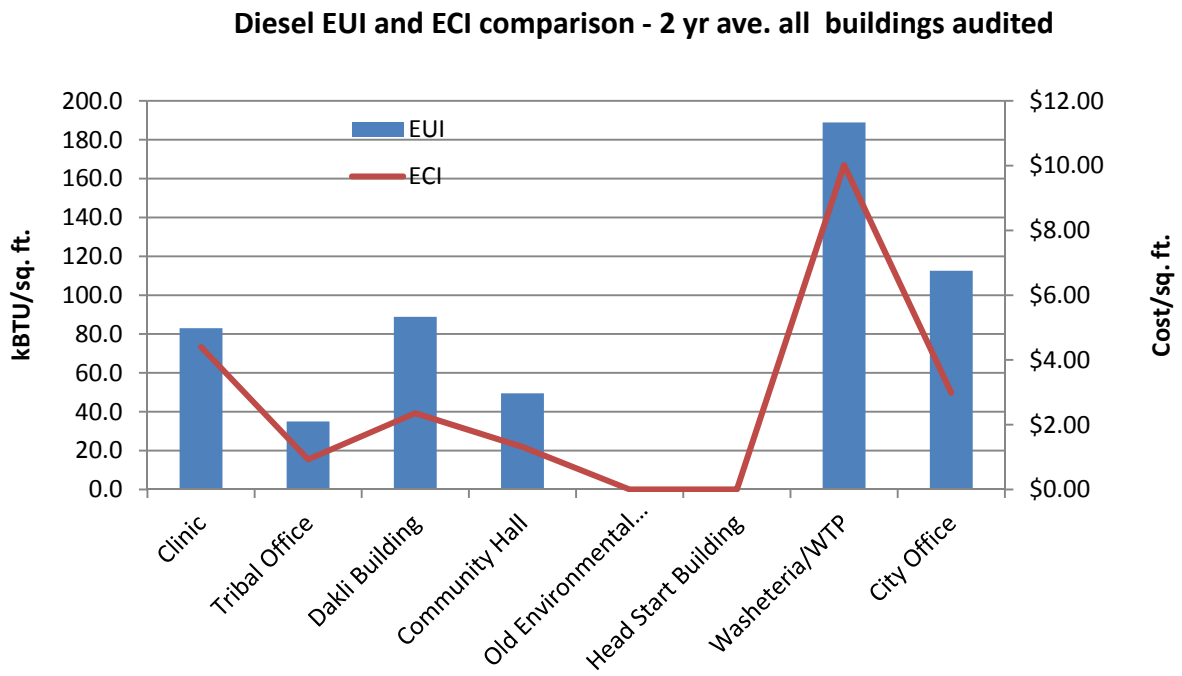


Figure 7 indicates that the Washeteria has excessive electrical and fuel oil consumption per square foot, when compared the other village buildings. But typically, the washeteria/water treatment plant has the highest EUI in a village and when Huslia's washeteria is compared with other villages in Figure 6 above, it is clear that Huslia's washeteria is the most efficient.

For benchmarking purposes, Figure's 4, 5 and 6 are much more informative and of more value than Figures 7 and 8. These figures give a clear picture that with the exception of the Dakli building's fuel oil EUI, Huslia's buildings are quite efficient. The Dakli building's high EUI will be discussed in more detail later ion this report.

The relative costs of electricity and fuel oil in Alaska are shown in Figure 9 below.

Figure 9 – Costs of energy

	Fuel Oil		Electricity (sm. Commercial)		Cord Wood	
	$/gallon	$/MMBTU	$/kWh	$/MMBTU	$/cord	$/MMBTU*
Hughes	$9.00	$68.18	$0.71	$208.03	$400	$23.53
Anvik	$6.00	$45.45	$0.56	$164.08	$300	$17.65
Koyukuk	$6.50	$49.24	$0.95	$278.35	$250	$14.71
Huslia	$6.00	$45.45	$0.51	$149.43	$350	$20.59
Anchorage	3.98	$30.15	$0.11	$32.23		
Fairbanks	3.98	$30.15	$0.21	$61.53		

Sources: Alaska Fuel price report, January 2013; AkWarm-C; Village personnel; Preliminary Feasibility Assessment, Biomass Energy Village of Hughes, Dalson Energy, 2012; Alaska DNR "Purchasing Firewood in Alaska"

Points of reference: 1 MMBTU = 1 million BTU; average Alaska Railbelt residence uses 620 MMBTU/yr; average Rural Alaska residence uses 300 MMBTU/yr. Source: Alaska Energy Authority at 2013 Rural Energy Conference

Energy Efficiency Measures

Various Energy Efficiency Measures (EEMs) have been analyzed for each building to determine if they would provide energy savings with reasonably good payback periods. EEMs are recommended for reasons including:

1.) they have a reasonably good payback period
2.) for code compliance
3.) end of life (EOL) replacement
4.) reasons pertaining to efficient building management strategy, operations, maintenance and/or safety

All the EEMs considered for this facility are detailed in Appendix B, C and D. Each EEM includes payback times, estimated installation costs and estimated energy savings.

The summary EEM's that follow are the only EEM's that are recommended for each building. Others have been considered (See Appendix D) but are not justified or cost effective. The recommended EEM's were selected based on consideration from four perspectives, in order of decreasing importance:

1. Total costs of all EEM's must fit within the $50,000 grant budget
2. Return on investment (ROI), i.e. short payback period
3. Reduction in amount of energy consumed
4. Overall efficiency of building management

Efficient building management dictates, as an example: that all lights be upgraded at the same time, that lamp inventory for a building be limited to a single version of a 28 watt or 25 watt T8 florescent tube, and that all appropriate rooms have similar occupancy controls and setback thermostats - despite the fact that a single or several rooms may have an unjustifiably long payback on their individual lighting or controls upgrade.

Note in the recommended EEM's in Appendix B that, depending on the light levels in the building, the auditor chooses either a 28 watt or 25 watt tube for the entire building.

Summary of Existing and Proposed energy consumption, reduction, costs and savings for each building:

Figure 10

Clinic	Existing conditions		Proposed Conditions			Effective reduction in building energy consumption
		kBTU	with EEM's	Avoided consumption from ECM's	Total kBTU of consumption	
kWh	22,568	77,025	19,075	2,018	58,216	24.1%
Gallons oil	1,669	220,308	1,644	376	167,392	
Total Building Energy Cost	$25,253		$22,973			

Figure 11

Tribal Council Office	Existing conditions		Proposed Conditions			Effective reduction in building energy consumption
		kBTU	with EEM's	Avoided consumption from ECM's	Total kBTU of consumption	
kWh	10,042	34,273	8,182	931	24,748	45.6%
Gallons oil	431	56,892	345	157	24,842	
Total Building Energy Cost	$9,052		$7,332			

.

Figure 12

Dakli Building	Existing conditions		Proposed Conditions			Effective reduction in building energy consumption
		kBTU	with EEM's	Avoided consumption from ECM's	Total kBTU of consumption	
kWh	2,742	9,358	1,706	307	4,775	46.8%
Gallons oil	546	72,072	527	235	38,544	
Total Building Energy Cost	$5,468		$4,712			

Old Environmental Office - No EEM's or ECM's

Figure 13

Community Hall	Existing conditions		Proposed Conditions			Effective reduction in building energy consumption
		kBTU	with EEM's	Avoided consumption from ECM's	Total kBTU of consumption	
kWh	2,033	6,939	1,593	159	4,894	30.6%
Gallons oil	515	67,980	474	117	47,124	
wood (cords)	0.45	8.1	0.41	0	0.72	
Total building energy cost	$4,981		$4,422			

The remaining sections in this executive summary (Sections 1.1, 1.2, 1.3 and 1.4) contain the following information for each building::

- Noteworthy conditions
- Suitability for Biomass heating
- Evaluation of consumption and benchmark data
- No-cost and low-cost Operations and Maintenance recommendations, commonly called Energy Conservation Measures (ECM's)
- Summary of recommended EEM's
- Savings comparison using the true cost vs. PCE-discounted cost of power

1.1 Rose Ambrose Health Clinic

Noteworthy conditions

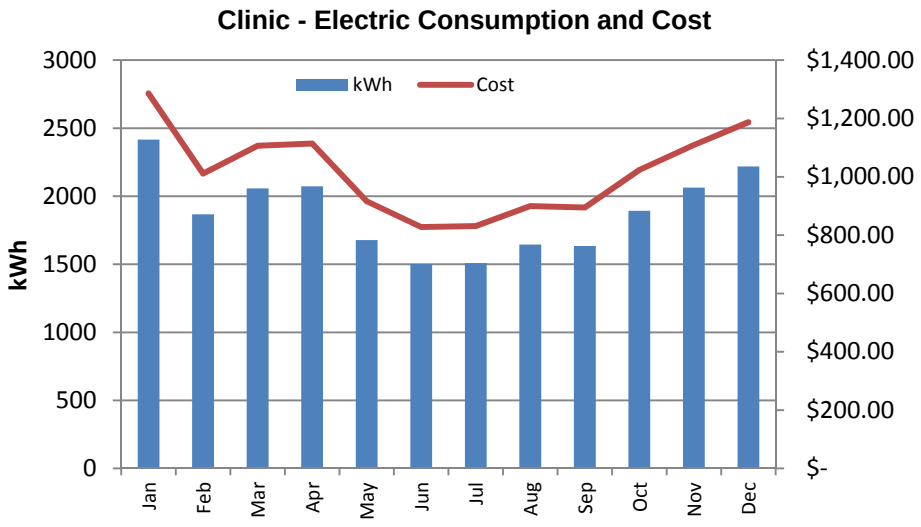
This is a relatively new building (2006) that remains in excellent condition. There is a significant amount of medical and dental equipment in the building, contributing to high plug loads. It was warm in the building during the audit, but that could be attributed to the 70F outside temperature. No one in the facility, including the maintenance person, understands certain aspects of the HVAC system including the HRV, the wireless digital thermometers (see Appendix A.1) and which wall thermometer goes to which heating elements.

Suitability for Biomass heating

This building utilizes a hydronic boiler, fintube baseboard radiators in the conditioned zones and in the insulated crawl space. From the perspective of this building's HVAC system, biomass-heated glycol could supply heat through the existing hydronic system without substantial modification. This assumes the biomass boiler supplies high quality heat (190F glycol) and is sufficiently close to this building to prevent excessive head and thermal losses. The HVAC schematic in Appendix I shows how a glycol loop from the biomass boiler might integrate with this building's HVAC system.

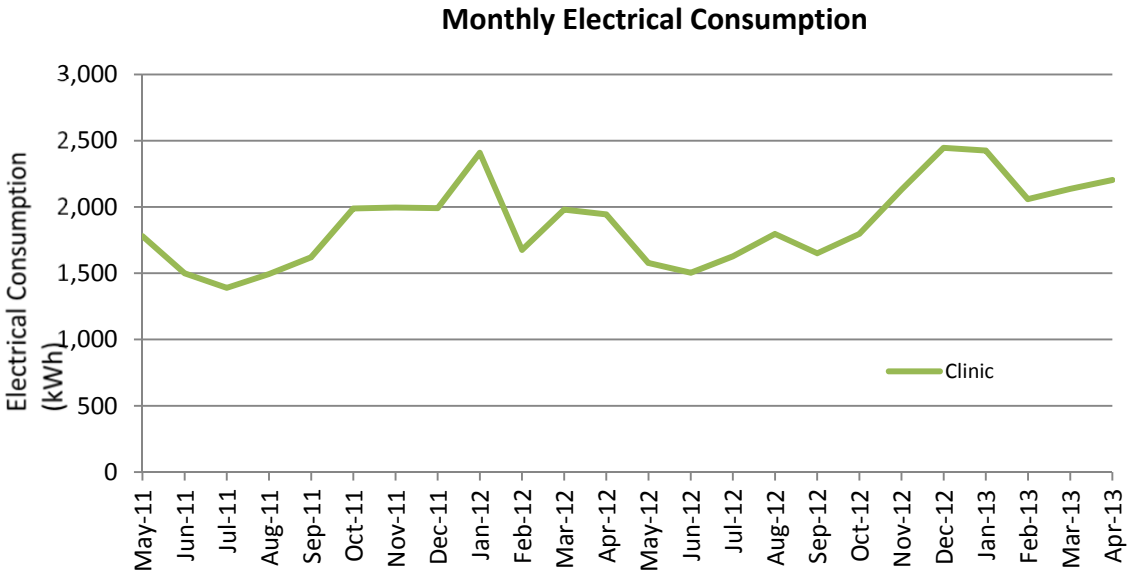
Evaluation of Energy Consumption and benchmark data

Figure 14 – 2 year average electric



The electric consumption and costs for this building, when averaged across 2 years, as shown in Figures 14 and 15 show two relatively anomalies. The first in January 2012 and the second in December of 2012 and January of 2013. Most of the other buildings in this village have the same spike in consumption in January of 2012, which would indicate that it is a weather related increase in fan energy of the boilers, pumps and fans.

Figure 15 – 24 Months electric



The fuel oil consumption for this building was received in 6 deliveries over 24 months. The monthly consumption shown in Figure 16 below has been seasonally normalized by the auditor, so the monthly distribution is not based on actual monthly consumption.

Figure 16 – 2 year average fuel oil

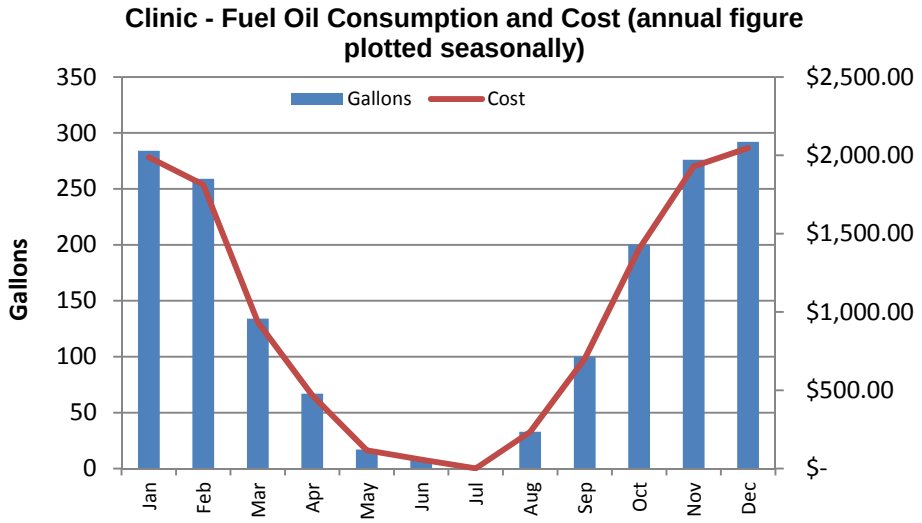


Figure 17 shows the monthly deliveries over a 2 year period. There is little in the way of insight or conclusions that can be drawn from either of these consumption charts.

Figure 17

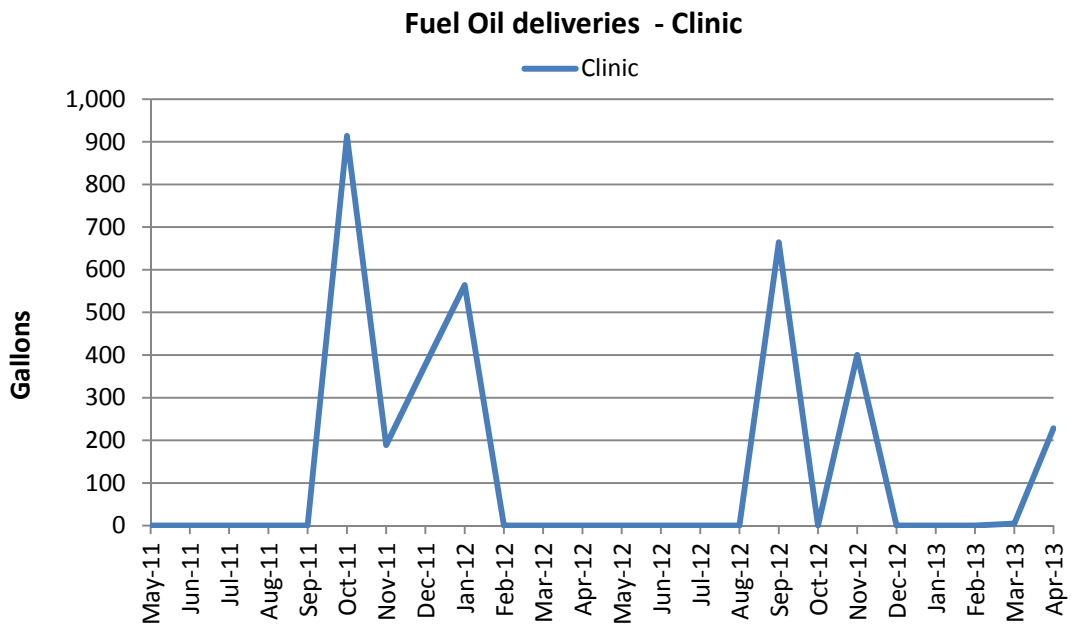
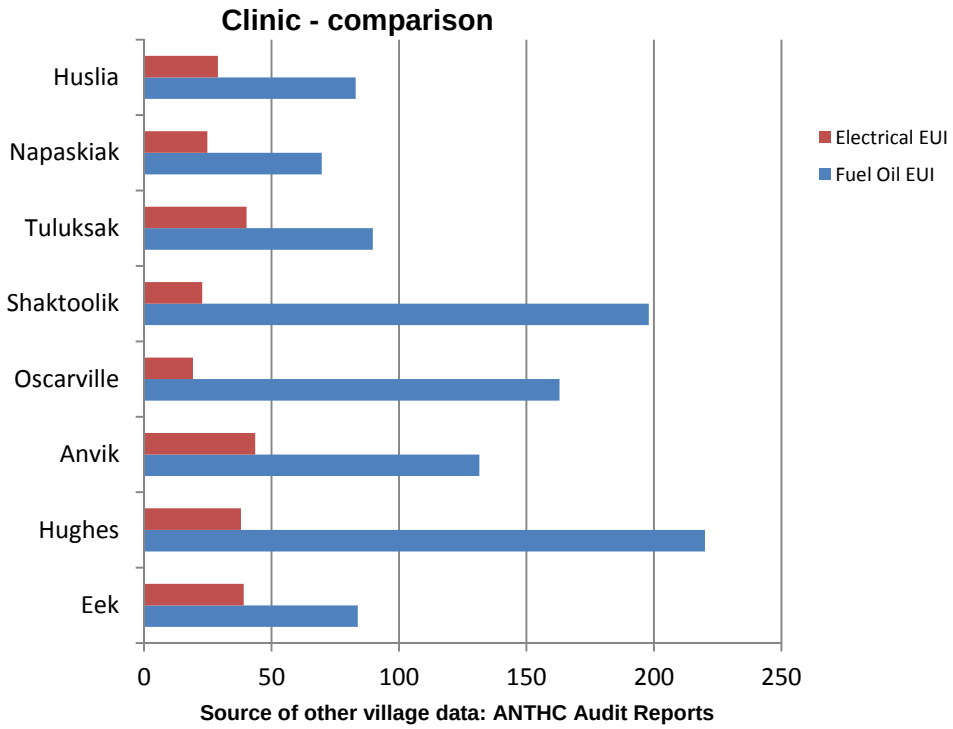


Figure 18



EUI comparison
Both the electrical and fuel oil EUI's of this clinic fall right into the average of the EUI's of other villages.

<u>Recommended no and low-cost ECM's</u>
Figure 19, below, summarized no- and low-cost EEM's for this building. The estimated annual energy cost savings are actually avoided costs. Avoided costs are energy expenses that are likely to occur if the ECM's are not implemented. They were calculated by AkWarm-C by changing the input parameters per the decriptions under "typical problems to be avoided."

Energy Conservation Measures (ECM's) and are usually implemented by the existing operations and maintenance staff (so are sometimes called O & M recommendations). The following ECM's are recommended for this facility. Additional detail is provided in Appendix B.

Figure 20 – ECM Summary

ECM		Typical problems avoided	Estimated Annual Energy Cost Savings	Cost	Gallons saved	kWh saved	kBTU's saved
1	Implement Building Monitoring (See Appendix L). Install cumulative fuel oil flow meter (See Appendix E).	Studies show a minimum 5% lower energy consumption by monitored buildings	$2,297	$1,500	164	1,907	28,209
2	Create a village "energy champion", provide 2 days of training to implement and sustain these ECM's.		--	$3,500			
	Energy Champion performs monthly Energy Checklist walk-through	Zone valve stuck open for 4 winter months, temperature rises to 75F, infiltration increases by 750 CFM as doors and windows are left open, uncontrolled heat output increases by 1.5 MBH	$408		58	4	7,733
		Unoccupied setback temperatures changed and no longer operating properly	$520		74	3	9,778
		Inappropriate or forgotten set point adjustement because occupant was cold. 2F increase in room temp.	$70		10	0	1,320
3	Properly maintain doors and windows and weather stripping	Increase in infiltration by 400 CFM	$89	$100	12	1	1,587

4	Turn off computers, faxes, printers, copiers, etc. when leaving the office. Add plug load management devices (PLMD) at workstations where occupant leaves the desk for periods of time	Assuming 30% of time spent away from desk. See graph in Appendix XX	$60	$115/PLMD	0	100	341
5	Re-configure building occupants to group un-occupied spaces in a single zone; reduce the temperature and ventilation in that zone		--	--	--	--	--
6	Scheduled lamp replacement	Maintenance person can easily spend an extra 20 hrs/yr changing individual lamps or ballasts	$800	$0	--	--	--
7	"Mini re-commissioning" of HVAC annually	Dirty filters and/or boiler tubes can cause 3% reduction in boiler efficiency	$402	$500	57	3	7,534
8	Maintain safety inventory of at least 1 zone valve and circulation pump		--	--	--	--	--
	TOTALS (including maintenance savings)		$4,646	$5,600	376	2,018	56,504

Recommended EEM's
See Appendix B for additional detail.

Figure 21 – EEM Summary

EEM		Estimated annual Energy Savings (includes maintenance savings)	Installed Cost	Payback (years)
1	Retrofit setback thermostats in all appropriate zones	$512	$2,025	4.0
2	Lighting de-wattage and controls upgrade	$1,120	$8,574	7.7
6	Desktop PC replaced with Laptops at EOL (incremental cost difference between desktop and laptop is $100 ea)	$648	$600	0.9
	50 hrs for logistics including: sourcing, ordering, shipping, receiving, staging, etc.		$2,000	
	TOTALS (including maintenance savings)	$2,280	$13,199	5.8

*Savings figures are based on the calibrated AkWarm-C model's existing building energy costs, which is never exactly equal to actual building energy costs – the model is typically calibrated to within 5% of actual energy costs.

Summary of Existing and Proposed energy consumption and costs:
Maintenance savings are not considered in these figures.

Figure 22 – consumption and overall building energy reduction

Clinic	Existing conditions		Proposed Conditions			Effective reduction in building energy consumption
		kBTU	with EEM's	Avoided consumption from ECM's	Total kBTU of consumption	
kWh	22,568	77,025	19,075	2,018	58,216	24.1%
Gallons oil	1,669	220,308	1,644	376	167,392	
Total Building Energy Cost	$25,253		$22,973			

Figure 23 – costs

Annual Energy Cost Estimate											
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Lighting**	**Refrigeration**	**Other Electrical**	**Cooking**	**Clothes Drying**	**Ventilation Fans**	**Service Fees**	**Total Cost**
Existing Building	$9,948	$0	$1,842	$3,260	$240	$7,597	$0	$1,757	$609	$0	**$25,253**
With All Proposed Retrofits	$9,767	$0	$1,842	$1,951	$240	$6,807	$0	$1,757	$609	$0	**$22,973**
SAVINGS	$181	$0	$0	$1,309	$0	$791	$0	$0	$0	$0	**$2,280**

C**omparison of Savings using the true cost vs. PCE-discounted cost of power.**

Figure 24

	Using True cost per kWh				With PCE discount of $.3831/kWh		
	Estimated Annual Savings (including maintenance savings)	Installed Cost	Payback (years)		Estimated Annual Savings (including maintenance savings)	Installed Cost	Payback (years)
Recommended EEM's	$2,280	$13,199	5.8		$1,147*	$13,199	11.5

***** The fact that there are substantially less savings when using the lower, PCE-discounted rate appears, at first, to be anomalous. It is not, here is the reason why:

For every kWh of electricity saved inside a building (from implementing an EEM) during the heating season, an equal measure of heat must be added back into the building to maintain the same inside air temperature. For example, when a 32 watt florescent lamp is replaced with a 28 watt lamp, there are 4 watts less heat being generated by the lighting, and therefore the heating system must generate an additional 4 watts of heat to maintain the building temperature. The table below converts kWh and gallons of fuel oil to a common energy unit, BTU and shows their relative cost.

True cost of electricity @ $.6012/kWh	$.000176/BTU
PCE discounted cost of electricity @ $.2181/kWh	$.000064/BTU
Cost of fuel oil @ $7.00/gallon	$.000053/BTU

Using the PCE-discounted rate of electricity cost, means that if you reducing your electric consumption by 1000 kWh, you will save $218, but you will spend $180 in fuel oil to maintain the same inside temperature. Whereas, if you were paying the true cost of electricity and you reduced consumption by the same 1000 kWh, you would have saved $601; you will still spend the same $180 in fuel oil to maintain a constant inside temperature.

1.2 Tribal Council Office Building

Noteworthy conditions

The walls of this building are 24" thick – they are furred in18" inside the exterior log wall. The roof appears to have 8" of rigid foam and the floor 12 of fiberglass batt. The auditor was told that this was originally the village freezer. It is one of the earliest examples (1980) of what are now called super-insulated buildings.

All (3) zone valves were manually over-ridden to full open position. It is not clear how long this situation has persisted and the maintenance person did not know it existed. It was corrected during the audit, although (1) of the (3) valves was not wired, so was entirely non-functional.

Suitability for Biomass heating

This building utilizes a hydronic boiler and fintube baseboard radiators around the building's periphery. From the perspective of this building's HVAC system, biomass-heated glycol could supply heat through the existing hydronic system without substantial modification. This assumes the biomass boiler supplies high quality heat (190F glycol) and is sufficiently close to this building to prevent excessive head and thermal losses. The HVAC schematic

in Appendix I shows how a glycol loop from the biomass boiler might integrate with this building's HVAC system.

Evaluation of Energy Consumption and benchmark data

Figure 25

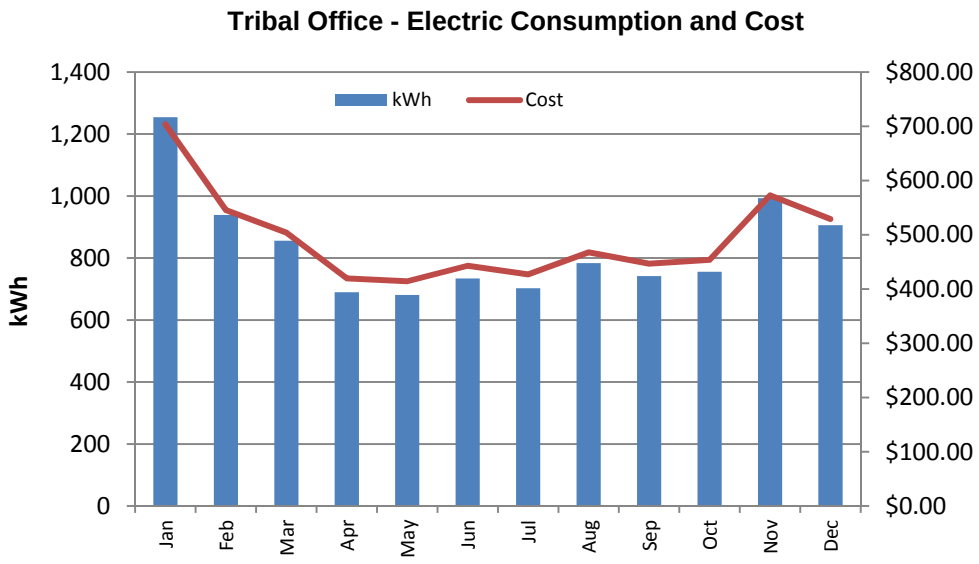
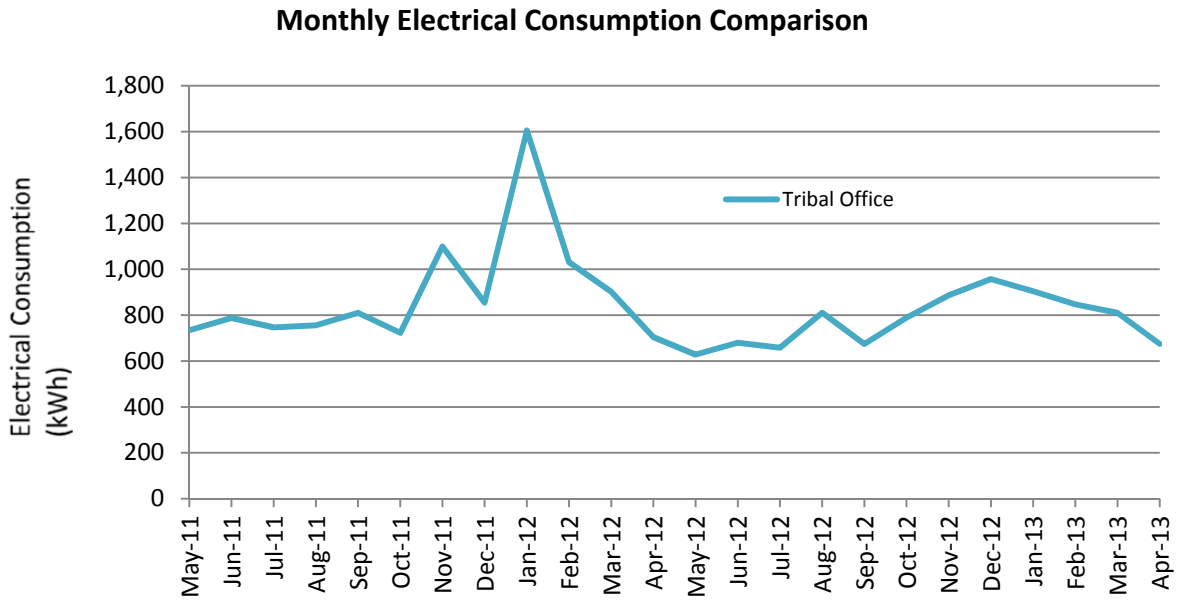


Figure 26



The electric consumption and costs for this building, when averaged across 2 years, as shown in Figures 25 and when shown monthly by month in Figure 26 show the same January 2012 spike in consumption as the Clinic. Otherwise the electric consumption curve is fairly flat and as expected.

This building has only 3-4 fuel oil deliveries each year, so the annual total was seasonally normalized by the auditor. Therefore, the monthly distribution in Figure 27 is not based on actual monthly consumption.

Figure 27

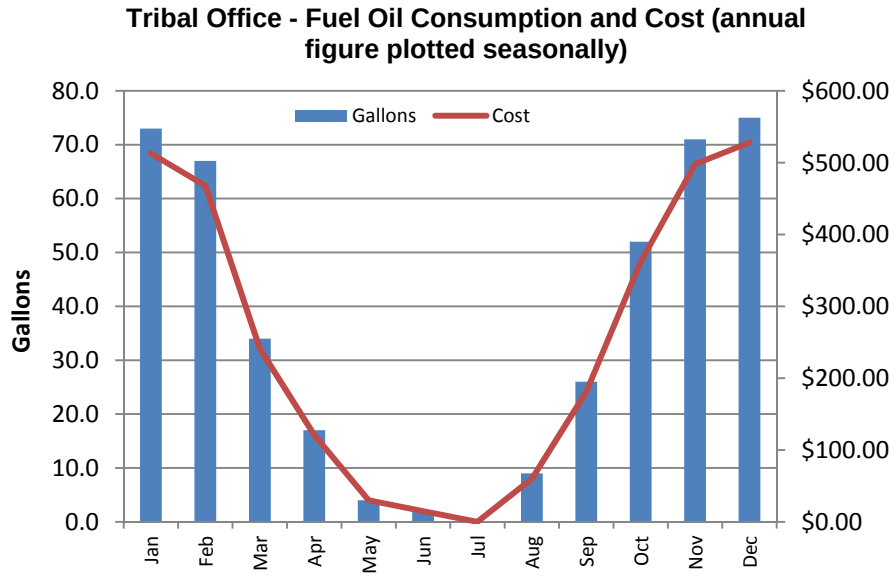


Figure 11 shows the monthly deliveries over a 2 year period. There is little in the way of insight or conclusions that can be drawn from either of these consumption charts.

Figure 28

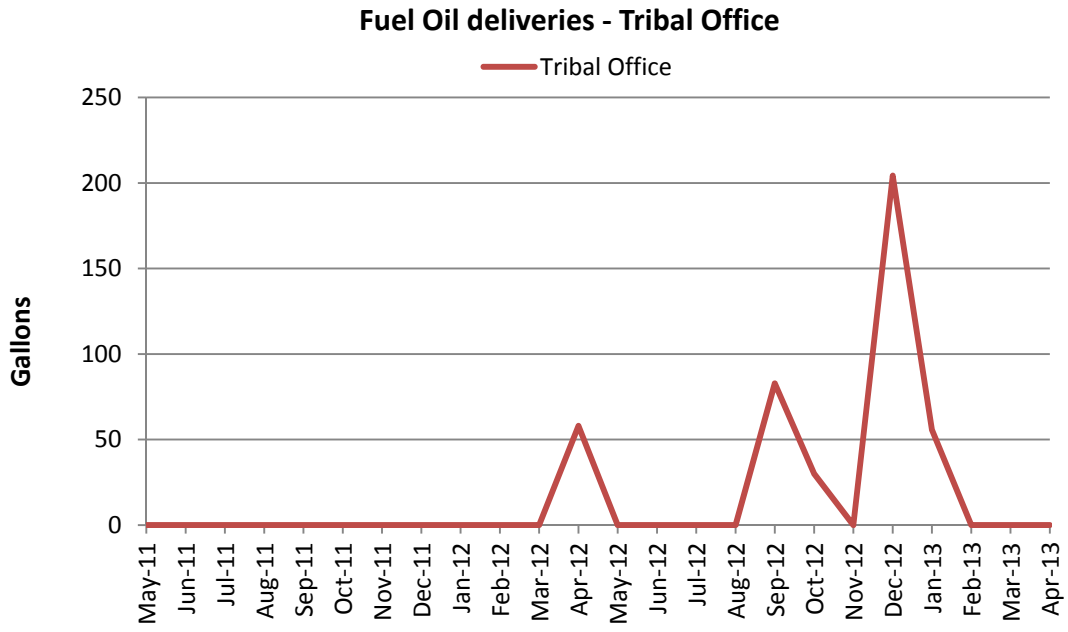
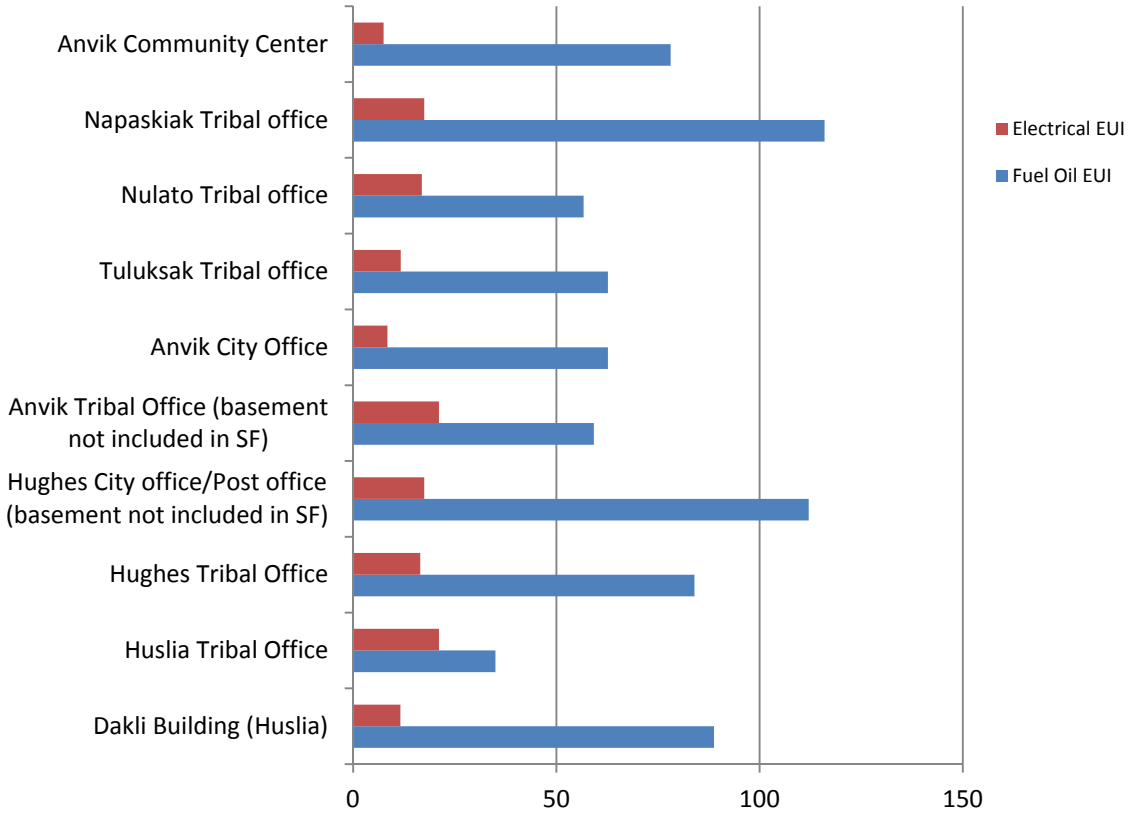


Figure 29

Village Office Buldings - comparison



EUI comparison

The fuel oil EUI of this office building is, as you would expect for a super-insulated building, quite low – there is only one building among this group that is lower. The electric EUI is among the highest. This is expected given the large refrigeration load in the kitchen. There are (3) freezers and (2) large refrigerators, which of course, are running constantly.

<u>Recommended no and low-cost ECM's</u>

Figure 30, below, summarized no- and low-cost EEM's for this building. The estimated annual energy cost savings are actually avoided costs. Avoided costs are energy expenses that are likely to occur if the ECM's are not implemented. They were calculated by AkWarm-C by changing the input parameters per the decriptions under "typical problems to be avoided".

Energy Conservation Measures (ECM's) and are usually implemented by the existing operations and maintenance staff (so are sometimes called O & M recommendations). The following ECM's are recommended for this facility. Additional detail is provided in Appendix B.

Figure 30

ECM		Typical problems avoided	Estimated Annual Energy Cost Savings	Cost	Gallons saved	kWh saved	kBTU's saved
1	Implement Building Monitoring (See Appendix L). Install cumulative fuel oil flow meter (See Appendix E).	Studies show a minimum 5% lower energy consumption by monitored buildings	$733	$1,500	34	818	7,280
2	Create a village "energy champion", provide 2 days of training to implement and sustain these ECM's.		--	$3,500			
	Energy Champion performs monthly Energy Checklist walk-through	Zone valve stuck open for 4 winter months, temperature rises to 75F, infiltration increases by 200 CFM as doors and windows are left open, uncontrolled heat output increases by 1.5 MBH	$474		41	7	5,409
		Unoccupied setback temperatures changed and no longer operating properly	$261		37	3	4,894
		Inappropriate or forgotten set point adjustment because occupant was cold. 2F increase in room temp.	$29		4	0	528
3	Properly maintain doors and windows and weather stripping	Increase in infiltration by 200 CFM	$195	$100	27	2	3,571
4	Turn off computers, faxes, printers, copiers, etc. when leaving the office. Add plug load management devices (PLMD) at workstations where occupant leaves	Assuming 30% of time spent away from desk. See graph in Appendix E	$60	$115/ PLMD	0	100	341

	the desk for periods of time						
5	Re-configure building occupants to group un-occupied spaces in a single zone; reduce the temperature and ventilation in that zone		--	--	--	--	--
6	Scheduled lamp replacement	Maintenance person can easily spend an extra 20 hrs/yr changing individual lamps or ballasts	$800	$0	--	--	--
7	"Mini re-commissioning" of HVAC annually	Dirty filters and/or boiler tubes can cause 3% reduction in boiler efficiency	$93	$500	14	1	1,851
8	Maintain safety inventory of at least 1 zone valve and circulation pump		--	--	--	--	--
	TOTALS (including maintenance savings)		$2,645	$5,600	157	931	23,875

Recommended EEM's

See Appendix B for additional detail.

Figure 31

EEM		Estimated annual Energy Savings (includes maintenance savings)	Installed Cost	Payback (years)
1	Retrofit setback thermostats in all appropriate zones	$233	$400	1.7
2	Lighting de-wattage and controls upgrade	$936	$3,884	4.1

3	Return (3) zone valves to auto position (they were all manually over-fidden to full open) or replace if defective. Full open zone valves cause overheated space, which means open doors and windows (increased infiltration) and uncontrolled heat output.	$459	$425	0.9
4	Desktop PC replaced with Laptops at EOL (incremental cost difference between desktop and laptop is $100 ea)	$212	$300	1.4
	40 hours for logistics including: sourcing, ordering, shipping, receiving, staging, etc.		$1,600	
	TOTALS (including maintenance savings)	$1,840	$6,609	3.6

Summary of Existing and Proposed energy consumption and costs:

Maintenance savings are not considered in these figures

Figure 32 – consumption and overall building energy reduction

Tribal Council Office	Existing conditions		Proposed Conditions			Effective reduction in building energy consumption
		kBTU	with EEM's	Avoided consumption from ECM's	Total kBTU of consumption	
kWh	10,042	34,273	8,182	931	24,748	45.6%
Gallons oil	431	56,892	345	157	24,842	
Total Building Energy Cost	$9,052		$7,332			

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Figure 33 – costs

Annual Energy Cost Estimate											
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Lighting**	**Refrigeration**	**Other Electrical**	**Cooking**	**Clothes Drying**	**Ventilation Fans**	**Service Fees**	**Total Cost**
Existing Building	$4,106	$0	$0	$1,996	$1,533	$964	$1,426	$0	$0	$0	**$10,025**
With All Proposed Retrofits	$4,007	$0	$0	$1,126	$1,533	$721	$1,426	$0	$0	$0	**$8,813**
SAVINGS	$99	$0	$0	$870	$0	$243	$0	$0	$0	$0	**$1,212**

1.3 Dakli Building

Noteworthy conditions
This is a small log structure that is among the most densely occupied of all the village buildings, with 6 people.

Suitability for Biomass heating
This building utilizes a hydronic boiler and fintube baseboard radiators around the building's periphery. From the perspective of this building's HVAC system, biomass-heated glycol could supply heat through the existing hydronic system without substantial modification. This assumes the biomass boiler supplies high quality heat (190F glycol) and is sufficiently close to this building to prevent excessive head and thermal losses. The HVAC schematic in Appendix I shows how a glycol loop from the biomass boiler might integrate with this building's HVAC system.

Evaluation of Energy Consumption and benchmark data

Figure 34

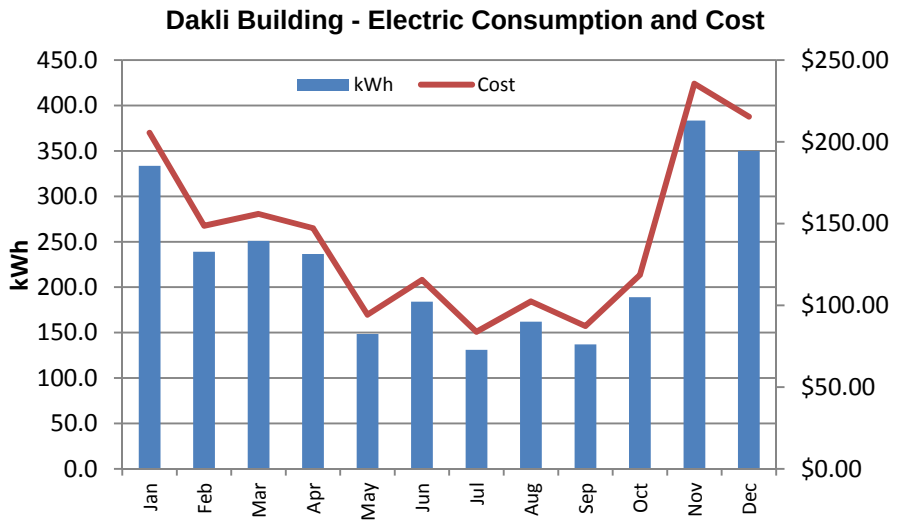
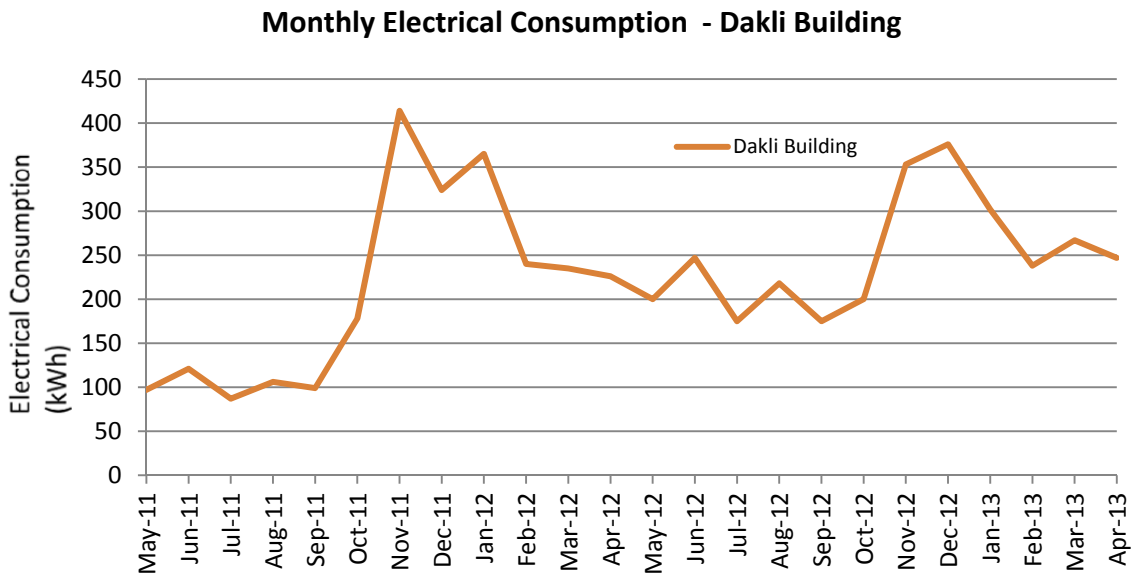


Figure 35 once again, shows the January 2012, December 2012 and January 2013 spikes. This building also displays an anomalous consumption from October through December of 2012. The maintenance person informed the auditor that the water lines to this building had been consistently freezing until he fixed the problem in mid-2012. The auditor's best guess is that this anomalous spike in consumption is a result of extra heat traces and heaters to prevent water line freeze-up.

Figure 35



Fuel oil benchmark data was only provided for 12 months, so Figures 36 and 37 represent 5 deliveries over 12 months. The total annual delivery amount was seasonally normalized by the auditor in Figure 36, and the monthly distribution is not based on actual monthly consumption. Based on the auditor's difficulty in calibrating the AkWarm-C model with the (estimated) actual consumption, the auditor does not have a high confidence level that the annual estimate is accurate.

Figure 36

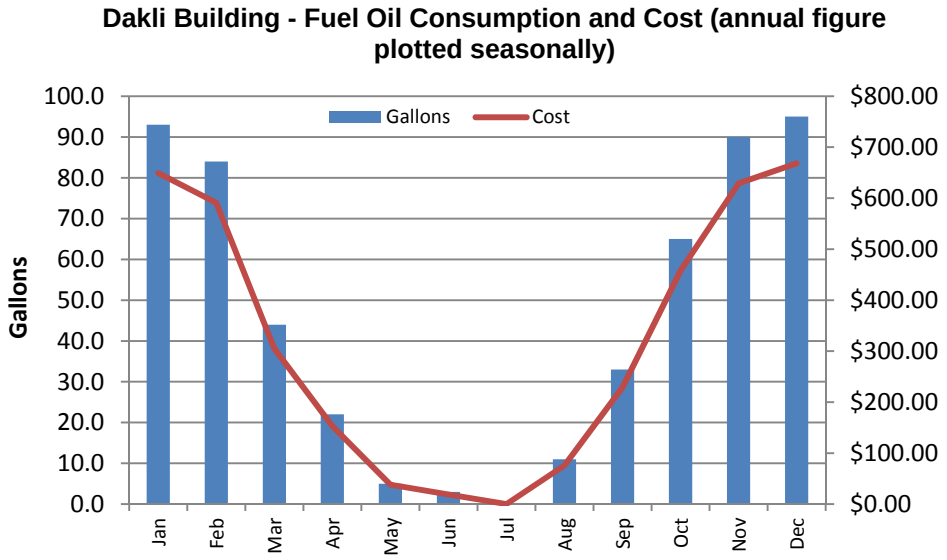
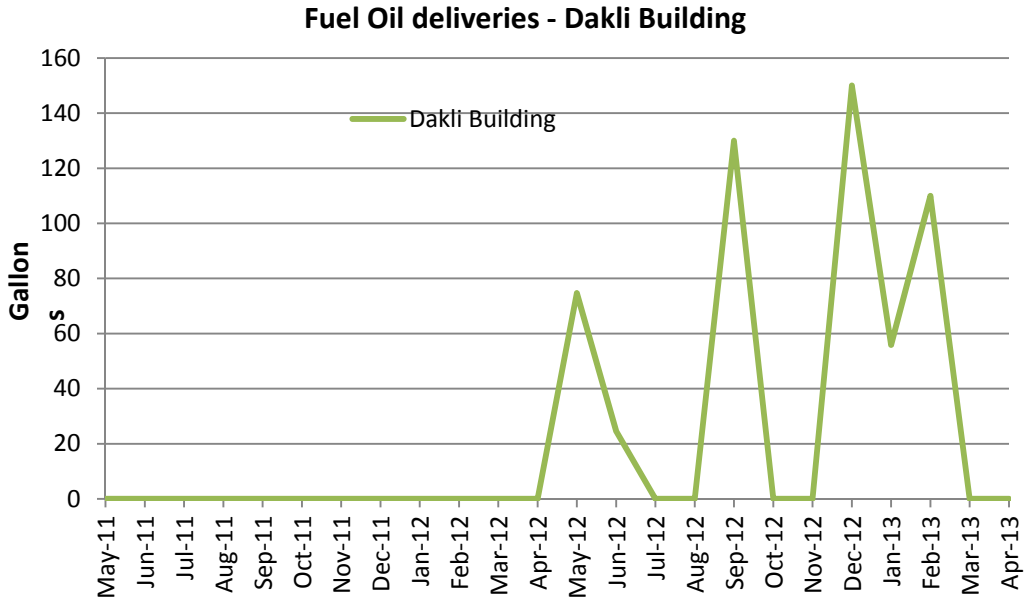


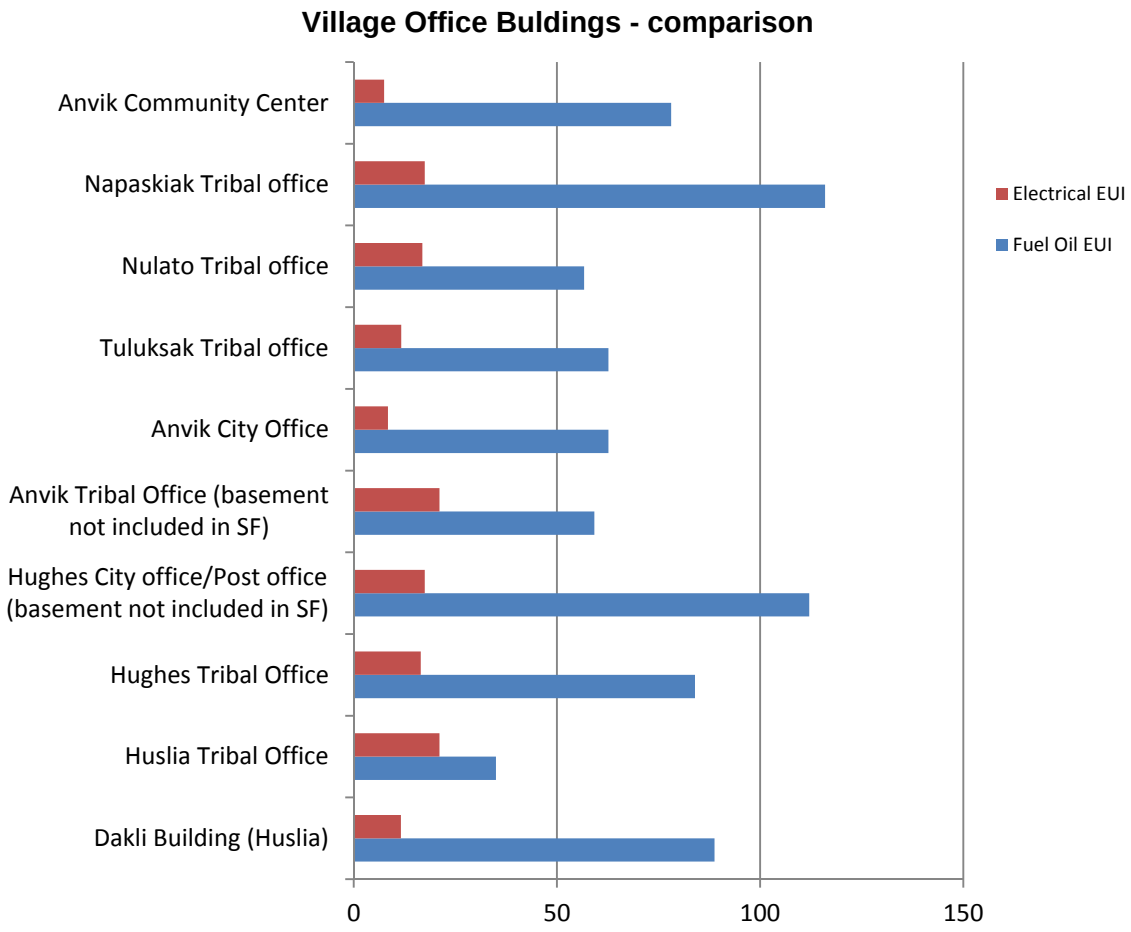
Figure 37



Fuel oil and Electric EUI comparison

A comparison of EUI's for a number of village office buildings is shown in Figure 38 below. The Dakli building falls into the middle of this group of similar buildings with respect to electric EUI but is quite high with respect to fuel oil EUI. No reasons for this were discovered during the site survey.

Figure 38



<u>Recommended no- and Low-cost EEM's</u>

Figure 39, below, summarized no- and low-cost EEM's for this building. The estimated annual energy cost savings are actually avoided costs. Avoided costs are energy expenses that are likely to occur if the ECM's are not implemented. They were calculated by AkWarm-C by changing the input parameters per the decriptions under "typical problems to be avoided".

Energy Conservation Measures (ECM's) and are usually implemented by the existing operations and maintenance staff (so are sometimes called O & M recommendations). The following ECM's are recommended for this facility. Additional detail is provided in Appendix B.

Figure 39

ECM		Typical problems avoided	Estimated Annual Energy Cost Savings	Cost	Gallons saved	kWh saved	kBTU's saved
1	Implement Building Monitoring (See Appendix L). Install cumulative fuel oil flow meter (See Appendix E).	Studies show a minimum 5% lower energy consumption by monitored buildings	$471	$1,500	53	170	7,576
2	Create a village "energy champion", provide 2 days of training to implement and sustain these ECM's.		--	$3,500			
	Energy Champion performs monthly Energy Checklist walk-through	Zone valve stuck open for 4 winter months, temperature rises to 75F, infiltration increases by 500 CFM as doors and windows are left open, uncontrolled heat output increases by 1.5 MBH	$906		76	16	10,112
		Unoccupied setback temperatures changed and no longer operating properly	$207		29	6	3,848
		Inappropriate or forgotten set point adjustement because occupant was cold. 2F increase in room temp.	$71		9	2	1,195
3	Properly maintain doors	Increase in infiltration by 300	$420	$100	54	11	7,166

	and windows and weather stripping	CFM					
4	Turn off computers, faxes, printers, copiers, etc. when leaving the office. Add plug load management devices (PLMD) at workstations where occupant leaves the desk for periods of time	Assuming 30% of time spent away from desk. See graph in Appendix XX	$60	$115/PLMD	0	100	341
5	Re-configure building occupants to group un-occupied spaces in a single zone; reduce the temperature and ventilation in that zone		--	--	--	--	--
6	Scheduled lamp replacement	Maintenance person can easily spend an extra 20 hrs/yr changing individual lamps or ballasts	$800	$0	--	--	--
7	"Mini re-commissioning" of HVAC annually	Dirty filters and/or boiler tubes can cause 3% reduction in boiler efficiency	$100	$500	14	2	1,855
8	Maintain safety inventory of at least 1 zone valve and circulation pump		--	--	--	--	--
TOTALS (including maintenance savings)			$3,035	$5,600	235	307	32,093

Recommended EEM's

Figure 40

EEM		Estimated annual Energy Savings (includes maintenance savings)	Installed Cost	Payback (years)
1	Retrofit setback thermostats in all appropriate zones	$208	$200	1.0
2	Lighting de-wattage and controls upgrade	$406	$2,382	5.9
3	Replace 1 remaining wood frame window with triple pane, low E, vinyl frame	$53	$1,664	31.4
4	Desktop PC replaced with Laptops at EOL (incremental cost difference between desktop and laptop is $100 ea)	$88	$100	1.1
	40 hours for logistics including: sourcing, ordering, shipping, receiving, staging, etc.		$1,600	
	TOTALS (including maintenance savings)	$755	$5,946	7.9

*Savings figures are based on the calibrated AkWarm-C model's existing building energy costs, which is never exactly equal to actual building energy costs – the model is typically calibrated to within 5% of actual energy costs.

Summary of Existing and Proposed energy consumption and costs:

Figure 41 – consumption and overall building energy reduction

Dakli Building	Existing conditions		Proposed Conditions			Effective reduction in building energy consumption
		kBTU	with EEM's	Avoided consumption from ECM's	Total kBTU of consumption	
kWh	2,742	9,358	1,706	307	4,775	46.8%
Gallons oil	546	72,072	527	235	38,544	
Total Building Energy Cost	$5,468		$4,712			

Figure 42

Annual Energy Cost Estimate											
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Lighting**	**Refrigeration**	**Other Electrical**	**Cooking**	**Clothes Drying**	**Ventilation Fans**	**Service Fees**	**Total Cost**
Existing Building	$3,865	$0	$0	$1,083	$0	$520	$0	$0	$0	$0	**$5,468**
With All Proposed Retrofits	$3,730	$0	$0	$580	$0	$402	$0	$0	$0	$0	**$4,712**
SAVINGS	$136	$0	$0	$503	$0	$118	$0	$0	$0	$0	**$756**

Comparison of savings using true cost and PCE-discounted cost of power

Figure 43

	Using True cost per kWh			With PCE discount of $.3831/kWh		
	Estimated Annual Savings (including maintenance savings)	Installed Cost	Payback (years)	Estimated Annual Savings (including maintenance savings)	Installed Cost	Payback (years)
Recommended EEM's	$755	$5,946	7.9	$429	$5,946	13.8

1.4 Old Environmental Office

Noteworthy conditions

This is a very small building that was formerly the environmental office. Apparently in the middle of 2011 there was a diesel spill of some kind and since that time the building has been out of use. It is currently being renovated for use as a youth center. The auditor performed a cursory walk through of the building for the purpose of contributing to the renovation from an energy efficiency perspective, if possible.

Suitability for Biomass heating

This building is not suitable for biomass heating.

Evaluation of Energy Consumption and benchmark data

There has been no power (the meter may have been locked out) or fuel oil used in this building until May of 2013 when the power was turned back on. A wood burning stove is in the plan to provide heat in this space.

After walking through the building with the maintenance person, the only recommendations presented are as follows:

1. While the flooring is removed, consider replacing the fiberglass batt with rigid foam. What appears to be 2” x 8” floor joists will hold batt sufficient to sustain an insulation value of R-25, while the same thickness of rigid foam will sustain an insulation value of R-40.
2. The same approach could be taken with the ceiling insulation. It appears that there is a vented attic, if the room lid is to be removed, add insulation above it.
3. Replace the existing T8 ballasts with program start ballasts and install occupancy sensors.
4. Install motion and photo sensors on all exterior lights and replace incandescent bulbs with LED’s.
5. There are secondary sliding “storm” windows on the outside of the double pane wood frame windows. They are in decent condition, but consider replacing the windows with triple pane, low E vinyl frame window.

1.5 Community Hall

Noteworthy conditions

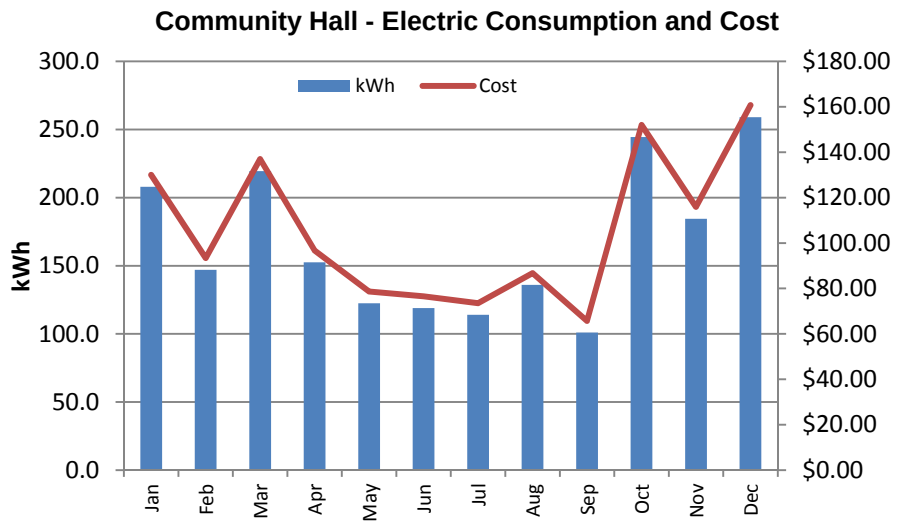
This building is identical to the community center in Hughes, but it is not as old and is used more regularly. Because these buildings have such low occupancy and use, there is little in the way of EEM's or ECM's that make technical and economic sense.

Suitability for Biomass heating

This building utilizes a free-standing oil burning heater (Toyo-type stove) and a wood stove for heat. It does not have any plumbing or DHW. The existing HVAC system is not suitable for biomass heating, however, a hydronic unit heater could be added to the building and biomass generated hot water (glycol) could be piped to the unit heater to supply heat to the building. This assumes the biomass boiler supplies high quality heat (190F glycol) and is sufficiently close to this building.

Evaluation of Energy Consumption and benchmark data

Figure 44



The electric consumption and costs, when averaged across 2 years, as shown in Figure 44 display an irregular pattern. This is probably attributed to the intermittent, event related use of the facility. The monthly consumption graph in Figure 45 reinforces this.

Figure 45

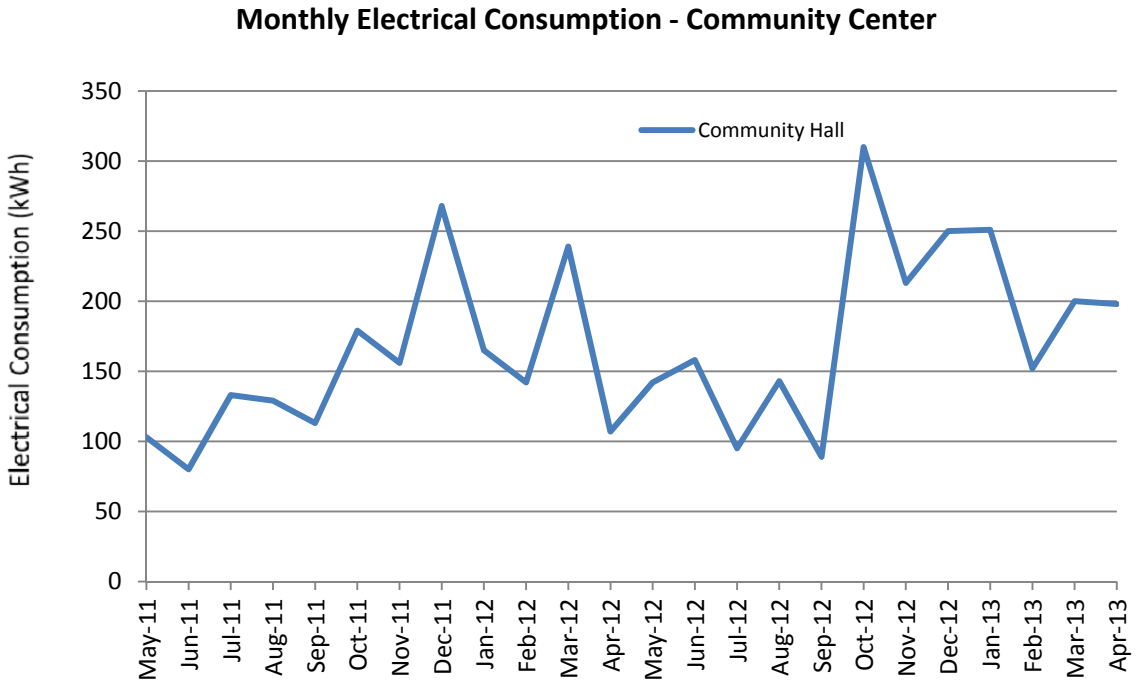


Figure 46

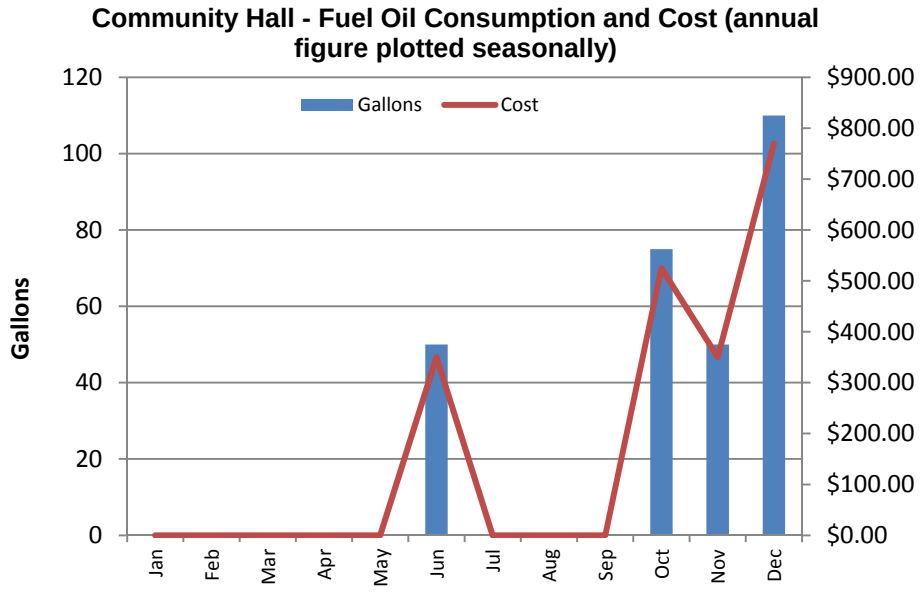
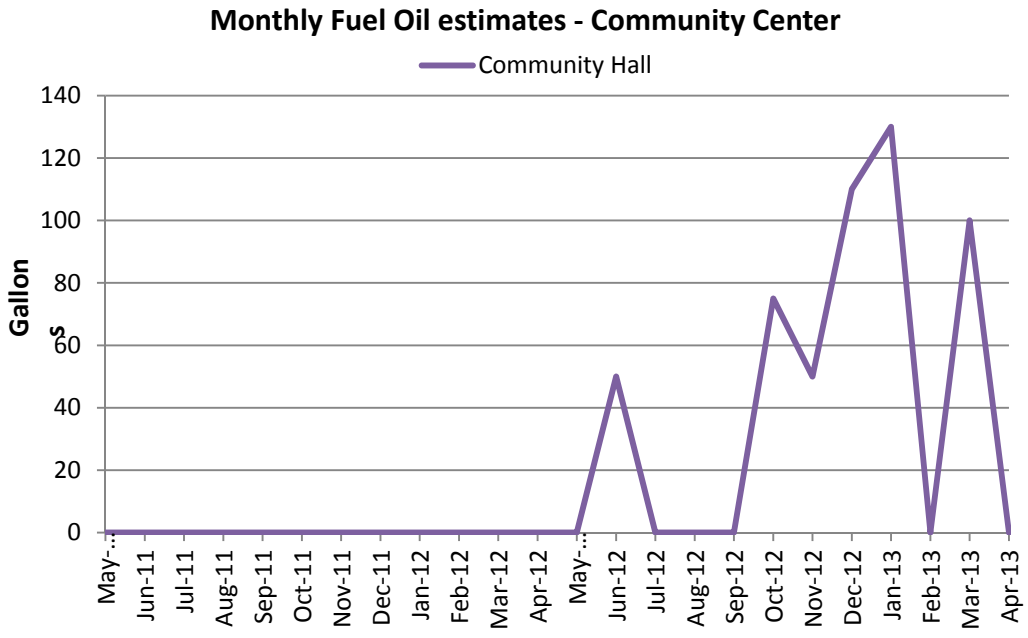


Figure 46 above, is not actual fuel deliveries. Fuel oil is not tracked for this building, so no benchmark data was available. The data above (and below) was determined by the auditor based on the AkWarm-C model's predicted consumption and his experience with the Hughes community center (regarding the percentage cord wood vs fuel oil). Consequently, neither Figure 46 nor Figure 47, below, provide much insight into this building's consumption patterns.

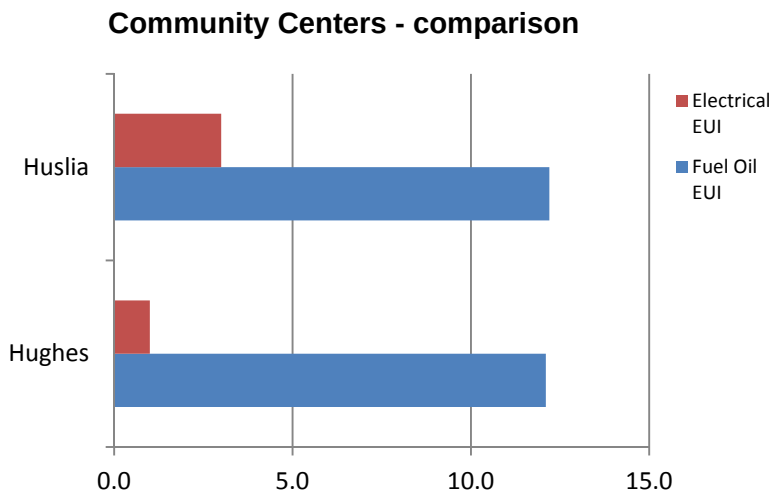
Figure 47



Fuel oil and Electric EUI comparison

A comparison of EUI's for the community centers in Hughes and Huslia is shown in Figure 48 below. The structures in these villages are identical, but the occupancy and use is very different. As previously mentioned, oil deliveries to this building in Huslia are not tracked, the auditor was informed that "someone just adds some oil to the barrel if we need it". The Electrical EUI's on the other hand, are accurate and clearly demonstrate the different usage of each village's community center. While the Hughes center is used only 1 evening per week, the Huslia center is used for 2 hours daily during the summer months and two evenings per week year round for bingo. Based on the usage and occupancy difference, a better estimate of fuel oil EUI would be 3x Hughes EUI.

Figure 48



Recommended no and low-cost ECM's

Figure 49, below, summarized no- and low-cost EEM's for this building. The estimated annual energy cost savings are actually avoided costs. Avoided costs are energy expenses that are likely to occur if the ECM's are not implemented. They were calculated by AkWarm-C by changing the input parameters per the decriptions under "typical problems to be avoided."

Energy Conservation Measures (ECM's) and are usually implemented by the existing operations and maintenance staff (so are sometimes called O & M recommendations). The following ECM's are recommended for this facility. Additional detail is provided in Appendix B.

Figure 49

ECM		Typical problems avoided	Estimated Annual Energy Cost Savings	Cost
1	Implement Building Monitoring (See Appendix L). Install cumulative fuel oil flow meter (See Appendix E).	Studies show a 10%-15% lower energy consumption in monitored buildings	$442	$1,500
2	Create a village "energy champion", provide 2 days of training to implement and sustain these ECM's.	Unoccupied setback temperatures changed and no longer operating properly	--	$3,500
	Energy Champion performs monthly Energy Checklist walk-through		$367	--
3	Properly maintain doors and windows and weather stripping	Increase in infiltration by 200 CFM	$129	$100
4	Scheduled lamp replacement	Maintenance person can easily spend an extra 10 hrs/yr changing individual lamps or ballasts	$400	$0
5	"Mini re-commissioning" of HVAC annually	Dirty coils, burners, etc on Toyostove can cause 3% reduction in efficiency	$129	$250
TOTALS (including maintenance savings)			$1,467	$5,350

Recommended EEM's - See Appendix B for additional detail.

Figure 50

EEM		Estimated annual Energy Savings (includes maintenance savings)	Installed Cost	Payback (years)
1	Retrofit setback thermostats in all appropriate zones	$367	$500	1.4
2	Lighting de-wattage and controls upgrade	$262	$1,863	7.1

	10 hours for logistics including: sourcing, ordering, shipping, receiving, staging, etc.		$400	
	TOTALS (including maintenance savings)	$629	$2,763	4.4

Summary of Existing and Proposed energy consumption, reduction, costs and savings:

Maintenance savings are not considered in these figures.

Figure 51– consumption and overall building energy reduction

Community Hall	Existing conditions		Proposed Conditions			Effective reduction in building energy consumption
		kBTU	with EEM's	Avoided consumption from ECM's	Total kBTU of consumption	
kWh	2,033	6,939	1,593	159	4,894	30.6%
Gallons oil	515	67,980	474	117	47,124	
wood (cords)	0.45	8.1	0.41	0	0.72	
Total building energy cost	$4,981		$4,422			

Figure 52 – Costs

Annual Energy Cost Estimate											
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Lighting**	**Refrigeration**	**Other Electrical**	**Cooking**	**Clothes Drying**	**Ventilation Fans**	**Service Fees**	**Total Cost**
Existing Building	$4,101	$0	$0	$768	$0	$112	$0	$0	$0	$0	**$4,981**
With All Proposed Retrofits	$3,807	$0	$0	$504	$0	$112	$0	$0	$0	$0	**$4,422**
SAVINGS	$295	$0	$0	$265	$0	$0	$0	$0	$0	$0	**$560**

Comparison of savings using true cost and PCE-discounted cost of power

Figure 53

	Using True cost per kWh				With PCE discount of $.4263/kWh		
	Estimated Annual Savings (including maintenance savings)	Installed Cost	Payback (years)		Estimated Annual Savings (including maintenance savings)	Installed Cost	Payback (years)
Recommended EEM's (ECM's not included)	$629	$2,763	4.4		$461	$2,763	5.9

Summary of recommended EEM's and ECM's for all Huslia Tribal Buildings:

Figure 54 – combined total of EEM's and ECM's recommended for the Village of Huslia

	Estimated Annual Savings, including maintenance savings (EEM's) plus Avoided Costs (ECM's)	Installed Cost
Rose Ambrose Clinic	$7,131	$18,799
Tribal Council Office	$4,605	$12,209
Dakli Building	$3,860	$11,546
Old Environmental Office	n/a	n/a
Community Center	$2,096	$8,113
TOTAL	**$17,692**	**$50,667**

2.0 Building Descriptions and Function

Underlined sentences in this section indicate improperly functioning, inefficient, unsafe or potential code violations in the building that should be addressed without delay.

2.1 Rose Ambrose Clinic

The site visit and survey of the subject building occurred on May 29th, 2013. This building was constructed in 2006 and other than the question around it's extreme consumption of fuel oil, it is in excellent condition. The clinic houses 3 exam rooms, a behavioral health office, itinerant quarters, a dental suite with 2 stations, a small lab and 2 offices.

Full building plans were available and compared with the actual building. The most significant discrepancies involve the HVAC controls. Plans call for wall mounted thermostats and a remote bulb thermostat monitoring the bare fin tubes in the crawlspace. The mechanical contractor installed DanFoss thermostatic control valves on the baseboard radiators in the building as well as on the bare fin tube in the crawlspace.

a. **Heating, Cooling, Ventilation and Controls:** Heat is provided by an oil fired, 175 MBH Weil McLain WGO-5 boiler with an 87% AFUE rating. The building has 9 heating zones, with redundant circulation pumps, manual thermostatic controls valves in 6 zones and manual low voltage wall mounted thermostats in locked plastic enclosures in the other 3 zones. Heat is supplied to each zone by baseboard fin tube radiators and 5 radiant ceiling panels in the lobby and toilet rooms.

During the site survey, the boiler had tripped off earlier in the day. The maintenance person was on-site trying to correct the problem, which apparently is recurring air lock in the diesel feed line from the outdoor tank. He also mentioned that the glycol lines have also had an airlock and had to be bled at the uppermost relief valve. He was very new in the position and was still in a steep learning curve with respect to the building systems.

Control is provided only by the thermostats and thermostatic control valves, and line temperature and upper limit aqua stats.

There is no cooling in this building.

b. **Appliances:** There is (1) full size residential type refrigerator used for medications, ice packs and lunches. There are 6 PC's in use and a large quantity and diversity of medical and dental equipment, which contribute to large plug loads.

c. **Plumbing:** There are (2) 1.6 gpf tank-type toilets with manual valves, (7) manual lavatories, (1) utility sinks and a shower. There is a potable water circulation pump in the plans, but it was not identified during the survey.

d. **Domestic Hot Water:** DHW is provided to sinks and the showers by a 41 gallon, indirect Amtrol hot water generator. A dedicated circulation pump supplies heat to the HWG.

e. **Interior Lighting & Lighting Controls**: Interior lighting consists primarily of (2) and (3) lamp T8-32 watt fixtures with electronic ballasts, operated by manual switches. There are occupancy sensors in the toilet rooms and janitors closet. In general, the facility is over-lit. Measured light level were as follows:

Lobby	65-70 FC
Office	70+ FC
Behavioral office	50-110 FC
Exam rooms	120 FC & 110-130 FC
Corridor	30-60 FC
Itinerant quarters	72 FC
Dental suites	60 FC
Lab	80 FC

The exit signs utilize LEDs.

f. **Exterior Lighting**: There is a 35 watt high pressure sodium entry light adjacent to the south door, a double flood with an incandescent and a CFL on the building front and another incandescent fixture adjacent to the main entry.

g. **Building Shell:** The 2” x 12” TJI floor joists are 24” OC and are supported by steel beams supported by posts and pads and poured perimeter concrete strip footings and insulated pony walls. There is no insulation between floor joists. Walls are 7-1/4” SIP panels and the painted metal roof is supported by manufactured wood trusses filled with R-38 batt, finished on the inside with gypsum over a suspended ceiling. Interior walls are finished with gypsum, exterior walls with pre-finished lapped metal siding.

h. **Motors:** There are no motors in this building larger than the circulation pumps and (1) ½ HP potable water booster pump.

2.2 Tribal Council Office building

The site visit and survey of the subject building occurred on May 29th, 2013.

This 1624 SF, single story log building was originally constructed in 1980 as a freezer house for the village. The north half now houses tribal council staff while the south half is a large dining room and moderately equipped kitchen. There is a small arctic entry on the north side.

Plans were not available for this building, so measurements were taken during the site survey and wall, floor and roof insulation values were determined by observation, conversations with on-site personnel and by the auditor's knowledge of construction processes. This information was used for AkWarm-C data entry.

Overall, the building's interior and exterior are in above average condition considering its age. The benchmark data for oil consumption in this building was higher than expected, especially considering the super-insulated walls, ceiling and floor. This is covered in more detail below.

a. **Heating, Cooling, Ventilation and Controls:** Heat is provided by an oil fired, 115 MBH, Weil McLain WGO-3 boiler using a Beckett burner. The boiler has an AFUE rating of 87%. A single Taco circulation pump supplies heat to the (2) building zones through fintube baseboard radiators around the periphery of the building and the the indirect hot water generator. Control is provided to each of the (2) room zone valve by single, low voltage, manual thermostat located in the dining room. A second thermostat in the offices could not be found. (1) zone valve was not wired, so was non-functional and all (3) were manually over-ridden and locked open, and the thermostat in the dining area was "pegged off". This was, of course, calling on the boiler for heat, and several windows and doors were open as a result (the outside temperature was 65F-70F).

A Toyostove Laser 30 oil fired stove is located in the lobby and provides supplementary heat to the north offices. Control is provided by a local, integral thermostat. This stove has a programmable setback thermostat, it was not programmed – it should be.

There is no cooling or ventilation in the building.

b. **Appliances:** There is a large refrigeration base load in this building. There are (2) large and (1) small chest freezers and (2) full size residential type refrigerators. The kitchen has a 5-burner electric stove with a double oven, a large microwave and several kitchen aid mixers. There are (4) PC's in use in the

building as well as other typical office equipment, but the plug loads are light.

c. **Plumbing Fixtures:** This building has (1) tank type toilet with a manual flush valve, (1) lavatory sink with manual valves, and a kitchen sink. The toilet appears to consume 1.6 gallons per flush (gpf). See Appendix C for EEM recommendations.

d. **Domestic Hot Water:** Hot water for sinks and the shower is provided by a 30 gallon indirect Amtrol hot water generator set at 149F, and located in the boiler room.

e. **Interior Lighting & Controls:** The lighting in this building consists primarily of T8-32 watt fixtures with 2 tubes and electronic ballasts. Several fixtures had 4 tubes, but 2 have been removed. In addition, the bathroom has a 6-bulb incandescent fixture with 1 bulb burned out. There are (4) incandescent ceiling mounted fixtures in the dining room, as well as (2) T12-2 lamp fixtures with magnetic ballasts, which are almost never used. All switches are manual. There are no lit exit signs in the building. Measured light levels in the offices varied from 25 FC to 60 FC, depending on the location.

f. **Exterior Lighting:** There are (2) incandescent double flood fixtures and a single ceiling mounted CFL fixture in the arctic entry.

g. **Building Shell:** The building is presumed to be constructed on concrete pads or footings; the lower course of logs are on or buried in the dirt. On-site personnel believed the floor to be supported by 2”x12” rough cut joists filled with R-38 batt. The exterior walls are 6” logs utilizing perma-chink. There are numerous openings cut into the logs, then repaired or partially repaired (See Appendix A), <u>these should be fully repaired to prevent infiltration</u>. The chinking is in good condition. The interior wall surface is 18” inside the inner log surface. On-site personnel believed the entire wall was filled with batt or insulation of some kind. The windows are triple pane, vinyl frame with the exception of two on the northeast side which are double pane, aluminum frame. The exterior periphery of some of the windows has been filled with fiberglass batt stuffed into the gap, these <u>should be trimmed out</u> to further prevent infiltration. The metal roof is supported by what appears to be 2” x 6” joists which are presumed to be filled with insulation and then covered with plywood to create a cold roof. The attic has no insulation over the offices and the roof over the dining area is a cathedral style. There is an open hole in the kitchen/dining area where a boiler flue looks to have been removed, <u>this should be insulated and repaired</u>.

h. **Motors:** There are no motors in this building larger than the 1/7 HP oil burner.

2.3 Dakli Building

The site visit and survey of the subject building occurred on May 30th, 2013. This 810 SF log building was built in 1980 and houses offices for 6 staff. Plans were not available for this building, so measurements were taken during the site survey and wall, floor and roof insulation values were determined by observation, conversations with on-site personnel and by the auditor's knowledge of construction processes. This information was used for AkWarm-C data entry.

Overall, the building is in average condition. Building details are as follows:

a. **Heating, Cooling, Ventilation and Controls:** Heat is provided by an oil fired, 115 MBH, Weil McLain WGO-3 boiler using a Beckett burner. The boiler has an AFUE rating of 87%. A single Grundfos circulation pump supplies heat to the fintube baseboard radiators around the periphery of the building. Control is provided by single, low voltage, manual thermostat located in the lobby. There is no ventilation or cooling in this building and no operable exhaust fans.

b. **Appliances:** There is a microwave and coffee maker in this building, and (2) PC's, (3) laptops and (6) personal printers in use at various times of day.

c. **Plumbing Fixtures:** There is (1) 3.5 gpf tank-type toilet with a manual flush valve and a lavatory sink with a manual valve in the building. See Appendix C for EEM recommendations.

d. **Domestic Hot Water:** There is no DHW in this building

e. **Interior Lighting & Controls:** The lighting in this building consists of T8-32 watt, 2 lamp fixtures utilizing electronic ballasts and manual switches. In addition, there are several screw-in CFL's. <u>There are no exit signs in the building</u>.

f. **Exterior Lighting:** There are (2) incandescent exterior fixtures, one with a bulb missing.

g. **Building Shell:** The lower course of logs is presumed to be supported by concrete blocks or footings. The floor is presumed to be supported by 2" x 8" joists filled with R-25 batt. The 6" log walls utilize perma-chink and are in good condition. They are furred in with what looks like 2" x 4" studs filled with R-11 batt. The windows are triple pane vinyl and are in excellent condition. The roof has recently been replaced and is in excellent condition as well. It is presumed to be supported by 2" x 8" joists filled with R-25 batt. The interior walls are painted plywood.

h. **Motors:** There are no large motors in this building.

2.4 Old Environmental Office

This building has been out of use since mid-2011, apparently the result of a diesel spill. It is currently under construction, so a cursory walk through was performed, with the intention to provide energy efficiency related suggestions as the renovation progresses.

It is a 775 SF, single story log structure. The logs and perma-chink are in good condition.

On-site personnel informed the auditor that a wood burning stove was to be used for heat, and there would be no plumbing. Its intended purpose is a youth center.

a. Heating, Cooling, Ventilation and Controls:

b. Appliances: There will be no appliances used.

c. Plumbing Fixtures: There is no plumbing or DHW

d. Interior Lighting & Controls: Lighting consists of T8-32 watt, 2 lamp florescent fixtures with electronic ballasts on manual switches.

e. Exterior Lighting: There is a double floodlight fixture on a motion/photo sensor on the front of the building. It is not known whether this fixture is functional – it did not operate when the switch was turned on.

f. Building Shell: The first course of 6” logs is supported by dirt-contact, wood blocks. The floor looks like 2” x 8” joists filled with R-25 batt. Interior walls appear to be furred in with 2” x 4” studs presumed to be filled with R-11 batt. They are finished with vertical paneling. The metal roof is presumed to be supported by 2” x 6” joists filled with R-19 batt.

g. Motors: There are no motors in this building.

2.5 Community Hall

The site visit and survey of the subject building occurred on May 29th, 2013. This is an octagonal log building, constructed in 1984, used an average of two evenings per week, year round for bingo and 5 days per week during the summer months for child care.

Plans were not available for this building, so measurements were taken during the site survey and wall, floor and roof insulation values were determined by conversations with on-site personnel and by the auditor's knowledge of construction processes. This information was used for AkWarm-C data entry.

i. **Heating, Cooling, Ventilation and Controls:** Heat is provided by an oil fired, 3-stage, 15 to 40 MBH, Toyostove Laser 73 heater and a wood stove. According to the manufacturer, the AFUE rating of this heater is 87%. Control while the unit is running is provided by an integral thermostat, staff indicated that the stove is turned off when the building is unoccupied. The auditor visited the building during an unoccupied period and the stove was still on, see EEM recommendation in Appendix B.

Oil and wood use are not tracked for this building, so the AkWarm-C model was reconciled by adding oil and wood until the model was calibrated.

There is a small, 1.5 Ton, window-type air conditioning unit mounted to the wall; it does not look functional. There is no ventilation in this building.

j. **Appliances: none used.**

k. **Plumbing: none in building.**

l. **Domestic Hot Water: none in use.**

m. **Interior Lighting & Lighting Controls**: There are (9) T8-32 watt fixtures operated by (2) manual switches and (9) CFL's operated by a different switch.

n. **Exterior Lighting**: There is a single incandescent bare-bulb fixture in the arctic entry of this building and (4) CFL's, controlled by a manual switch.

o. **Building Shell:** The base course of logs looks to be supported by wood and concrete blocks, but also appears to have a lot of dirt contact. The base course supports what is presumed to be 2" x 8" wood joists which support the floor. R-25 fiberglass batt is presumed to fill the spaces between the floor joists

The walls are constructed of 6" logs; fiberglass batt is used to seal the joints between log courses and in the corners. There are (2) metal doors and no windows in this structure.

The metal roof is presumed to be supported by 2” x 8” wood rafters which are finished on the inside with painted plywood. R-25 batt is presumed to fill the spaces between rafters.

The octagonal cupola is also supported by the 2” x 8” rafters and a ½” circumferential steel cable. The cupola walls appear to be 2” x 4” studs, finished outside and inside with painted plywood. The dome roof appears to also use 2” x 4” rafters and has painted metal roof. The cupola windows look to be single or double pane and several are broken.

3.0 Audit and Analysis Background

Program Description: This audit included services to identify, develop, and evaluate EEM's for the subject buildings. The scope of this project included evaluating each building's:

- Shell
- Lighting
- Hot water generation
- HVAC equipment
- Plumbing fixtures

And for the village as a whole, its:

- Street lighting
- Sewer and potable water heat traces
- Power plant heat recovery

The auditor may or may not identify system deficiencies if they exist. The auditor's role is to identify areas of potential savings, many of which may require more detailed investigation and analysis by other qualified professionals.

Audit Description and Methodology: Preliminary audit information was gathered in preparation for the site survey, including benchmark utility consumption data, floor and lighting plans, and equipment schedules where available. A site visit is then performed to inventory and evaluate the actual building condition, including:

i. Building envelope (walls, doors, windows, etc)
ii. Heating, ventilating, and air conditioning
iii. Lighting systems and controls
iv. Building specific equipment
v. Plumbing Systems
vi. Street lighting
vii. Generator plant heat recovery

Benchmark Utility Data Validation: Benchmark utility data provided by on-site personnel or off-site administrative personnel is validated, confirming that meter numbers on the subject building match the meters from which the energy consumption and cost data were collected. If the data is inaccurate, missing, or appears to be anomalous, new benchmark data is obtained. In the event that there are anomalies, inconsistencies or gaps in the data, and the reasons cannot be determined, then the existing data is normalized, and any missing data points are interpolated based on similar buildings and the auditors experience.

Method of Analysis: The information gathered prior to and during the site visit is entered into AkWarm-C, an energy simulation modeling software program developed for AHFC to identify forecasted energy consumption. Prior to forecasting potential energy savings and paybacks, the AkWarm-C model is calibrated to the actual benchmark energy consumption. AkWarm-C calculates projected energy savings based on occupancy schedules, utility rates, building construction type, building function, existing conditions, and climatic data uploaded to the program based on the zip code of the building. When new equipment is proposed, energy consumption is calculated based on manufacturer's cataloged information input by the auditor.

Energy cost savings are calculated based on the historical energy costs for the building. Installation costs include the labor and equipment required to implement an EEM retrofit, but design and construction management costs are excluded. Cost estimates are typically +/- 30% for this level of audit, and are derived from Appendix K and one or more of the following: Means Cost Data, industry publications, experience of the auditor, local contractors and equipment suppliers and/or wage scales provided by on-site personnel. Maintenance savings are calculated where applicable, and are added to the energy savings for each EEM.

The costs and savings are considered and a simple payback period and ROI is calculated. The simple payback period is based on the number of years that it takes for the savings to pay back the net installation cost (Payback period = Net Installation costs divided by Net Savings.) In cases where the EEM recommends replacement at EOL, the incremental cost difference between the standard equipment in place, and the higher efficiency equipment being recommended is used as the cost basis for payback calculation. The SIR found in the AkWarm-C report is the Savings to Investment Ratio, defined as the annual savings multiplied by the lifetime of the improvement, divided by the initial installed cost. SIR's greater than 1.0 indicate a positive lifetime ROI.

The life-time for each EEM is entered into AkWarm-C by the auditor; it is estimated based on the typical life of the equipment being replaced or altered.

Interactive Effects of Projects: Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. If a building is in cooling mode, these contribute to the overall cooling demands of the building; therefore lighting efficiency improvements will reduce cooling requirements on air conditioned buildings. Conversely, lighting efficiency improvements are anticipated to increase heating requirements during the heating season. Heating penalties resulting from reductions in building electrical consumption are included in the lighting analysis that is performed by AkWarm-C.

The AkWarm-C program calculates savings assuming that all recommended EEM are implemented in the order shown in Appendix B. The EEM's in Appendix C are not included in the AkWarm-C model. If some EEMs are not implemented, savings for the remaining EEMs will be affected, in some cases

positively, and in others, negatively. In general all projects - where calculated savings took place in the AkWarm-C model - were evaluated sequentially so that energy savings associated with one EEM would not be attributed to another EEM as well. By modeling the recommended projects sequentially, the analysis accounts for interactive effects between the EEMs and does not “double count” savings.

Limitations of the Study: All results are dependent on the quality of input data provided, and may only act as an approximation. Most input data such as building and equipment usage, occupancy hours and numbers, building and HVAC operating hours, etc. was provided to the auditor by on site personnel.

In some instances, several methods may achieve the identified savings. This report is not a design document. A design professional, licensed to practice in Alaska and in the appropriate discipline, who is following the recommendations, shall accept full responsibility and liability for the results.

Budgetary estimates for engineering and design of these projects in not included in the cost estimate for each EEM recommendation, but these costs can be approximated at 15% of the cost of the work.

4.0 Acknowledgements:

We wish to acknowledge the help of numerous individuals who have contributed information that was used to prepare this report, including:

The Denali Commission (Grantor): The Denali Commission provided the grant funds, guidelines, background, village contacts and direction for the audits. The Commission determined the short list of buildings to be audited based on their history, knowledge and historical relationships with each village.

The City of Huslia: The City provided building sizing information and two years fuel oil and electrical usage data.

The Village Council of Huslia (Owner): The Tribe provided access and an escort through each building, as well as valuable historical information, future plans, building structure information, building schedules and age. The Tribe also provided housing for the auditor.

Richard S. Armstrong, PE, LLC (Prime Contractor): This is the prime contract service provider who was awarded this project. The principal of this firm, Richard "Dick" Armstrong,is the Foraker Group's contract energy engineer. He provides program management and oversight, technical consulting and peer review of all audit activities under this program.

Energy Audits of Alaska, LLC (Energy Auditor): This firm has been selected to provide audits under this contract. The firm has a principal mechanical engineer licensed in Washington State, and his application for licensure in Alaska by comity has been approved and is pending issuance by the Alaska Board of Registration for a Professional Engineering license in Alaska. He is also certified as an energy auditor and building commissioning professional through the Association of Energy Engineers. He has also received additional training from Richard S. Armstrong, PE, LLC to acquire further specific information regarding audit requirements and potential EEM applications for this project.

Vendors and Suppliers: Seamless Siding and J & S Siding, both of Fairbanks provided rough budgetary figures for adding rigid foam to the outside of walls and re-siding. Alaska Quality Insulation provided rough budgetary figures for adding blown cellulose insulation to existing buildings. These budgetary estimates were used to adjust (150% to 200% increase) the cost factors embedded in AkWarm-C for these two retrofits.

APPENDIX A - PHOTOGRAPHS AND THEMAL IMAGES

Appendix A.1.a –Tribal Community Hall - Photos

Clinic main entry, viewed from the northwest

Open window, overheated interior

Oil tank, height of feed line to boiler causing air lock, may need booster pump

Lobby, looking into arctic entry

HRV control and one of the unexplained remote, digital thermometers in each room

Digital thermometer adjacent to one of the wall mounted thermostats

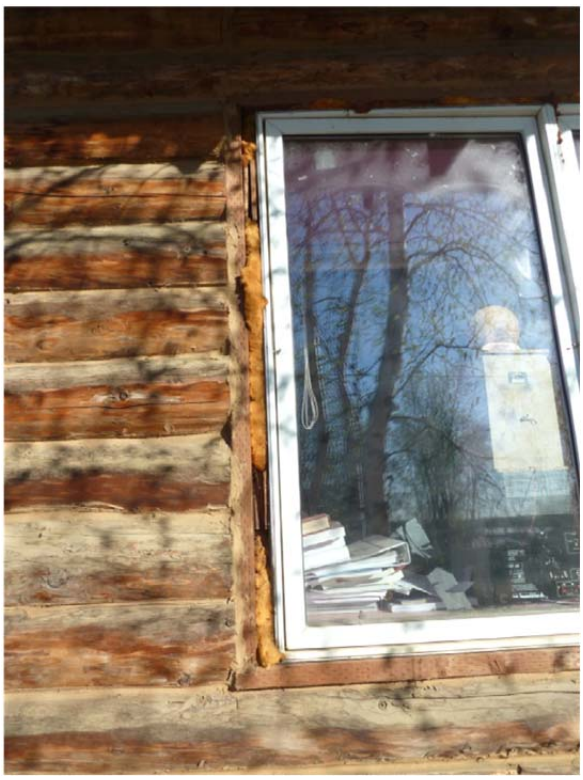
Some of the high plug load equipment in this building

Bare fintube radiators in crawlspace, DanFoss manual, thermostatic control valve

Appendix A.1.b – Clinic - No thermal Images taken

Appendix A.2.a – Tribal Council office – Photos

Looking from the southwest



Window should be trimmed out to prevent infiltration

One of the several envelope penetrations that should be sealed

More envelope penetrations

Kitchen

Dining area, some of the refrigeration loads evident

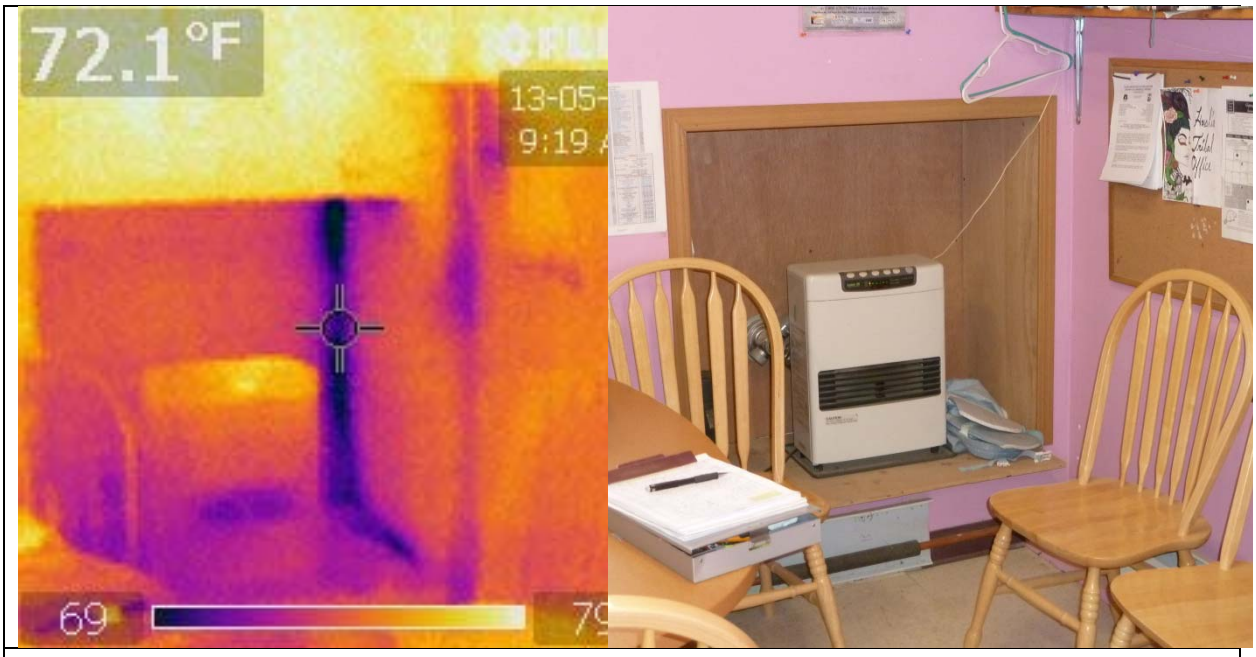
Typical office, north side of building

Underside of roof, foam panels at least as deep as roof joists

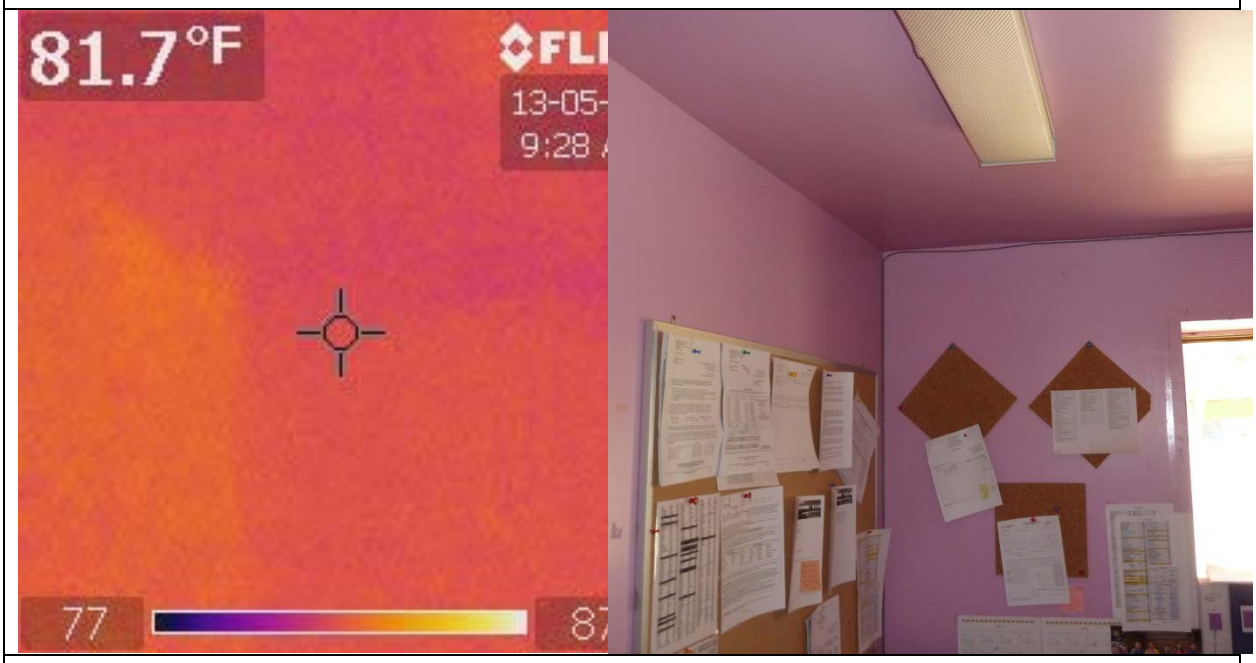
Sole thermostat located; appears to be non-functional since boiler still called for heat, and even if functional, with all zone valves locked open, tstat has no influence on boiler

Boiler; HWG far left. Upper and Lower zone valve locked open, upper not even wired, so non-functional

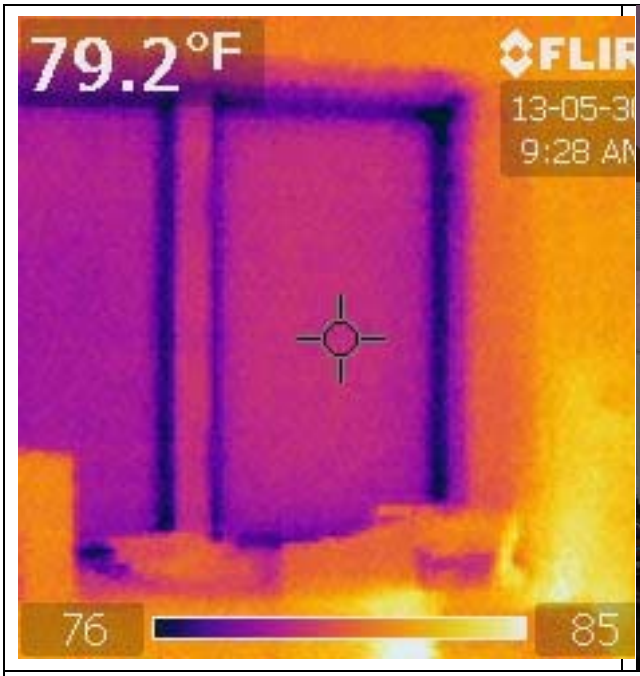
Appendix A.2.b – Tribal Council office – Thermal Images

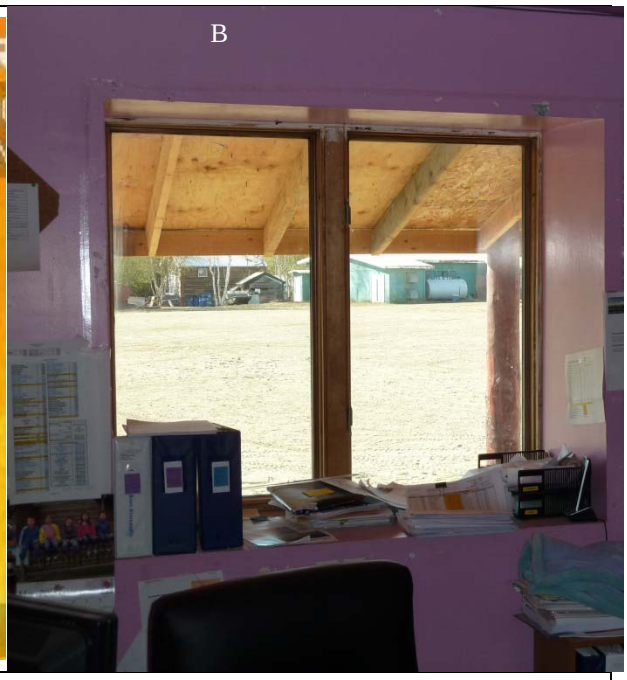


1. Significant heat loss through corner of Toyo enclosure.

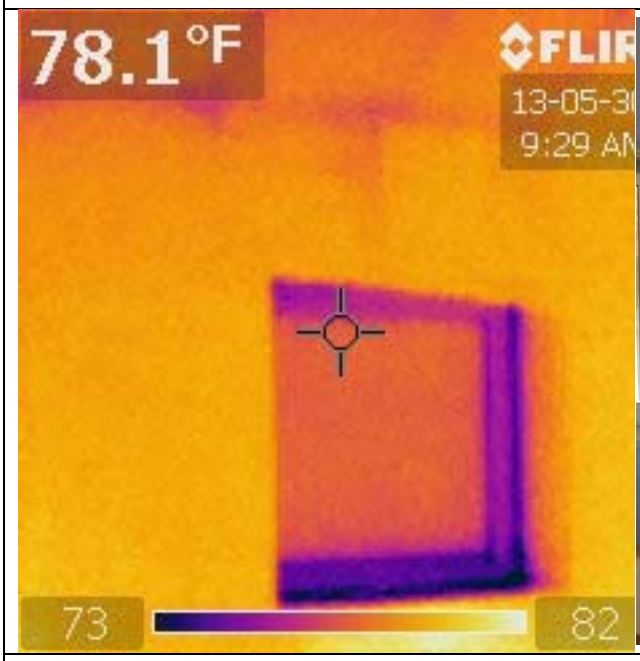


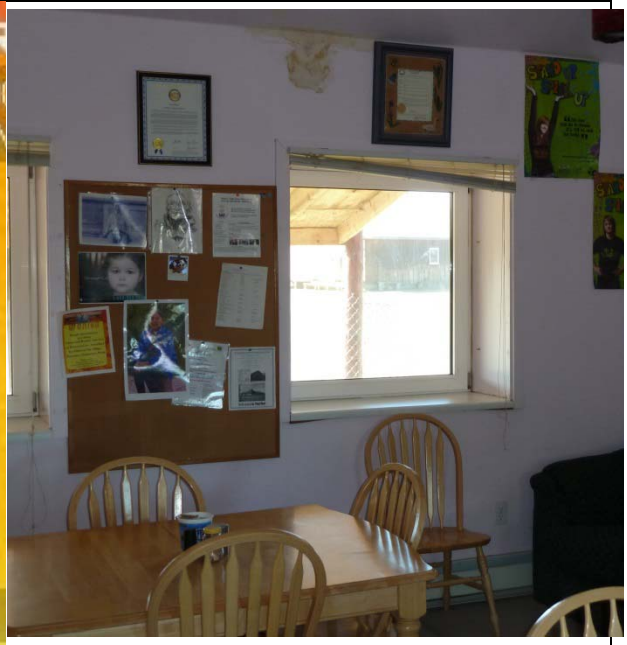
2. No heat loss through super-insulated envelope





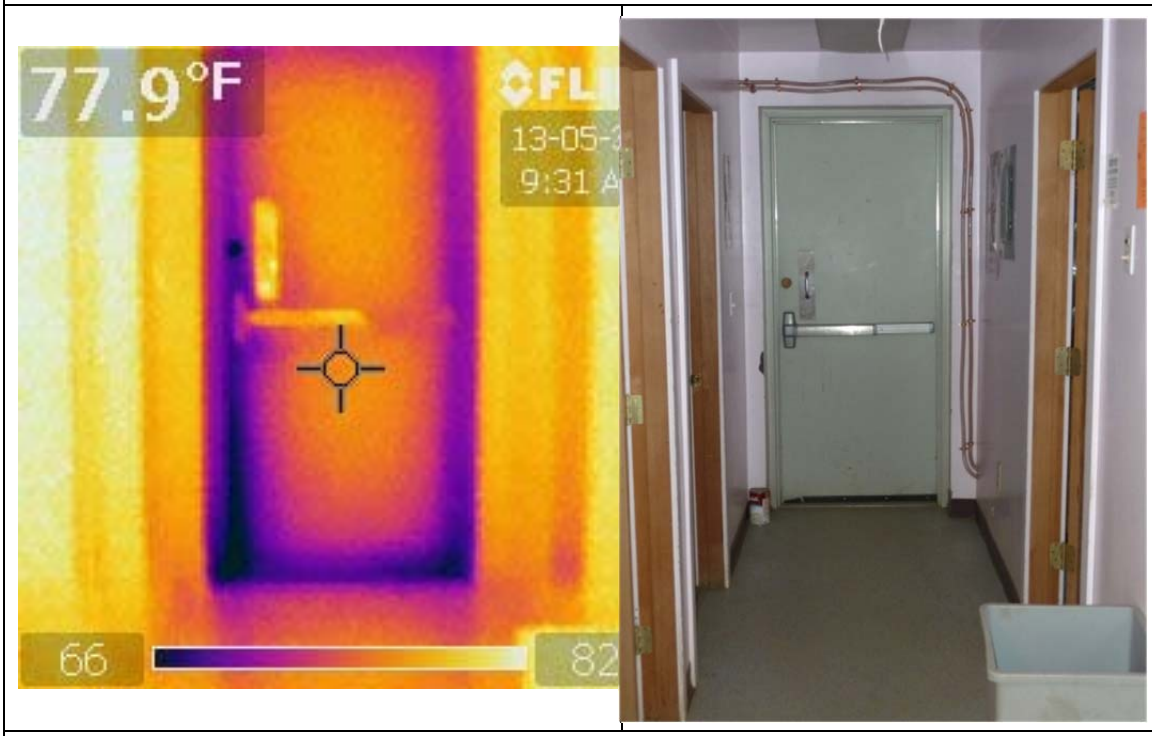
3. Typical and normal heat loss through window frame





4. All windows in good condition

1. Normal heat loss at joist locations

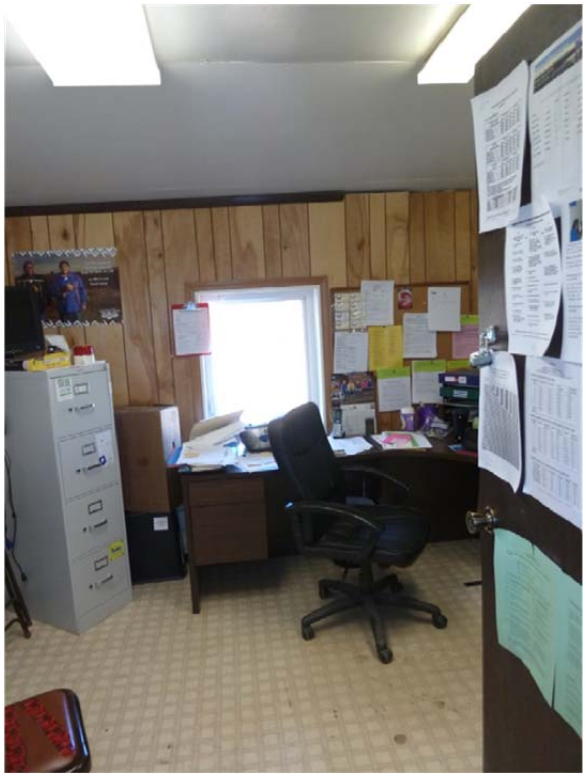


2. Significant (16F temperature differential) heat loss around door, should be weather-stripped

Appendix A.3.a – Dakli Building – Photos

Dirt mounded to prevent water line freeze was successful in 2012/2013 winter (high heat trace loads during 2011/2012 winter)

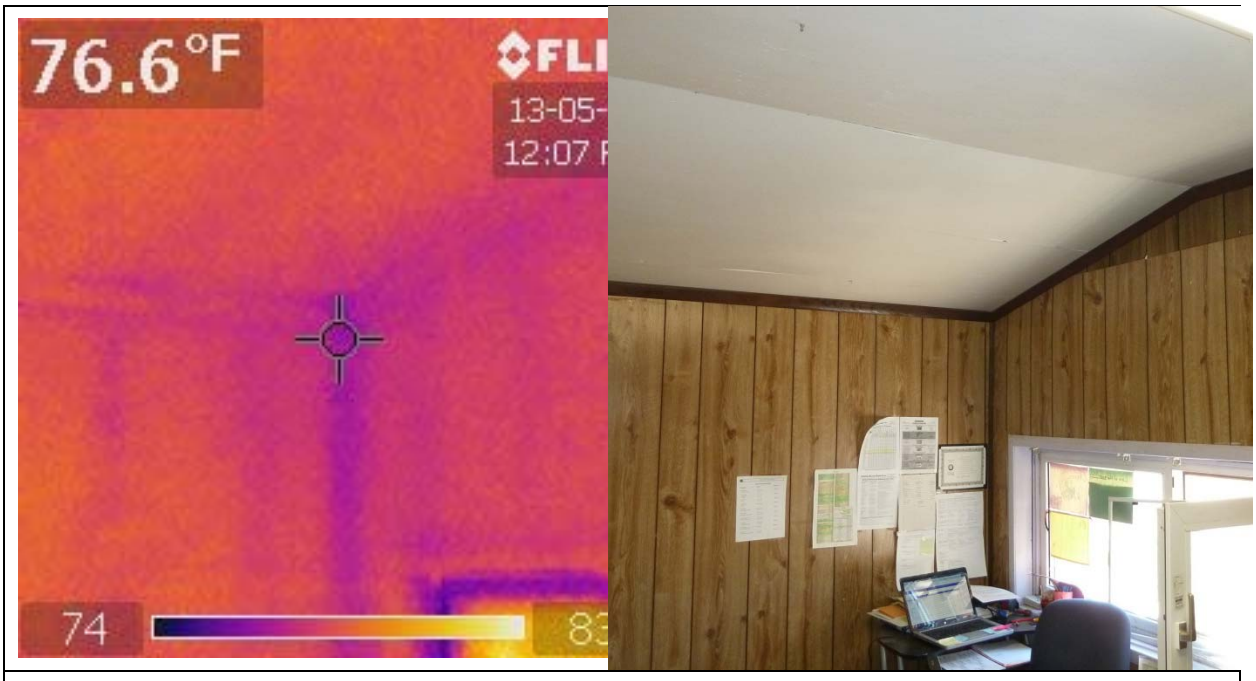
Dense occupancy in this building



Typical office

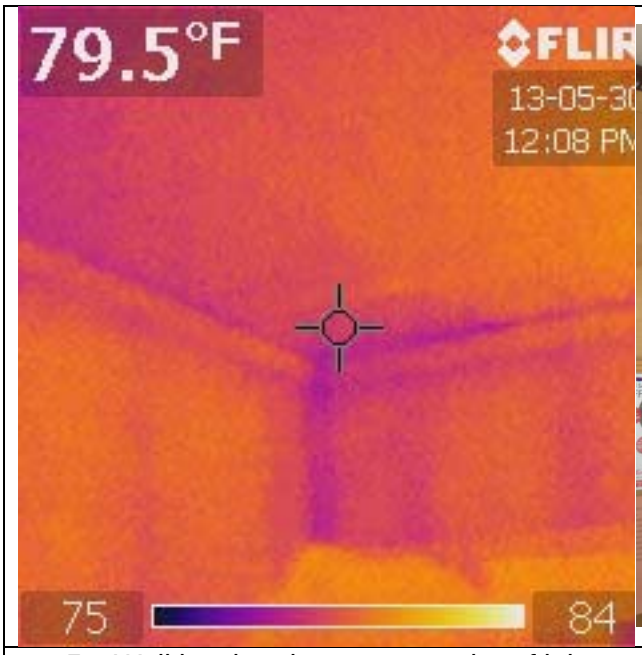
Boiler room

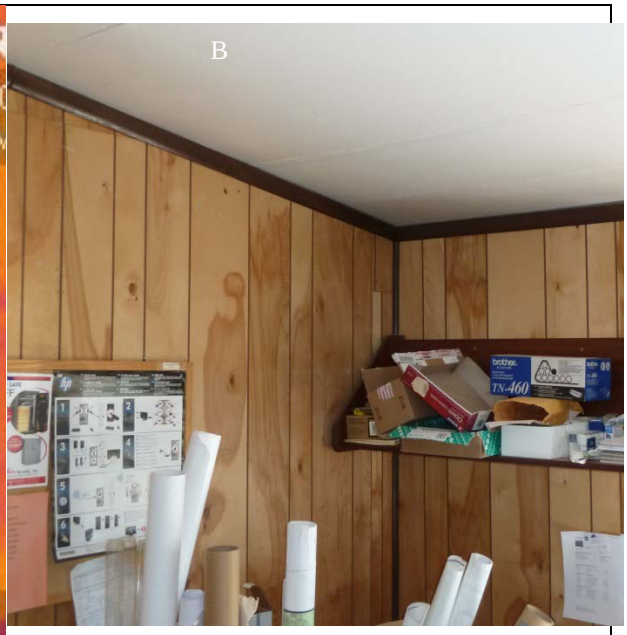
Appendix A.3.b – Dakli Building - Thermal Images



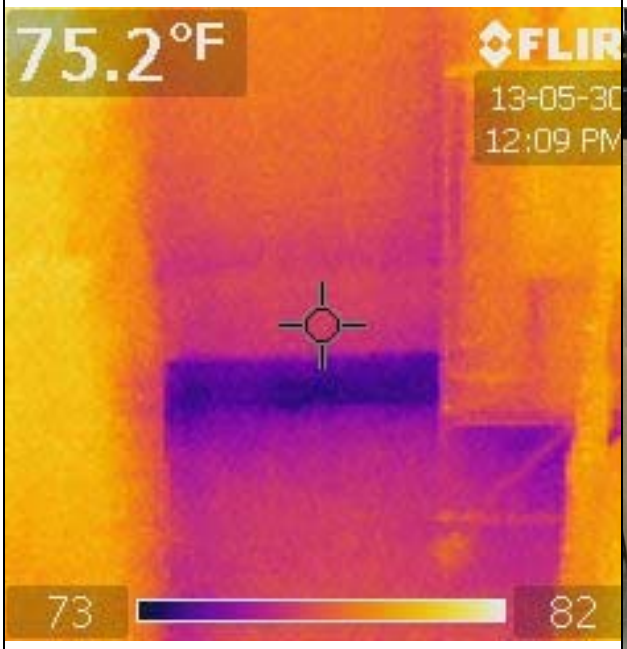
3. Well insulated at corner and roof joints; building was re-roofed in 2011, so insulation probably upgraded

4. Significant heat loss at wall/floor sill joint





5. Well insulated at corner and roof joints, again, probably a result of new roof and upgraded insulation



6. Another example of heat loss at wall/floor joint

Appendix A.4.a – Old Environmental Building - Photos

Wood block foundation supports

Perma-chink in excellent condition

Open floor provides opportunity for insulation upgrade; wood stove will be replaced after renovation

If room ceiling to be removed, another opportunity for insulation upgrade

Appendix A.4.b – Old Environmental Building – No Thermal Images

Appendix A.5.a – Community Hall - Photos

Presumably non-functional AC unit; note fiberglass batt instead of perma-chink

Interior view; Toyostove in background; roof joist shadowing probably a result of soot adhesion from wood burning

Cupola, windows in poor conidtion, should be repaired

Cupola windows – several are broken

Wood burning stove

Appendix A.4.b – Community Hall - No thermal Images

APPENDIX B –EEM AND ECM DETAIL

See Appendix E for sample manufacturer's spec sheets

Appendix B.1.a - Clinic - Detailed AkWarm-C report (See Appendix E for manufacturer's sample spec sheets)

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Clinic

ENERGY AUDIT REPORT – PROJECT SUMMARY – Created 6/12/2013 5:07 PM

General Project Information

PROJECT INFORMATION	AUDITOR INFORMATION
Building: Clinic	**Auditor Company:** Energy Audits of Alaska
Address: Sam Rd.	**Auditor Name:** Jim Fowler, PE
City: Huslia	**Auditor Address:** P.O. Box 220215
Client Name: MaryAnne Sam	Anchorage, AK 99522
Client Address: P.O. Box 70	**Auditor Phone:** (907) 269-4350
Huslia, AK 99746	**Auditor FAX:** ( ) -
Client Phone: (907) 829-2280	**Auditor Comment:**
Client FAX:	

Design Data

Building Area: 2657 square feet in building, additional 2657 square feet of insulated crawl space for a total of 5,314 square feet in thermal model	**Design Heating Load:** Design Loss at Space: 57,243 Btu/hour with Distribution Losses: 61,552 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 93,829 Btu/hour Note: Additional Capacity should be added for DHW load, if served.
Typical Occupancy: 6 people	**Design Indoor Temperature:** 58.1 deg F (building average)
Actual City: Huslia	**Design Outdoor Temperature:** -39.8 deg F
Weather/Fuel City: Huslia	**Heating Degree Days:** 14,942 deg F-days

Utility Information

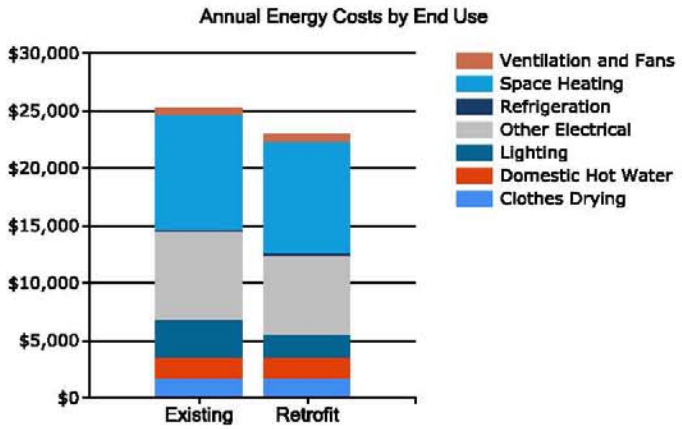
Electric Utility: AVEC-Huslia - Commercial - Sm	**Natural Gas Provider:** None
Average Annual Cost/kWh: $0.601/kWh	**Average Annual Cost/ccf:** $0.000/ccf

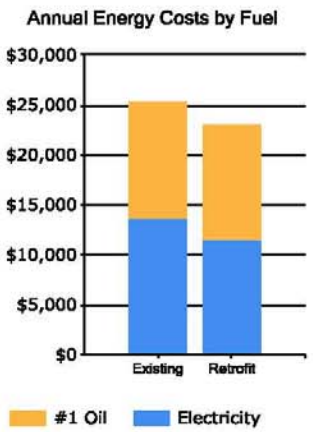
Annual Energy Cost Estimate

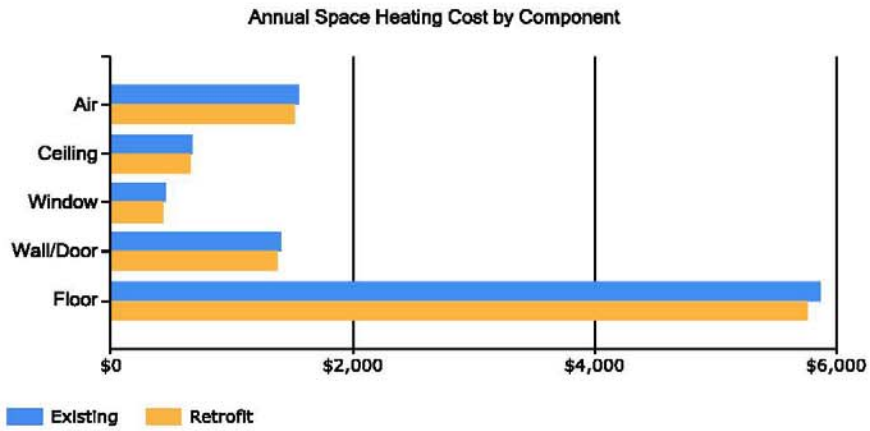
Description	Space Heating	Space Cooling	Water Heating	Lighting	Refrigeration	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	$9,948	$0	$1,842	$3,260	$240	$7,597	$0	$1,757	$609	$0	$25,253
With Proposed Retrofits	$9,767	$0	$1,842	$1,951	$240	$6,807	$0	$1,757	$609	$0	$22,973
SAVINGS	$181	$0	$0	$1,309	$0	$791	$0	$0	$0	$0	$2,280

These totals do not include maintenance savings.

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Clinic







Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Clinic

PRIORITY LIST – RECOMMENDED ENERGY EFFICIENCY MEASURES						
Rank	Feature	Recommendation	Annual Energy Savings	Installed Cost	SIR	Payback (Years)
1	Lighting - Power Retrofit: Entry light	Replace with 3 LED 12W Module StdElectronic	$176	$95	15.56	0.5
2	Setback Thermostat: All other offices and spaces using Danfoss Thermostatic radiator valves	Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the All other offices and spaces using programmable Danfoss Thermostatic radiator valves space.	$448	$1,025	5.93	2.3
3	Other Electrical - Combined Retrofit: Personal Computers	Replace with 6 Laptop at EOL, for incremental cost of @$100 ea	$648	$600	4.01	0.9
4	Lighting - Power Retrofit: South entry light	Replace with LED 10W Module StdElectronic	$108 + $5 Maint. Savings	$430	3.09	4
5	Setback Thermostat: Arctic Entrys	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Arctic Entry space.	$46	$400	1.55	8.7
6	Lighting - Combined Retrofit: Low use rooms, Dental	Replace with 4 FLUOR (3) T8 4' F32T8 28W Energy-Saver Instant StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$157 + $20 Maint. Savings	$754	1.43	4.8
7	Lighting - Combined Retrofit: High use rooms	*Replace with 19 FLUOR (3) T8 4' F32T8 28W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$513 + $95 Maint. Savings	$3,479	1.07	6.8
8	Lighting - Combined Retrofit: High use rooms	Replace with 8 FLUOR (3) T8 4' F32T8 28W Energy-Saver Program HighLight StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$87 + $40 Maint. Savings	$1,508	0.52	17.4
9	Setback Thermostat: Lobby & 2 toilet room Radiant panels	Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the Lobby & 2 toilet room Radiant panels space.	$18	$600	0.42	32.6

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Clinic

PRIORITY LIST – RECOMMENDED ENERGY EFFICIENCY MEASURES						
Rank	Feature	Recommendation	Annual Energy Savings	Installed Cost	SIR	Payback (Years)
10	Lighting - Combined Retrofit: Low use room: server, arctic entries, morgue, storage	Replace with 4 FLUOR (3) T8 4' F32T8 28W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor and Improve Clock Timer or Other Scheduling Control	$47 + $15 Maint. Savings	$1,044	0.36	22.4
11	Lighting - Combined Retrofit: Low use rooms: Boiler, (2) storage, dental storage, (2) toilet	Replace with 6 FLUOR (2) T8 4' F32T8 28W Energy-Saver (2) Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$33 + $30 Maint. Savings	$1,264	0.31	38
	TOTAL		**$2,280 + $205 Maint. Savings**	**$11,199**	**1.65**	**4.9**

Sample translations of the nomenclature used above:

* (item 7) Replace the (19) existing T8-2 lamp, 32 watt fluorescent tubes with T8-28 watt energy saving tubes. Replace the manual switches with the number and type of occupancy sensors stated in Auditors Notes in Appendix B which immediately follows.

AkWarmCalc Ver 2.2.0.4, Energy Lib 2/12/2013

Appendix B.1.b – Clinic - Detailed AkWarm-C report with auditor's comments

Existing Conditions, electrical and fuel oil consumption:

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	514	468	514	394	407	394	407	407	394	514	497	514
Refrigeration	34	31	34	33	34	33	34	34	33	34	33	34
Other_Electrical	1073	977	1073	1038	1073	1038	1073	1073	1038	1073	1038	1073
Clothes_Drying	248	226	248	240	248	240	248	248	240	248	240	248
Ventilation_Fans	86	78	86	83	86	83	86	86	83	86	83	86
DHW	9	8	9	9	9	9	9	9	9	9	9	9
Space_Heating	13	11	9	4	0	0	0	0	1	5	10	13
Space_Cooling	0	0	0	0	0	0	0	0	0	0	0	0

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	22	20	22	21	22	21	22	22	21	22	21	22
Space_Heating	280	226	192	86	5	0	0	2	29	109	212	275

Night Setback Thermostat Measures

Rank	Building Space	Recommendation
2	All other offices and spaces using Danfoss Thermostatic radiator valves	Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the All other offices and spaces using Danfoss Thermostatic radiator valves space.

Installation Cost	$1,025	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$448
Breakeven Cost	$6,081	**Savings-to-Investment Ratio**	5.9	**Simple Payback yrs**	2

Auditors Notes:

Rank	Building Space	Recommendation
5	Arctic Entrys	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Arctic Entrys space.

Installation Cost	$400	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$46
Breakeven Cost	$621	**Savings-to-Investment Ratio**	1.6	**Simple Payback yrs**	9

Auditors Notes:

Rank	Building Space			Recommendation	
9	Lobby & 2 toilet room Radiant panels			Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the Lobby & 2 toilet room Radiant panels space.	
Installation Cost	$600	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$18
Breakeven Cost	$250	**Savings-to-Investment Ratio**	0.4	**Simple Payback yrs**	33
Auditors Notes:					

Lighting Measures

Rank	Location	Existing Condition		Recommendation	
1	Entry light	3 INCAN A Lamp, Std 60W with Manual Switching		Replace with 3 LED 12W Module StdElectronic	
Installation Cost	$95	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$176
Breakeven Cost	$1,478	**Savings-to-Investment Ratio**	15.6	**Simple Payback yrs**	1
Auditors Notes: Replace incandescent bulb with screw in LED @ $25 + .5 hr labor @ $40/hr.					

Rank	Location	Existing Condition		Recommendation	
4	South entry light	HPS 35 Watt Magnetic with On/Off Photoswitch		Replace with LED 10W Module StdElectronic	
Installation Cost	$430	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$108
				Maintenance Savings (/yr)	$5
Breakeven Cost	$1,327	**Savings-to-Investment Ratio**	3.1	**Simple Payback yrs**	4
Auditors Notes: Replace existing HID fixture with LED fixture @ $350 + 2 hrs labor @ $40/hr. Maint. savings $5/fixture since LED's last 15 years					

Rank	Location	Existing Condition		Recommendation	
6	Low use rooms, Dental	4 FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with 4 FLUOR (3) T8 4' F32T8 28W Energy-Saver Instant StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	
Installation Cost	$754	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$157
				Maintenance Savings (/yr)	$20
Breakeven Cost	$1,080	**Savings-to-Investment Ratio**	1.4	**Simple Payback yrs**	5
Auditors Notes: Replace T8 32 watt lamps in each fixture with T8 28 watt lamps @ $2 ea., replace instant start ballast with program start ballast @ $50 ea + 1.5 hrs/fixture @ $40/hr labor. Add (2) switch mounted occupancy sensors @ $125 parts + .5 hr labor. Maint. savings $5/fixture since new lamps and ballast.					

Rank	Location	Existing Condition	Recommendation
7	High use rooms	19 FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with 19 FLUOR (3) T8 4' F32T8 28W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$3,479	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$513
				Maintenance Savings (/yr)	$95
Breakeven Cost	$3,720	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	7

Auditors Notes: Replace T8-32 watt lamps with T8-28 watt lamps@ $2 ea. and new program start ballasts @ $50/ballast plus labor @ 1.5 hr/fixture @ $40/hr labor rate. Install (5) switch mounted occupancy sensors in (5) offices @ $125 ea plus .5 hrs labor ea. Install (2) ceiling mounted occupancy sensors in the lobby and corridor @ $125 ea + power pack @ $70 ea + 4 hrs labor. Maint. savings $5/fixture due to re-lamp and re-ballast.

Rank	Location	Existing Condition	Recommendation
8	High use rooms	8 FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with 8 FLUOR (3) T8 4' F32T8 28W Energy-Saver Program HighLight StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$1,508	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$87
				Maintenance Savings (/yr)	$40
Breakeven Cost	$777	**Savings-to-Investment Ratio**	0.5	**Simple Payback yrs**	17

Auditors Notes: Replace T8-32 watt lamps with T8-28 watt lamps@ $2 ea. and new program start ballasts in the 4 rooms @ $50/ballast plus labor @ 1.5 hr/fixture @ $40/hr labor rate. Install (4) switch mounted occupancy sensors @ $125 ea plus .5 hrs labor ea. Maint. savings $5/fixture due to re-lamp and re-ballast.

Rank	Location	Existing Condition	Recommendation
10	Low use room: server, arctic entrys, morgur storage	4 FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with 4 FLUOR (3) T8 4' F32T8 28W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor and Improve Clock Timer or Other Scheduling Control

Installation Cost	$1,044	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$47
				Maintenance Savings (/yr)	$15
Breakeven Cost	$378	**Savings-to-Investment Ratio**	0.4	**Simple Payback yrs**	22

Auditors Notes: Replace T8 32 watt lamps in each fixture with T8 28 watt lamps @ $2 ea., replace instant start ballast with program start ballast @ $50 ea + 1.5 hrs/fixture @ $40/hr labor. Add (4) switch mounted occupancy sensors @ $125 parts + .5 hr labor. Maint. savings $5/fixture since new lamps and ballast.

Rank	Location	Existing Condition	Recommendation
11	Low use rooms: Boiler, (2) storage, dental storage, (2) toilet	6 FLUOR (2) T8 4' F32T8 32W Standard (2) Instant StdElectronic with Manual Switching	Replace with 6 FLUOR (2) T8 4' F32T8 28W Energy-Saver (2) Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$1,264	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$33
				Maintenance Savings (/yr)	$30
Breakeven Cost	$390	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	38

Auditors Notes: Replace T8 32 watt lamps in each fixture with T8 28 watt lamps @ $2 ea., replace instant start ballast with program start ballast @ $50 ea + 1.5 hrs/fixture @ $40/hr labor. Add (4) switch mounted occupancy sensors @ $125 parts + .5 hr labor. Maint. savings $5/fixture since new lamps and ballast.

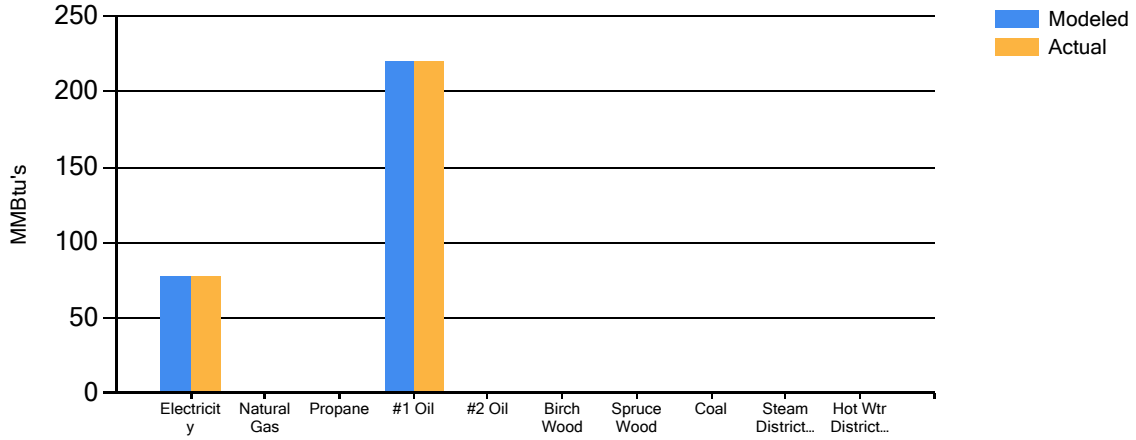
Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation
3	Personal Computers	6 Desktop PC with LCD monitor with Manual Switching	Replace with 6 Laptop at EOL, for incremental cost of @$100 ea and Remove Manual Switching and Add new Other Controls

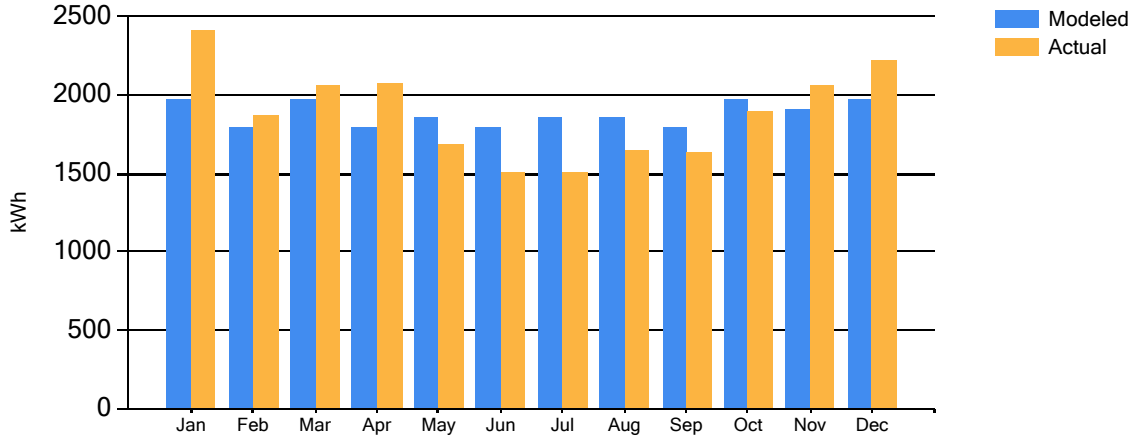
Installation Cost	$600	**Estimated Life of Measure (yrs)**	4	**Energy Savings (/yr)**	$648
Breakeven Cost	$2,407	**Savings-to-Investment Ratio**	4.0	**Simple Payback yrs**	1

Auditors Notes:

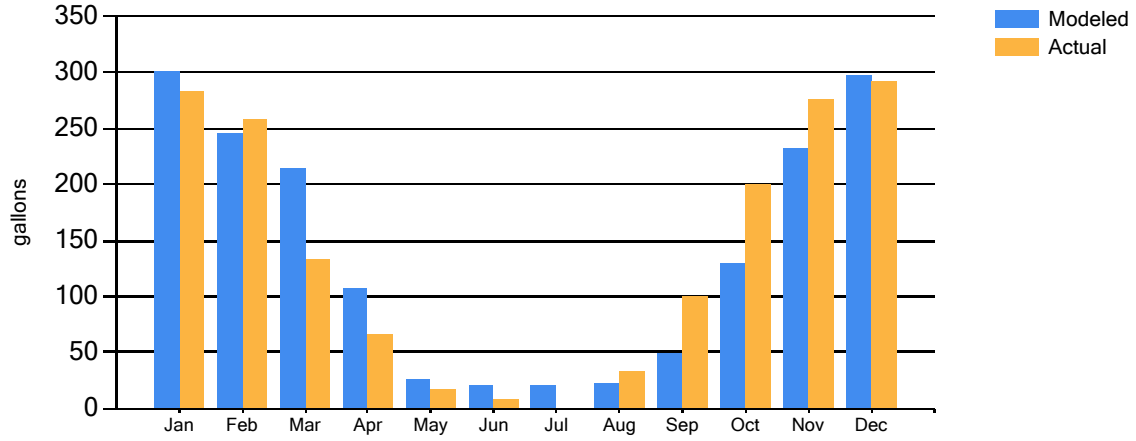
Annual Fuel Use



Electric Fuel Use



#1 Fuel Oil Fuel Use



Demand Loads

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	11.3	11.3	11.3	11.2	11.2	11.2	11.2	11.2	11.2	11.3	11.3	11.3
As Proposed	9.6	9.6	9.6	9.5	9.5	9.5	9.5	9.5	9.5	9.6	9.6	9.6

Estimated Demand Charges (at $0.00/kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
As Proposed	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Appendix B.1.c – Clinic – Detailed ECM's

No and low-cost EEM's are called ECM's and are usually implemented by the existing operations and maintenance staff (so are sometimes called O & M recommendations). The following ECM's are recommended for this facility.

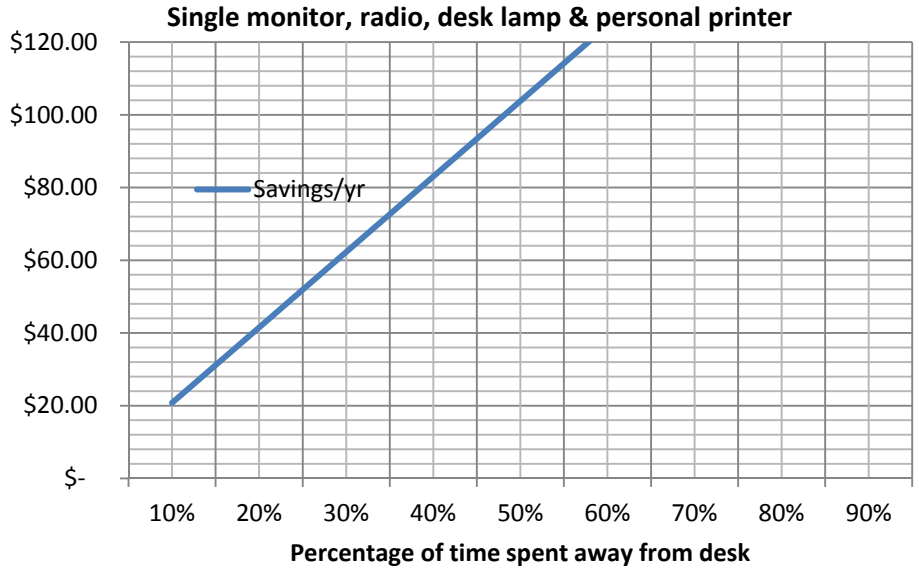
1. Implement building monitoring, see Appendix L. Install a cumulative flow meter (see Appendix E) to measure actual gallons used by the building; the "energy champion" should take monthly readings during his walk through and enter consumption into the energy monitoring spreadsheet. Tracking actual usage this way will bring a building systems inefficiency to light within a month or two, whereas without a system like this, an inefficiency may never be identified and rectified. Studies have shown monitored buildings consume up to 15% less energy than un-monitored buildings. A 10% increase in energy costs in this building is $2,297/yr.
2. Create a village "energy champion" and provide training. It can be an existing staff person, typically a maintenance person, to perform a monthly walk-through of each building using an Energy Checklist similar to the sample in Appendix J. Savings from this activity can vary from zero to 10% of the building's annual heating cost.

   As an example, if the recommended programmable setback thermostat in the main room of this building were to be altered by an occupant (which happens regularly) and the setback no longer worked, there would be a $520/yr increase on heating cost.

   If a zone valve is stuck or locked open for 4 winter months, or the contacts that turn off the circulation pump are not functioning properly, the boiler continues to produce heat and occupants start opening windows and doors. This can easily result in 750 CFM of additional infiltration. AkWarm-C calculates an additional heating cost of $408/yr resulting from this additional infiltration.

   If an occupant raises the room temperature by 2F, the energy costs for this building will increase by $70/yr.
3. All man-doors, roll-up doors and windows should be properly maintained and adjusted to close and function properly. Additionally, weather stripping should be maintained if it exists or added if it does not. Door periphery heat loss is very apparent in the IR images in Appendix A. Poorly maintained weather stripping or leaky doors or windows can add 400 CFM of infiltration, which is calculated to add $89/yr by AkWarm-C to heating costs in this building.
4. Turn off computers, printers, faxes, etc. when leaving the office. For workstations where the occupant regularly leaves their desk, add an occupancy sensing plug load management device (PLMD) like the "Isole" shown in Appendix E.5. The graph below demonstrates annual savings for various amounts of time spent away from the desk - it is not

unusual to be away from the desk for 30% of the work day, which translates to $60/yr savings per occupant.



5. If possible, re-configure building occupants and activities to group un-occupied offices (i.e. no tenant or staff using the space) or little used spaces, into the same HVAC zone so that zone's temperature can be set back to minimal levels.
6. Lamp replacement should be a scheduled, preventative maintenance activity. Re-lamp the entire building, so lamps have roughly the same lifetime, as part of a scheduled preventative maintenance routine. This assures all lamps are the same color temperature (e.g. 2700K, 3000K, etc.) which enhances occupant comfort and working efficiency and minimizes expense. It is estimated to save 40 labor hours each year if the maintenance person does not have to change any lamps, and instead, confines that activity to a building re-lamp once each 7 years.
7. HVAC – A mini re-commissioning of the HVAC system should occur annually. This would include boiler blow down and cleaning, check all zone valves for correct operation (they tend to be stuck open in the spring and stuck closed in the fall), check dampers, actuators and valves for correct operation and replacement of filters. An un-maintained boiler can result in a 3% drop in efficiency, which translates to $402 in this building.
8. A building is a living mini-ecosystem and its use changes. Re-evaluate building usage at least annually and confirm that building set points, zones, lighting levels, etc. are optimized for the current usage and occupancy. Maintain safety stock of critical HVAC components such as zone valves, circulation pumps.

Appendix B.2.a – Tribal Council Office - Detailed AkWarm-C report

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Tribal Council Office

ENERGY AUDIT REPORT – PROJECT SUMMARY – Created 6/12/2013 6:18 PM

General Project Information

PROJECT INFORMATION	AUDITOR INFORMATION
Building: Tribal Council Office	**Auditor Company:** Energy Audits of Alaska
Address: Lakeview Dr	**Auditor Name:** Jim Fowler, PE
City: Huslia	**Auditor Address:** P.O. Box 220215 Anchorage, AK 99522
Client Name: MaryAnne Sam	
Client Address: P.O. Box 70 Huslia, AK 99746	**Auditor Phone:** (907) 269-4350
	Auditor FAX: ( ) -
Client Phone: (907) 829-2280	**Auditor Comment:**
Client FAX:	

Design Data

Building Area: 1,624 square feet	**Design Heating Load:** Design Loss at Space: 11,836 Btu/hour with Distribution Losses: 12,459 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 18,993 Btu/hour Note: Additional Capacity should be added for DHW load, if served.
Typical Occupancy: 10 people	**Design Indoor Temperature:** 70 deg F (building average)
Actual City: Huslia	**Design Outdoor Temperature:** -39.8 deg F
Weather/Fuel City: Huslia	**Heating Degree Days:** 14,942 deg F-days

Utility Information

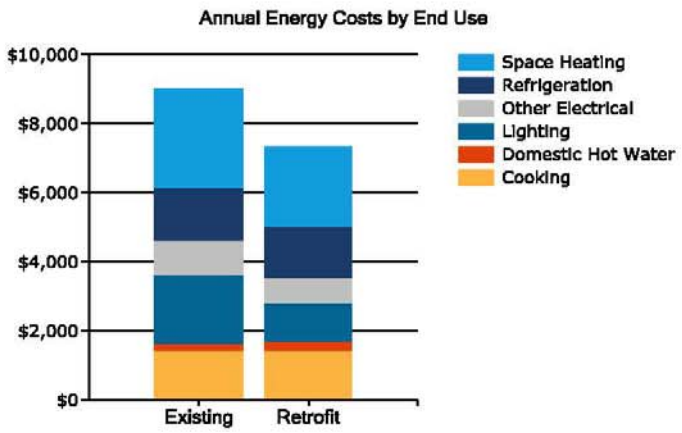
Electric Utility: AVEC-Huslia - Commercial - Sm	**Natural Gas Provider:** None
Average Annual Cost/kWh: $0.601/kWh	**Average Annual Cost/ccf:** $0.000/ccf

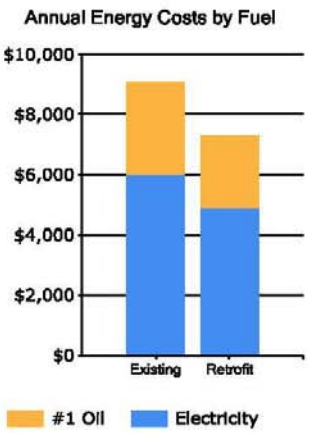
Annual Energy Cost Estimate

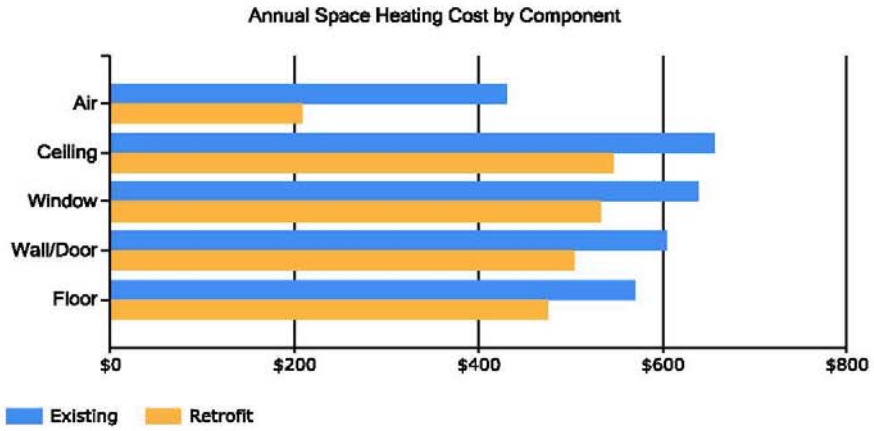
Description	Space Heating	Space Cooling	Water Heating	Lighting	Refrigeration	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	$2,900	$0	$233	$1,996	$1,533	$964	$1,426	$0	$0	$0	**$9,052**
With Proposed Retrofits	$2,265	$0	$261	$1,126	$1,533	$721	$1,426	$0	$0	$0	**$7,332**
SAVINGS	$634	$0	-$28	$870	$0	$243	$0	$0	$0	$0	**$1,720**

Maintenance savings not included in these totals.

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Tribal Council Office







Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Tribal Council Office

PRIORITY LIST – RECOMMENDED ENERGY EFFICIENCY MEASURES						
Rank	Feature	Recommendation	Annual Energy Savings	Installed Cost	SIR	Payback (Years)
1	Lighting - Power Retrofit: Exterior double floods	Replace with 3 LED (2) 20W Module StdElectronic	$414 + $10 Maint. Savings	$90	55.34	0.2
2	Lighting - Power Retrofit: Entry light	Replace with FLUOR CFL, A Lamp 15W	$27	$9	18.83	0.3
3	Setback Thermostat: Kitchen	Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the Kitchen space.	$137	$200	9.29	1.5
4	HVAC and Air Tightening	Replace zone valves if they are faulty; if not, keep on automatic; zone valves were manually over-ridden open, so causing excessive uncontrolled heat output. 1500 Btu/hr should go to 0 with auto zone valves. Heads are $75 ea, assume 5 hrs labor to change. This will also reduce air infiltration since windows and doors will be closed.	$459	$425	10.03	1.7
5	Setback Thermostat: Lobby and offices	Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the Lobby and offices space.	$96	$200	6.52	2.1
6	Lighting - Combined Retrofit: Dining lights	Replace with 4 LED (2) 10W Module StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$157 + $40 Maint. Savings	$425	5.66	2.7
7	Lighting - Controls Retrofit: Dining - peak of ceiling	Remove Manual Switching and Add new Clock Timer or Other Scheduling Control	$40	$80	3.06	2
8	Other Electrical - Combined Retrofit: Personal Computers	Replace with 4 Laptop at EOL, for incremental cost of @$100 ea and Remove Manual Switching and Add new Other Controls	$212	$300	2.62	1.4
9	Lighting - Combined Retrofit: Toilet room	Replace with FLUOR (6) CFL, A Lamp 9W and Remove Manual Switching and Add new Occupancy Sensor	$29	$195	0.92	6.7

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Tribal Council Office

PRIORITY LIST – RECOMMENDED ENERGY EFFICIENCY MEASURES						
Rank	Feature	Recommendation	Annual Energy Savings	Installed Cost	SIR	Payback (Years)
10	Lighting - Combined Retrofit: Kitchen	Replace with 2 FLUOR (4) T8 4' F32T8 25W Energy-Saver Instant StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$23 + $10 Maint. Savings	$421	0.49	17.9
11	Lighting - Combined Retrofit: Lobby and offices	Replace with 11 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program HighLight StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$116 + $55 Maint. Savings	$2,239	0.47	19.4
12	Lighting - Combined Retrofit: Storage light	Replace with FLUOR (2) T8 4' F32T8 25W Energy-Saver Instant StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$10 + $5 Maint. Savings	$425	0.22	41.8
	TOTAL		$1,720 + $120 Maint. Savings	$5,010	3.9	2.9

See notes following Appendix B.1.a for AkWarm-C nomenclature used.

Appendix B.2.b – Tribal Council Office - Detailed AkWarm-C report with auditor's comments

Existing Conditions, electrical and fuel oil consumption:

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	390	355	390	161	167	185	191	191	175	390	377	348
Refrigeration	216	197	216	209	216	209	216	216	209	216	209	216
Other_Electrical	140	128	140	136	140	136	140	140	136	140	136	91
Cooking	201	183	201	195	201	195	201	201	195	201	195	201
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	17	15	15	14	13	13	13	14	13	14	15	17
Space_Cooling	0	0	0	0	0	0	0	0	0	0	0	0

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	80	66	58	53	53	1	1	3	52	56	65	82

Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
3	Kitchen			Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the Kitchen space.	
Installation Cost	$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$102
Breakeven Cost	$1,383	**Savings-to-Investment Ratio**	6.9	**Simple Payback yrs**	2
Auditors Notes:					

Rank	Building Space			Recommendation	
5	Lobby and offices			Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the Lobby and offices space.	
Installation Cost	$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$61
Breakeven Cost	$826	**Savings-to-Investment Ratio**	4.1	**Simple Payback yrs**	3
Auditors Notes:					

Lighting Measures

Rank	Location	Existing Condition	Recommendation
1	Exterior double floods	3 INCAN (2) A Lamp, Std 75W with On/Off Photoswitch	Replace with 3 LED (2) 20W Module StdElectronic

Installation Cost	$90	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$414
				Maintenance Savings (/yr)	$10
Breakeven Cost	$4,980	**Savings-to-Investment Ratio**	55.3	**Simple Payback yrs**	0

Auditors Notes: (1) fixture has no bulbs, they are added in this EEM. Replace existing incandescent bulbs with LED bulbs @ $35 ea parts + .5 hr labor @ $40/hr for all fixtures. Maint. savings $5/fixture since LED's last 15 years

Rank	Location	Existing Condition	Recommendation
2	Entry light	INCAN A Lamp, Std 60W with Manual Switching	Replace with FLUOR CFL, A Lamp 15W

Installation Cost	$9	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$27
Breakeven Cost	$170	**Savings-to-Investment Ratio**	18.8	**Simple Payback yrs**	0

Auditors Notes: Replace incandescent bulb with CFL @ $5 + .1 hr labor @ $40/hr.

Rank	Location	Existing Condition	Recommendation
4	Dining lights	4 INCAN (2) A Lamp, Std 60W with Manual Switching	Replace with 4 LED (2) 10W Module StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$425	**Estimated Life of Measure (yrs)**	16	**Energy Savings (/yr)**	$161
				Maintenance Savings (/yr)	$40
Breakeven Cost	$2,459	**Savings-to-Investment Ratio**	5.8	**Simple Payback yrs**	3

Auditors Notes: Replace the incandescent bulbs with LED bulbs (these fixtures require either scaffolding or a lift, so bulb changes = high maintenance cost and the LED' s will last for 20 yeras) @ $25 ea + 2 hrs labor @ $40/hr; add switch mounted occupancy sensor @ $125 parts + .5 hrs labor. Maint savings $10/fixture

Rank	Location	Existing Condition	Recommendation
8	Toilet room	INCAN (6) A Lamp, Std 25W with Manual Switching	Replace with FLUOR (6) CFL, A Lamp 9W and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$195	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$30
Breakeven Cost	$186	**Savings-to-Investment Ratio**	1.0	**Simple Payback yrs**	6

Auditors Notes: Replace incandescent bulbs with CFL's @ $5 ea + $.2 labor @ $40/hr. Install switch mounted occupancy sensor @ $125 parts + .5 hr labor.

Rank	Location	Existing Condition	Recommendation
9	Kitchen	2 FLUOR (2) T8 4' F32T8 32W Standard (2) Instant StdElectronic with Manual Switching	Replace with 2 FLUOR (4) T8 4' F32T8 25W Energy-Saver Instant StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$421	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$24
				Maintenance Savings (/yr)	$10
Breakeven Cost	$212	**Savings-to-Investment Ratio**	0.5	**Simple Payback yrs**	17

Auditors Notes: Remove 1 fixture @ 1 hr @ $40/hr labor. Replace (2) T8 32 watt lamps in each remaining fixture with T8 25 watt lamps @ $2 ea., replace instant start ballst with program start ballast @ $50 ea + 1.5 hrs/fixture @ $40/hr labor. Add switch mounted occupancy sensor @ $125 parts + .5 hr labor. Maint. savings $5/fixture since new lamps and ballast.

Rank	Location	Existing Condition	Recommendation
10	Lobby and offices	11 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with 11 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program HighLight StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$2,239	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$121
				Maintenance Savings (/yr)	$55
Breakeven Cost	$1,085	**Savings-to-Investment Ratio**	0.5	**Simple Payback yrs**	19

Auditors Notes: Replace T8-32 watt lamps with T8-25 watt lamps@ $2 ea. and new program start, HIGH OUTPUT ballasts in the 3 offices (light levels are sub-standard in these offices) and standard output ballasts in the lobby and corridor, all @ $50/ballast plus labor @ 1.5 hr/fixture @ $40/hr labor rate. Install (2) ceiling mounted occupancy sensors in lobbylcorridor area @ $125 ea and power pack @ $70 ea. plus 2 hrs labor ea; install (3) switch mounted occupancy sensors in the (3) offices @ $125 parts + .5 hrs labor each. Maint. savings $5/fixture due to re-lamp and re-ballast.

Rank	Location	Existing Condition	Recommendation
11	Storage light	FLUOR (2) T8 4' F32T8 32W Standard (2) Instant StdElectronic with Manual Switching	Replace with FLUOR (2) T8 4' F32T8 25W Energy-Saver Instant StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$425	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$11
				Maintenance Savings (/yr)	$5
Breakeven Cost	$96	**Savings-to-Investment Ratio**	0.2	**Simple Payback yrs**	40

Auditors Notes: Replace existing fixture (which has 2 lamps removed) with 2-lamp T8 fixture with program start electronic ballast @ $200 parts + 2 hrs labor @ $40/hr. Install switch mounted occupancy sensor @ $125 parts + .5 hrs labor. Maint. savings $5/fixture since new lamps and ballast.

Rank	Location	Existing Condition	Recommendation
6	Dining - peak of ceiling	2 FLUOR (2) T12 4' F40T12 40W Standard Magnetic with Manual Switching	Remove Manual Switching and Add new Clock Timer or Other Scheduling Control

Installation Cost	$80	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$41
Breakeven Cost	$254	**Savings-to-Investment Ratio**	3.2	**Simple Payback yrs**	2

Auditors Notes: Remove these 2 fixtures, they are almost never used according to Tracy the cook.

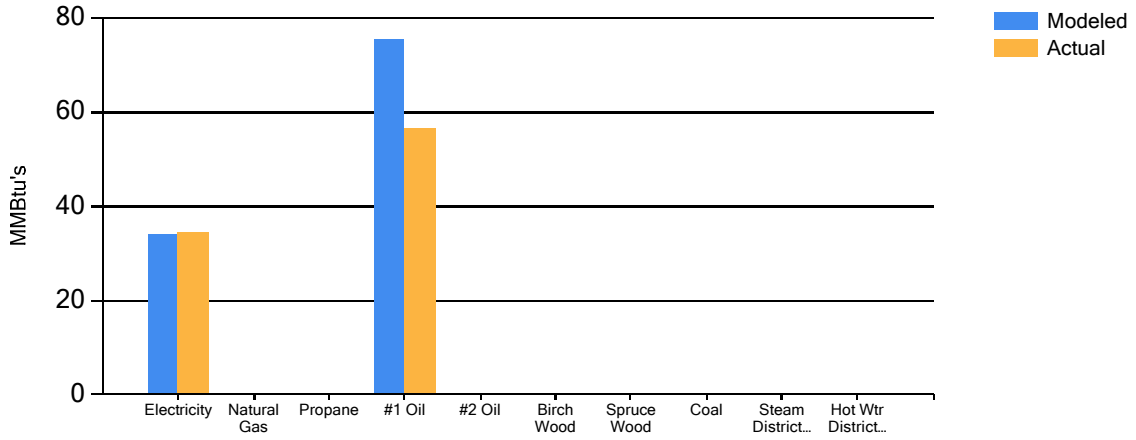
Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation
7	Personal Computers	4 Desktop PC with LCD monitor with Manual Switching	Replace with 4 Laptop at EOL, for incremental cost of @$100 ea and Remove Manual Switching and Add new Other Controls

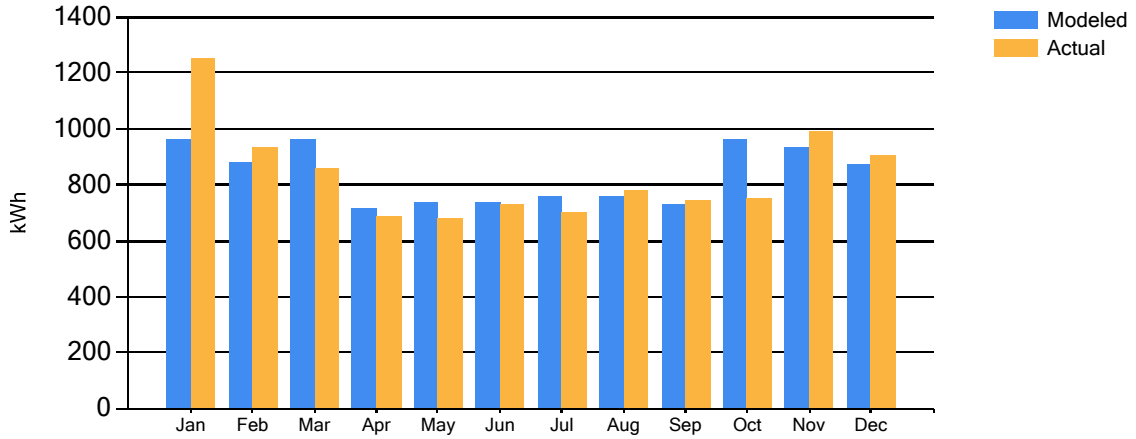
Installation Cost	$300	**Estimated Life of Measure (yrs)**	4	**Energy Savings (/yr)**	$220
Breakeven Cost	$818	**Savings-to-Investment Ratio**	2.7	**Simple Payback yrs**	1

Auditors Notes:

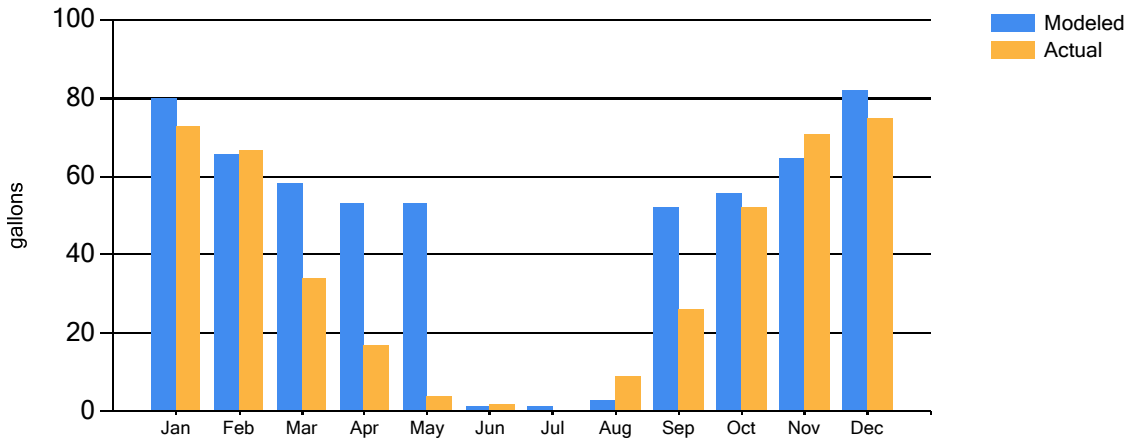
Annual Fuel Use



Electric Fuel Use



#1 Fuel Oil Fuel Use



Demand Loads

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	6.3	6.3	6.3	6.0	6.0	4.8	4.8	4.8	5.1	6.3	6.3	5.8
As Proposed	5.5	5.5	5.5	5.3	5.3	4.1	4.1	4.1	4.5	5.5	5.5	5.1

Estimated Demand Charges (at $0.00/kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
As Proposed	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Appendix B.2.c – Tribal Council Office – Detailed ECM's

No and low-cost EEM's are called ECM's and are usually implemented by the existing operations and maintenance staff (so are sometimes called O & M recommendations). The following ECM's are recommended for this facility.

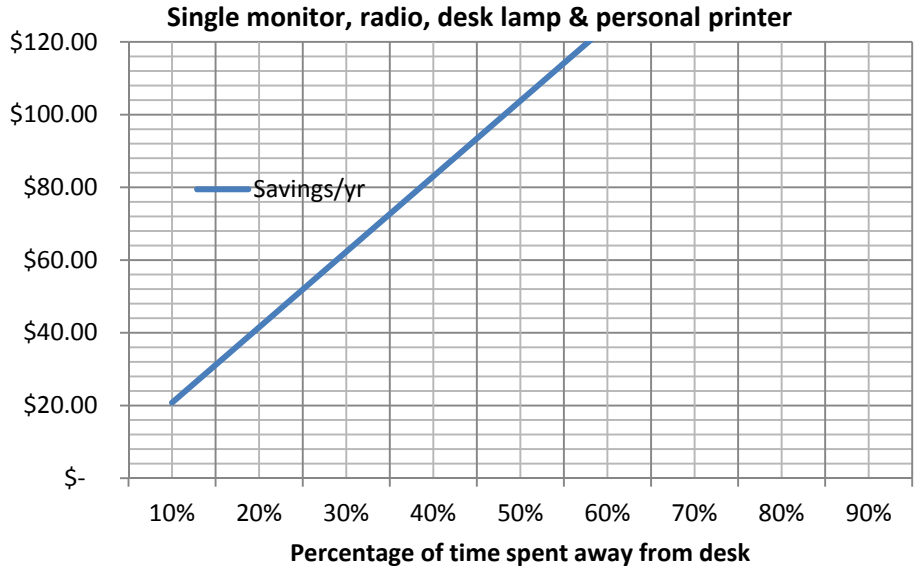
1. Implement building monitoring, see Appendix L. Install a cumulative flow meter (see Appendix E) to measure actual gallons used by the building; the "energy champion" should take monthly readings during his walk through and enter consumption into the energy monitoring spreadsheet. Tracking actual usage this way will bring a building systems inefficiency to light within a month or two, whereas without a system like this, an inefficiency may never be identified and rectified. Studies have shown monitored buildings consume up to 15% less energy than un-monitored buildings. A 10% increase in energy consumption in this building translates to $733/yr.
2. Create a village "energy champion" and provide training. It can be an existing staff person, typically a maintenance person, to perform a monthly walk-through of each building using an Energy Checklist similar to the sample in Appendix J. Savings from this activity can vary from zero to 10% of the building's annual heating cost.

   As an example, if the recommended programmable setback thermostat in the main room of this building were to be altered by an occupant (which happens regularly) and the setback no longer worked, there would be a $261/yr increase on heating cost.

   If a zone valve is stuck or locked open for 4 winter months, or the contacts that turn off the circulation pump are not functioning properly, the boiler continues to produce heat and occupants start opening windows and doors. This can easily result in 750 CFM of additional infiltration. AkWarm-C calculates an additional heating cost of $474/yr resulting from this additional infiltration.

   If an occupant raises the room temperature by 2F, the energy costs for this building will increase by $29/yr.
3. All man-doors, roll-up doors and windows should be properly maintained and adjusted to close and function properly. Additionally, weather stripping should be maintained if it exists or added if it does not. Door periphery heat loss is very apparent in the IR images in Appendix A. Poorly maintained weather stripping or leaky doors or windows can add 200 CFM of infiltration, which is calculated to add $195/yr by AkWarm-C to heating costs in this building.
4. Turn off computers, printers, faxes, etc. when leaving the office. For workstations where the occupant regularly leaves their desk, add an occupancy sensing plug load management device (PLMD) like the "Isole" shown in Appendix E.5. The graph below demonstrates annual savings for various amounts of time spent away from the desk – it is not

unusual to be away from the desk for 30% of the work day, which translates to $60/yr savings per occupant.



5. If possible, re-configure building occupants and activities to group un-occupied offices (i.e. no tenant or staff using the space) or little used spaces, into the same HVAC zone so that zone's temperature can be set back to minimal levels.
6. Lamp replacement should be a scheduled, preventative maintenance activity. Re-lamp the entire building, so lamps have roughly the same lifetime, as part of a scheduled preventative maintenance routine. This assures all lamps are the same color temperature (e.g. 2700K, 3000K, etc.) which enhances occupant comfort and working efficiency and minimizes expense. It is estimated to save 40 labor hours if the maintenance person does not have to change any lamps, and instead, confines that activity to a building re-lamp once each 7 years.
7. HVAC – A mini re-commissioning of the HVAC system should occur annually. This would include boiler blow down and cleaning, check all zone valves for correct operation (they tend to be stuck open in the spring and stuck closed in the fall), check dampers, actuators and valves for correct operation and replacement of filters. An un-maintained boiler can result in a 3% drop in efficiency, which translates to $93/yr in this building.
8. A building is a living mini-ecosystem and its use changes. Re-evaluate building usage at least annually and confirm that building set points, zones, lighting levels, etc. are optimized for the current usage and occupancy. Maintain safety stock of critical HVAC components such as zone valves, circulation pumps

Appendix B.3.a – Dakli Building - Detailed AkWarm-C report

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Dakli Building

ENERGY AUDIT REPORT – PROJECT SUMMARY – Created 6/12/2013 7:02 PM

General Project Information

PROJECT INFORMATION	AUDITOR INFORMATION
Building: Dakli Building	**Auditor Company:** Energy Audits of Alaska
Address: Dakli Street	**Auditor Name:** Jim Fowler, PE
City: Huslia	**Auditor Address:** P.O. Box 220215 Anchorage, AK 99522
Client Name: MaryAnne Sam	
Client Address: P.O. Box 70 Huslia, AK 99746	**Auditor Phone:** (907) 269-4350
	Auditor FAX:
Client Phone: (907) 829-2280	**Auditor Comment:**
Client FAX:	

Design Data

Building Area: 810 square feet	**Design Heating Load:** Design Loss at Space: 15,076 Btu/hour with Distribution Losses: 16,751 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 25,536 Btu/hour Note: Additional Capacity should be added for DHW load, if served.
Typical Occupancy: 6 people	**Design Indoor Temperature:** 70 deg F (building average)
Actual City: Huslia	**Design Outdoor Temperature:** -39.8 deg F
Weather/Fuel City: Huslia	**Heating Degree Days:** 14,942 deg F-days

Utility Information

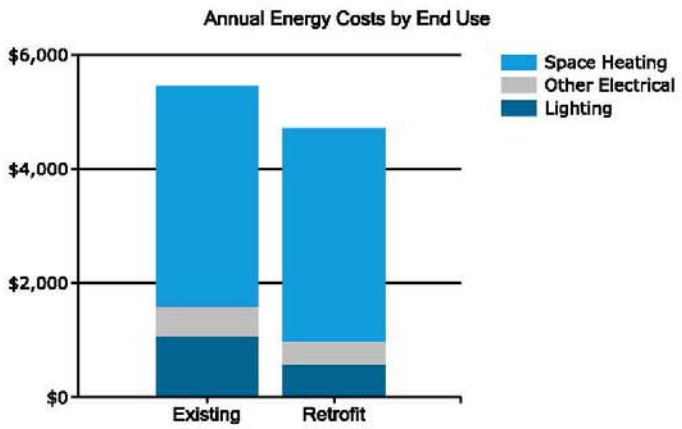
Electric Utility: AVEC-Huslia - Commercial - Sm	**Natural Gas Provider:** None
Average Annual Cost/kWh: $0.601/kWh	**Average Annual Cost/ccf:** $0.000/ccf

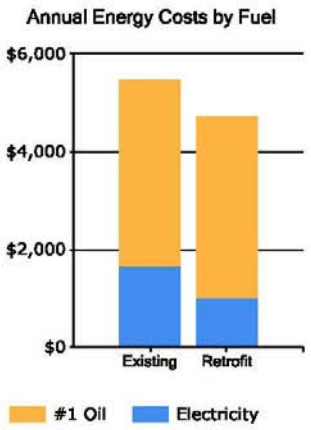
Annual Energy Cost Estimate

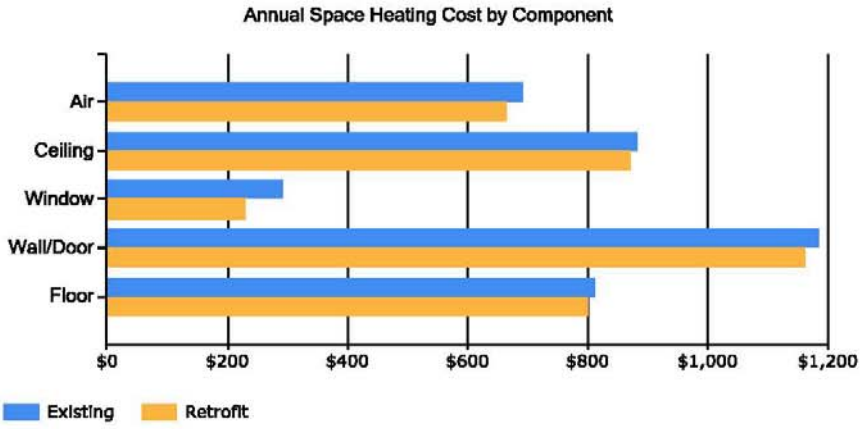
Description	Space Heating	Space Cooling	Water Heating	Lighting	Refrigeration	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	$3,865	$0	$0	$1,083	$0	$520	$0	$0	$0	$0	**$5,468**
With Proposed Retrofits	$3,730	$0	$0	$580	$0	$402	$0	$0	$0	$0	**$4,712**
SAVINGS	$136	$0	$0	$503	$0	$118	$0	$0	$0	$0	**$756**

These totals do not include maintenance savings.

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Dakli Building







Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Dakli Building

PRIORITY LIST – RECOMMENDED ENERGY EFFICIENCY MEASURES						
Rank	Feature	Recommendation	Annual Energy Savings	Installed Cost	SIR	Payback (Years)
1	Lighting - Power Retrofit: Entry Flood	Replace with LED 17W Module StdElectronic	$142	$54	30.82	0.4
2	Setback Thermostat: Entire Building	Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the Entire Building space.	$208	$200	14.11	1
3	Other Electrical - Power Retrofit: Desktop PC	Replace with 2 Laptop at PC's EOL @ $100 incremental cost each.	$88	$100	3.28	1.1
4	Lighting - Combined Retrofit: Lobby, corridor and 1 office	Replace with 5 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$152 + $20 Maint. Savings	$845	1.24	5.6
5	Lighting - Combined Retrofit: 2 other offices - less occupied	Replace with 4 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$77 + $20 Maint. Savings	$746	0.80	9.6
6	Lighting - Combined Retrofit: Toilet room	Replace with 2 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$57 + $10 Maint. Savings	$518	0.79	9.1
7	Window/Skylight: Windows double wood	Remove existing glass and install triple, 1 low-E, argon glass.	$53	$1,664	0.55	31.4
8	Lighting - Combined Retrofit: Entry - surface mt on switch	Replace with 2 FLUOR CFL, A Lamp 15W and Controls retrofit	-$22 + $20 Maint. Savings	$219	-0.09	-9.9
	TOTAL		**$756 + $70 Maint. Savings**	**$4,346**	**1.79**	**5.7**

See notes following Appendix B.1.a for AkWarm-C nomenclature used.

Appendix B.3.b – Dakli Building - Detailed AkWarm-C report with auditor's comments

Existing Conditions, electrical and fuel oil consumption:

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	153	139	153	148	153	148	153	153	148	153	148	153
Other_Electrical	73	67	73	71	73	71	73	73	71	73	71	73
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	14	12	10	5	0	0	0	0	2	6	11	14
Space_Cooling	0	0	0	0	0	0	0	0	0	0	0	0

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	88	73	66	38	15	14	15	15	19	45	71	87

Window Measures

Rank	Location	Size/Type, Condition	Recommendation
7	Window/Skylight: Windows double wood	Glass: Double, glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.51 Solar Heat Gain Coefficient including Window Coverings: 0.46	Remove existing glass and install triple, 1 low-E, argon glass.

Installation Cost	$1,664	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$53
Breakeven Cost	$922	**Savings-to-Investment Ratio**	0.6	**Simple Payback yrs**	31

Auditors Notes:

Night Setback Thermostat Measures

Rank	Building Space	Recommendation
2	Entire Building	Implement a Heating Temperature Unoccupied Setback to 64.0 deg F for the Entire Building space.

Installation Cost	$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$208
Breakeven Cost	$2,821	**Savings-to-Investment Ratio**	14.1	**Simple Payback yrs**	1

Auditors Notes:

Lighting Measures

Rank	Location	Existing Condition	Recommendation
1	Entry Flood	INCAN A Lamp, Std 75W with Manual Switching	Replace with LED 17W Module StdElectronic

Installation Cost	$54	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$142
Breakeven Cost	$1,664	**Savings-to-Investment Ratio**	30.8	**Simple Payback yrs**	0

Auditors Notes: Replace incandescent flood with 20 watt LED @ $50 + .1 hr labor @ $40/hr

Rank	Location	Existing Condition	Recommendation
4	Lobby, corridor and 1 office	5 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with 5 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$845	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$152
				Maintenance Savings (/yr)	$20
Breakeven Cost	$1,046	**Savings-to-Investment Ratio**	1.2	**Simple Payback yrs**	6

Auditors Notes: Replace T8-32 watt lamps with T8-25 watt lamps@ $2 ea. and new program start ballast @ $50 ballast plus labor @ 1.5 hr/fixture @ $40/hr labor rate. Install (1) ceiling mounted occupancy sensors @ $125 ea and power pack @ $70 ea. plus 2 hrs labor. Maint. savings $5/fixture due to re-lamp and re-ballast.

Rank	Location	Existing Condition	Recommendation
5	2 other offices - less occupied	4 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with 4 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$746	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$77
				Maintenance Savings (/yr)	$20
Breakeven Cost	$594	**Savings-to-Investment Ratio**	0.8	**Simple Payback yrs**	10

Auditors Notes: Replace T8-32 watt lamps with T8-25 watt lamps@ $2 ea. and new program start ballast @ $50 ballast plus labor @ 1.5 hr/fixture @ $40/hr labor rate. Install (2) switch mounted occupancy sensors @ $125 ea + .5 hr labor @ $40/hr. Maint. savings $5/fixture due to re-lamp and re-ballast.

Rank	Location	Existing Condition	Recommendation
6	Toilet room	2 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with 2 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$518	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$57
				Maintenance Savings (/yr)	$10
Breakeven Cost	$407	**Savings-to-Investment Ratio**	0.8	**Simple Payback yrs**	9

Auditors Notes: Replace T8-32 watt lamps with T8-25 watt lamps@ $2 ea. and new program start ballast @ $50 ballast plus labor @ 1.5 hr/fixture @ $40/hr labor rate. Install (2) switch mounted occupancy sensors @ $125 ea + .5 hr labor @ $40/hr. Maint. savings $5/fixture due to re-lamp and re-ballast.

Rank	Location	Existing Condition	Recommendation
8	Entry - surface mt on switch	FLUOR CFL, A Lamp 15W with Manual Switching	Replace with 2 FLUOR CFL, A Lamp 15W and Controls retrofit

Installation Cost	$219	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	-$22
				Maintenance Savings (/yr)	$20
Breakeven Cost	-$20	**Savings-to-Investment Ratio**	-0.1	**Simple Payback yrs**	1000

Auditors Notes: Replace burned out bulb.

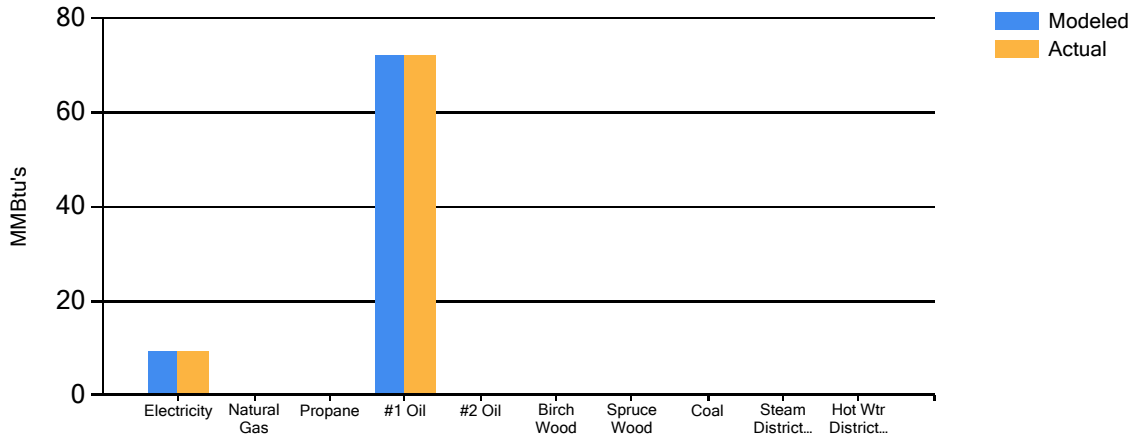
Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation
3	Desktop PC	2 Desktop PC with LCD screen with Manual Switching	Replace with 2 Laptop at PC's EOL @ $100 incremental cost each.

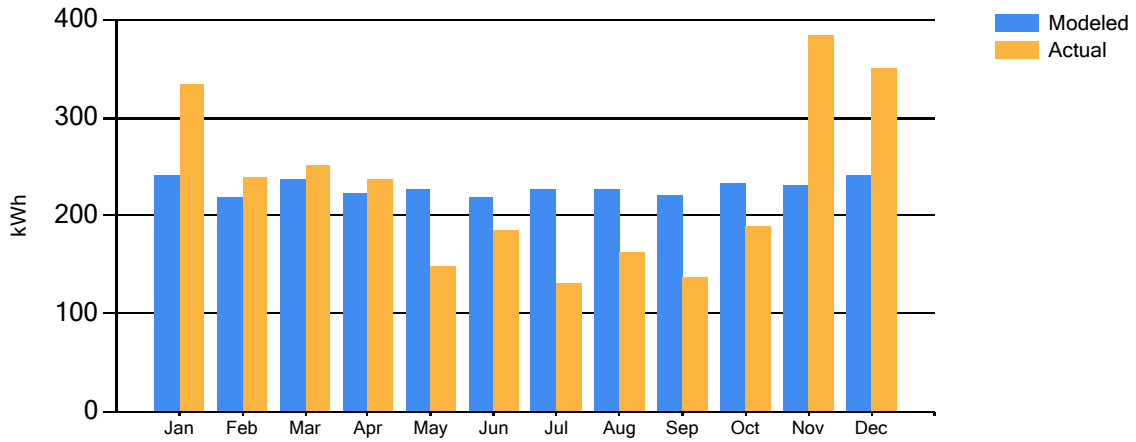
Installation Cost	$100	**Estimated Life of Measure (yrs)**	4	**Energy Savings (/yr)**	$88
Breakeven Cost	$328	**Savings-to-Investment Ratio**	3.3	**Simple Payback yrs**	1

Auditors Notes:

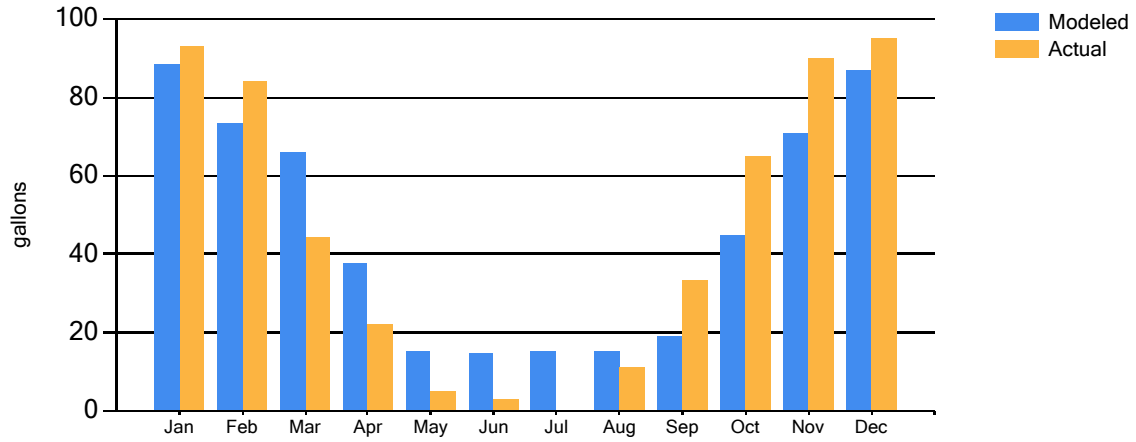
Annual Fuel Use



Electric Fuel Use



#1 Fuel Oil Fuel Use



Demand Loads

2.

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
As Proposed	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5

Estimated Demand Charges (at $0.00/kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
As Proposed	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Appendix B.3.c – Dakli Building – Detailed ECM's

No and low-cost EEM's are called ECM's and are usually implemented by the existing operations and maintenance staff (so are sometimes called O & M recommendations). The following ECM's are recommended for this facility.

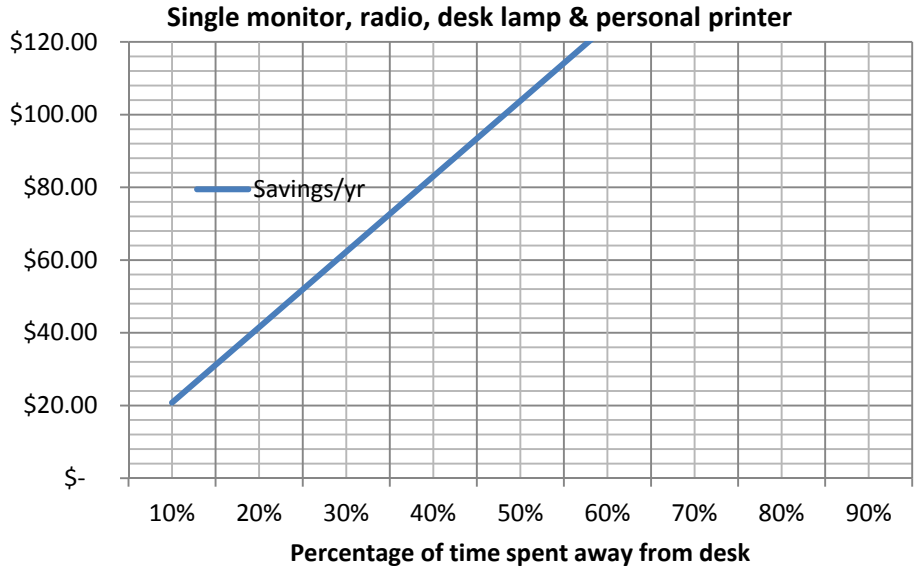
1. Implement building monitoring, see Appendix L. Install a cumulative flow meter (see Appendix E) to measure actual gallons used by the building; the "energy champion" should take monthly readings during his walk through and enter consumption into the energy monitoring spreadsheet. Tracking actual usage this way will bring a building systems inefficiency to light within a month or two, whereas without a system like this, an inefficiency may never be identified and rectified. Studies have shown monitored buildings consume up to 15% less energy than un-monitored buildings. A 10% increase in energy consumption in this building translates to $373/yr.
2. Create a village "energy champion" and provide training. It can be an existing staff person, typically a maintenance person, to perform a monthly walk-through of each building using an Energy Checklist similar to the sample in Appendix J. Savings from this activity can vary from zero to 10% of the building's annual heating cost.

   As an example, if the recommended programmable setback thermostat in the main room of this building were to be altered by an occupant (which happens regularly) and the setback no longer worked, there would be a $207/yr increase on heating cost.

   If a zone valve is stuck or locked open for 4 winter months, or the contacts that turn off the circulation pump are not functioning properly, the boiler continues to produce heat and occupants start opening windows and doors. This can easily result in 550 CFM of additional infiltration. AkWarm-C calculates an additional heating cost of $906/yr resulting from this additional infiltration.

   If an occupant raises the room temperature by 2F, the energy costs for this building will increase by $71/yr.
3. All man-doors, roll-up doors and windows should be properly maintained and adjusted to close and function properly. Additionally, weather stripping should be maintained if it exists or added if it does not. Door periphery heat loss is very apparent in the IR images in Appendix A. Poorly maintained weather stripping or leaky doors or windows can add 300 CFM of infiltration, which is calculated to add $420/yr by AkWarm-C to heating costs in this building.
4. Turn off computers, printers, faxes, etc. when leaving the office. For workstations where the occupant regularly leaves their desk, add an occupancy sensing plug load management device (PLMD) like the "Isole" shown in Appendix E.5. The graph below demonstrates annual savings for various amounts of time spent away from the desk – it is not

unusual to be away from the desk for 30% of the work day, which translates to $60/yr savings per occupant.



5. If possible, re-configure building occupants and activities to group un-occupied offices (i.e. no tenant or staff using the space) or little used spaces, into the same HVAC zone so that zone's temperature can be set back to minimal levels.
6. Lamp replacement should be a scheduled, preventative maintenance activity. Re-lamp the entire building, so lamps have roughly the same lifetime, as part of a scheduled preventative maintenance routine. This assures all lamps are the same color temperature (e.g. 2700K, 3000K, etc.) which enhances occupant comfort and working efficiency and minimizes expense. It is estimated to save 40 labor hours if the maintenance person does not have to change any lamps, and instead, confines that activity to a building re-lamp once each 7 years.
7. HVAC – A mini re-commissioning of the HVAC system should occur annually. This would include boiler blow down and cleaning, check all zone valves for correct operation (they tend to be stuck open in the spring and stuck closed in the fall), check dampers, actuators and valves for correct operation and replacement of filters. An un-maintained boiler can result in a 3% drop in efficiency, which translates to $100/yr in this building.
8. A building is a living mini-ecosystem and its use changes. Re-evaluate building usage at least annually and confirm that building set points, zones, lighting levels, etc. are optimized for the current usage and occupancy. Maintain safety stock of critical HVAC components such as zone valves, circulation pumps.

Appendix B.4.a – Old Environmental Office- Detailed AkWarm-C report

No AkWarm-C model created.

Appendix B.4.b – Old Environmental Office - Detailed AkWarm-C report with auditor's comments

No AkWarm-C model created.

Appendix B.4.c – Old Environmental Office - Detailed ECM's

See Section 1.4

Appendix B.5.a – Community Hall - Detailed AkWarm-C report

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Community Center

ENERGY AUDIT REPORT – PROJECT SUMMARY – Created 6/12/2013 7:23 PM

General Project Information

PROJECT INFORMATION	AUDITOR INFORMATION
Building: Community Hall	**Auditor Company:** Energy Audits of Alaska
Address: Lakeview Dr	**Auditor Name:** Jim Fowler, PE
City: Huslia	**Auditor Address:** P.O. Box 220215 Anchorage, AK 99522
Client Name: MaryAnne Sam	
Client Address: P.O. Box 70 Huslia, AK 99746	**Auditor Phone:** (907) 269-4350
	Auditor FAX:
Client Phone: (907) 829-2280	**Auditor Comment:**
Client FAX:	

Design Data

Building Area: 1,374 square feet	**Design Heating Load:** Design Loss at Space: 32,569 Btu/hour with Distribution Losses: 32,569 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 49,649 Btu/hour Note: Additional Capacity should be added for DHW load, if served.
Typical Occupancy: 0 people	**Design Indoor Temperature:** 70 deg F (building average)
Actual City: Huslia	**Design Outdoor Temperature:** -39.8 deg F
Weather/Fuel City: Huslia	**Heating Degree Days:** 14,942 deg F-days

Utility Information

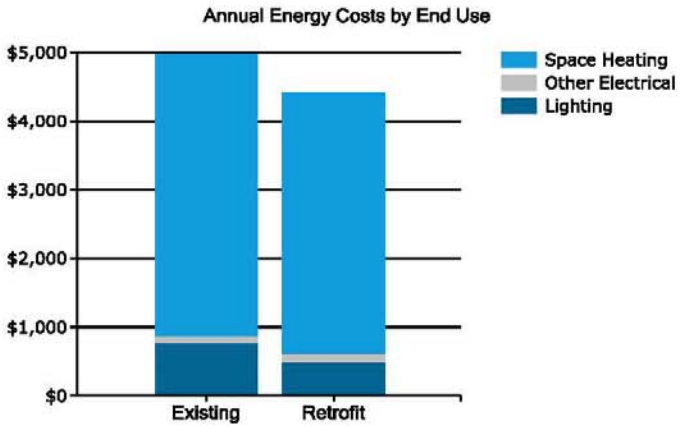
Electric Utility: AVEC-Huslia - Commercial - Sm	**Natural Gas Provider:** None
Average Annual Cost/kWh: $0.601/kWh	**Average Annual Cost/ccf:** $0.000/ccf

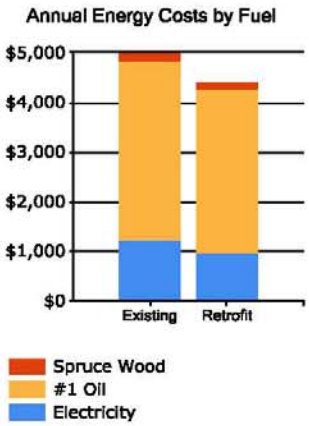
Annual Energy Cost Estimate

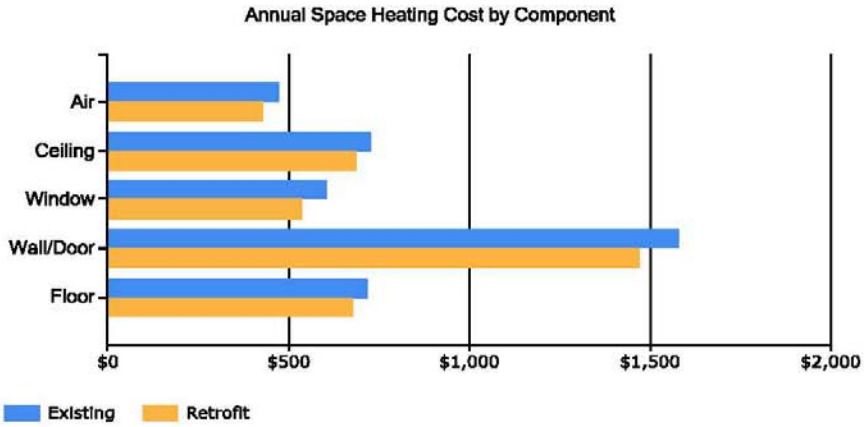
Description	Space Heating	Space Cooling	Water Heating	Lighting	Refrigeration	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	$4,101	$0	$0	$768	$0	$112	$0	$0	$0	$0	**$4,981**
With Proposed Retrofits	$3,807	$0	$0	$504	$0	$112	$0	$0	$0	$0	**$4,422**
SAVINGS	$295	$0	$0	$265	$0	$0	$0	$0	$0	$0	**$560**

These totals to not include maintenance savings.

Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Community Center







Energy Audit – Energy Analysis and Cost Comparison AkWarm Commercial Audit Software	Community Center

PRIORITY LIST – RECOMMENDED ENERGY EFFICIENCY MEASURES						
Rank	Feature	Recommendation	Annual Energy Savings	Installed Cost	SIR	Payback (Years)
1	Setback Thermostat: Main room	Implement a Heating Temperature Unoccupied Setback to 40.0 deg F for the Main room space.	$367	$500	9.91	1.4
2	Lighting - Combined Retrofit: Outside Light	Replace with 4 LED 8W Module StdElectronic and Remove Manual Switching and Add new On/Off Photoswitch	$29 + $20 Maint. Savings	$220	2.65	7.5
3	Lighting - Combined Retrofit: Main Room	Replace with 2 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$27 + $10 Maint. Savings	$119	1.92	4.3
4	Lighting - Power Retrofit: Entry light	Replace with LED 10W Module StdElectronic	$3	$29	1.32	8.9
5	Lighting - Combined Retrofit: Main room	Replace with 8 FLUOR (4) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor	$165 + $40 Maint. Savings	$1,494	0.83	9.1
6	Lighting - Power Retrofit: Main room	Replace with 9 FLUOR CFL, A Lamp 15W	-$32	$1	-270.47	0
	TOTAL		**$560 + $70 Maint. Savings**	**$2,363**	**2.87**	**4.2**

See description of AkWarm-C nomenclature at end of Appendix B.1.a.

Appendix B.5.b – Community Hall - Detailed AkWarm-C report with auditor's comments

Existing Conditions, electrical and fuel oil consumption:

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	82	74	82	115	147	142	147	147	102	82	79	82
Other_Electrical	11	10	11	17	22	22	22	22	15	11	11	11
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	48	44	48	47	48	47	48	48	47	48	47	48
Space_Cooling	0	0	0	0	0	0	0	0	0	0	0	0

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	102	81	65	28	7	1	1	7	9	38	77	100

Spruce Wood Consumption (Cords)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	0	0	0	0	0	0	0	0	0	0	0	0

Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
1	Main room			Implement a Heating Temperature Unoccupied Setback to 40.0 deg F for the Main room space.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$367
Breakeven Cost	$4,954	**Savings-to-Investment Ratio**	9.9	**Simple Payback yrs**	1
Auditors Notes:					

Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition		Recommendation	
2	Outside Light	4 FLUOR CFL, Reflector 15W R30 with Manual Switching		Replace with 4 LED 8W Module StdElectronic and Remove Manual Switching and Add new On/Off Photoswitch	
Installation Cost	$220	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$29
				Maintenance Savings (/yr)	$20
Breakeven Cost	$582	**Savings-to-Investment Ratio**	2.6	**Simple Payback yrs**	8
Auditors Notes: Replace (4) CFL's with LED screw in @ $25 ea + $25 screw in photosensor + .5 hr @ 40/hr, maintenance savings due to 20,000 hr life of LED					

Rank	Location	Existing Condition	Recommendation
3	Main Room	2 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with 2 FLUOR (2) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$119	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$27
				Maintenance Savings (/yr)	$10
Breakeven Cost	$228	**Savings-to-Investment Ratio**	1.9	**Simple Payback yrs**	4

Auditors Notes: Replace T8-32 watt lamps with T8-25 watt lamps@ $2 ea. and new program start ballast @ $50 ballast plus labor @ 1.5 hr/fixture @ $40/hr labor rate. Ceiling mounted occupancy sensors installed under previous EEM. Maint. savings $5/fixture due to re-lamp and re-ballast.

Rank	Location	Existing Condition	Recommendation
4	Entry light	INCAN A Lamp, Std 75W with Manual Switching	Replace with LED 10W Module StdElectronic

Installation Cost	$29	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$3
Breakeven Cost	$38	**Savings-to-Investment Ratio**	1.3	**Simple Payback yrs**	9

Auditors Notes: Replace incandescent (currently burned out) with 11 watt LED @ $25 + .1 hr labor @ $40/hr

Rank	Location	Existing Condition	Recommendation
5	Main room	8 FLUOR (4) T8 4' F32T8 32W Standard (2) Instant StdElectronic with Manual Switching	Replace with 8 FLUOR (4) T8 4' F32T8 25W Energy-Saver Program StdElectronic and Remove Manual Switching and Add new Occupancy Sensor

Installation Cost	$1,494	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$165
				Maintenance Savings (/yr)	$40
Breakeven Cost	$1,246	**Savings-to-Investment Ratio**	0.8	**Simple Payback yrs**	9

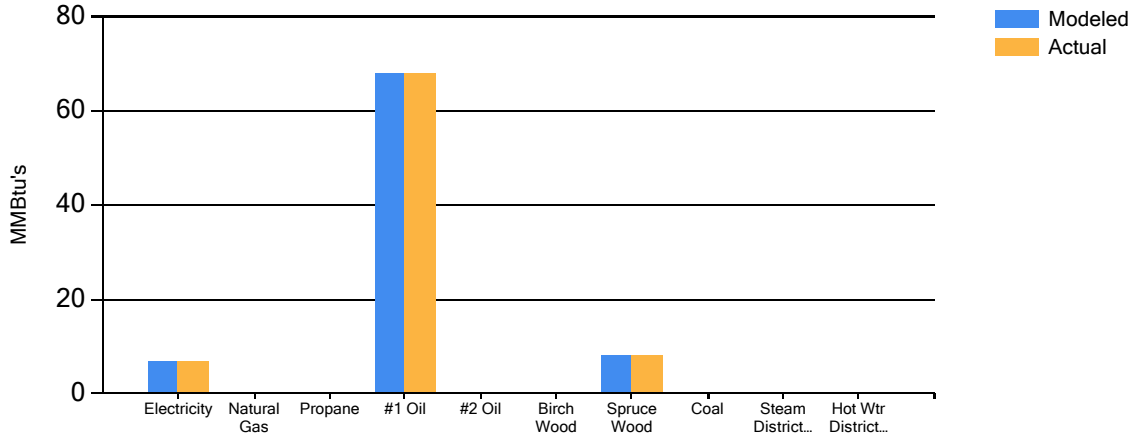
Auditors Notes: Replace T8-32 watt lamps with T8-25 watt lamps@ $2 ea. and new program start ballast @ $50 ballast plus labor @ 1.5 hr/fixture @ $40/hr labor rate. Install (2) ceiling mounted occupancy sensors @ $125 ea and power pack @ $70 ea. plus 4 hrs labor. Maint. savings $5/fixture due to re-lamp and re-ballast.

Rank	Location	Existing Condition	Recommendation
6	Main room	9 FLUOR CFL, A Lamp 15W with Manual Switching	Replace with 9 FLUOR CFL, A Lamp 15W

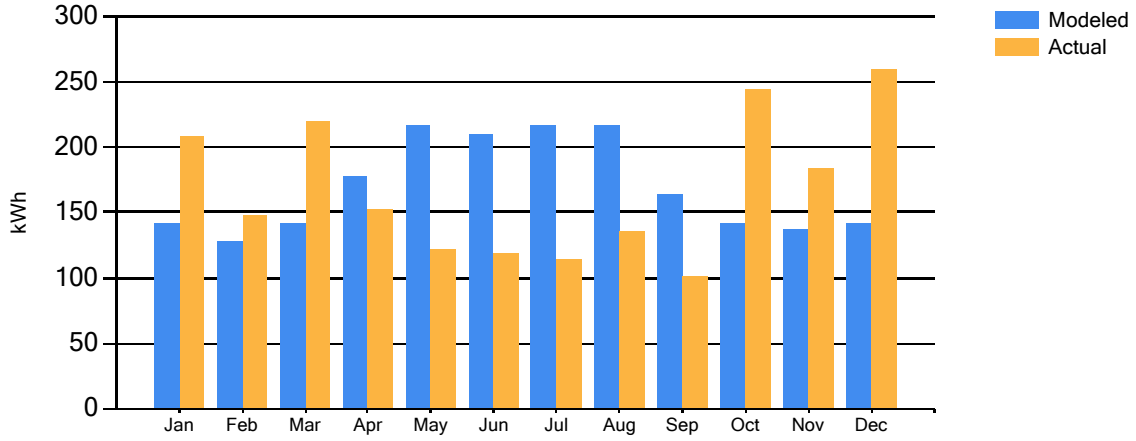
Installation Cost	$1	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	-$32
Breakeven Cost	-$270	**Savings-to-Investment Ratio**	-270.5	**Simple Payback yrs**	1000

Auditors Notes: 3 burned out bulbs replaced. Routine maintenance, no cost allocated

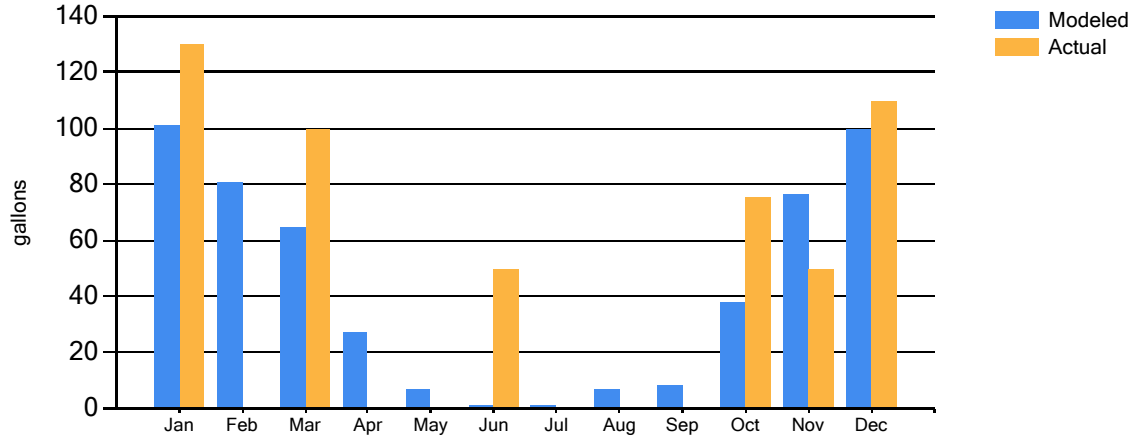
Annual Fuel Use

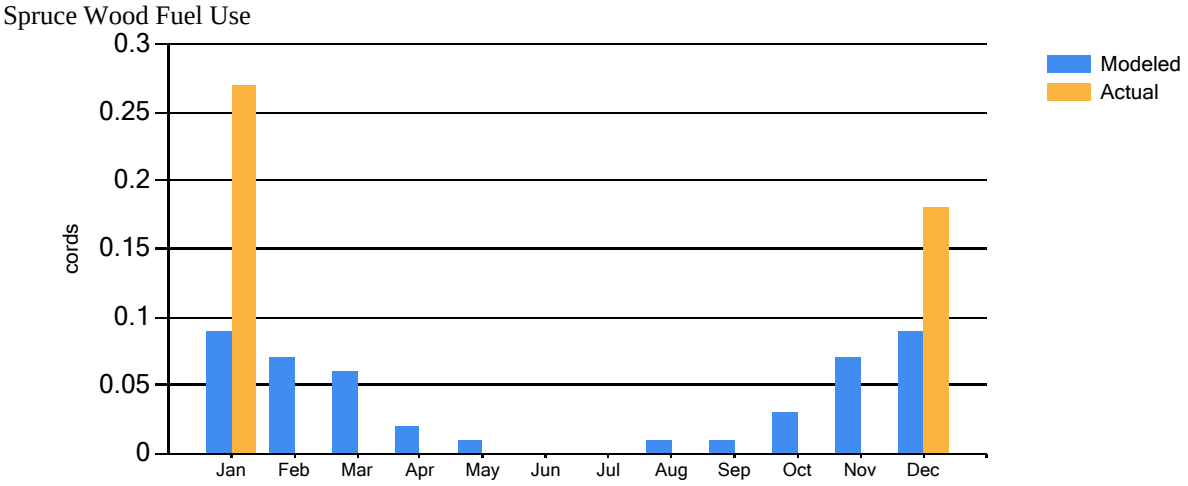


Electric Fuel Use



#1 Fuel Oil Fuel Use





Peak Demands

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	1.3	1.3	1.3	0.8	1.3	1.3	1.3	1.3	0.9	1.3	1.3	1.3
As Proposed	1.0	1.0	1.0	0.6	1.0	1.0	1.0	1.0	0.7	1.0	1.0	1.0

Estimated Demand Charges (at $0.00/kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
As Proposed	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Appendix B.5.b – Community Hall - Detailed ECM's

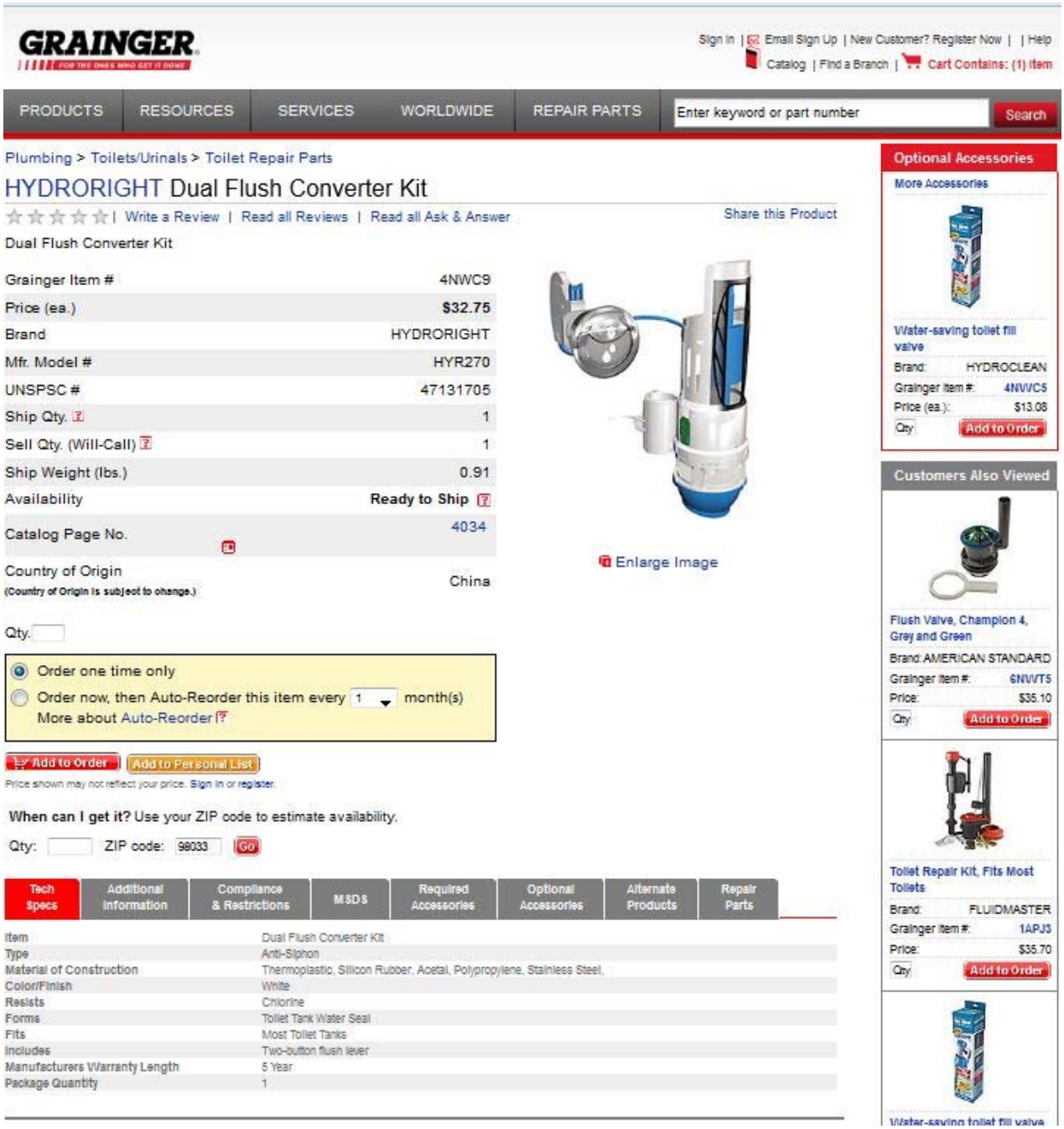
No and low-cost EEM's are called ECM's and are usually implemented by the existing operations and maintenance staff (so are sometimes called O & M recommendations). The following ECM's are recommended for this facility.

1. Implement building monitoring, see Appendix L. Install a cumulative flow meter (see Appendix E) to measure actual gallons used by the building; the "energy champion" should take monthly readings during his walk through and enter consumption into the energy monitoring spreadsheet. Tracking actual usage this way will bring a building systems inefficiency to light within a month or two, whereas without a system like this, an inefficiency may never be identified and rectified. Studies have shown monitored buildings consume up to 15% less energy than un-monitored buildings. A 10% increase in energy consumption in this building translates to $442/yr.
2. Create a village "energy champion" and provide training. It can be an existing staff person, typically a maintenance person, to perform a monthly walk-through of each building using an Energy Checklist similar to the sample in Appendix J. Savings from this activity can vary from zero to 10% of the building's annual heating cost.

   As an example, if the recommended programmable setback thermostat in the main room of this building were to be altered by an occupant (which happens regularly) and the setback no longer worked, there would be a $367/yr increase on heating cost.
3. All man-doors, roll-up doors and windows should be properly maintained and adjusted to close and function properly. Additionally, weather stripping should be maintained if it exists or added if it does not. Door periphery heat loss is very apparent in the IR images in Appendix A. Poorly maintained weather stripping or leaky doors or windows can add 200 CFM of infiltration, which is calculated to add $129/yr by AkWarm-C to heating costs in this building.
4. Lamp replacement should be a scheduled, preventative maintenance activity. Re-lamp the entire building, so lamps have roughly the same lifetime, as part of a scheduled preventative maintenance routine. This assures all lamps are the same color temperature (e.g. 2700K, 3000K, etc.) which enhances occupant comfort and working efficiency and minimizes expense. It is estimated to save 40 labor hours if the maintenance person does not have to change any lamps, and instead, confines that activity to a building re-lamp once each 7 years.
5. HVAC – A mini re-commissioning of the HVAC system should occur annually. This would include cleaning the Toyostove coils, fan housing, burners, etc. (per manufacturer's recommendations). An un-maintained stove can result in a 3% drop in efficiency, which translates to $129/yr in this building.

APPENDIX C
EEM's recommended but not included in AkWarm-C model

Plumbing fixtures: The shower head should be replaced with a low flow model. The toilets should be retrofitted with dual flush valves (see below) and the lavatory faucets should be retrofitted with low flow aerators (see next page). This audit does not include water usage and AkWarm-C does not allow for the modeling of it, but a dual flush toilet valve will typically pay back within 1-3 years, depending on usage. These payback periods are reduced by 66% or more if the fixture or valve is replaced at its EOL rather than while it's still functioning. For an EOL replacement, the cost used is the incremental difference in cost between an ultra-low-flow fixture and a straight across replacement with the same fixture.



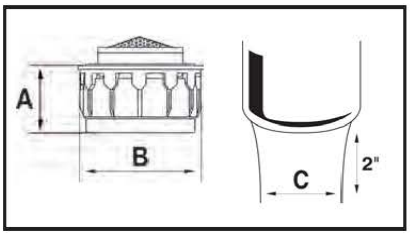
Low Flow Aerator – 1.5 gpm

NEOPERL®

PCA® Care
Laminar Stream

1.5 gpm
Pressure compensating
Regular Size

FEATURES
- Provides a splash free crystal clear (non aerated) stream.
- Unique screenless 100% plastic Cascade® construction prevents lime build up.
- Color-coded to identify flow rate.
- Recommended for use in medical facilities to prevent airborne bacteria from entering the water stream.
- Pressure compensating for constant flow from 20 to 80 psi.
- Virtually unbreakable single piece insert ensures a longer useable life.
- Available housing finishes: unplated, chrome and PVD.
- Laser marked housings: statutory mark and custom logo.
- Rubber washer.



CERTIFICATION
ANSI/NSF 61
ASME A112.18.1M
CSA B125
Complies with VHA Directive 2002-073

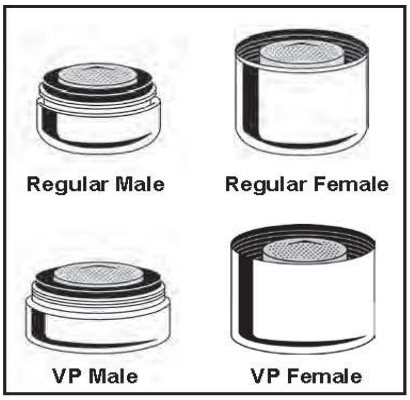
PART NUMBERS* & PACKING

Designation	Part #	Packing
Insert only	A5.4162.0	3000
Regular male 15/16"-27	B1.7723.1	500
Regular female 55/64"-27	B1.7713.1	500
Reg. dual thread 15/16"-27 55/64"-27	B1.7773.1	500
Vandal proof male 15/16"-27	B9.7723.1	400
Vandal proof female 55/64"-27	B9.7713.1	400
Vandal proof dual thread	B9.77F3.1	400
Vandal key	BX.399C.1	

*Other combinations also available

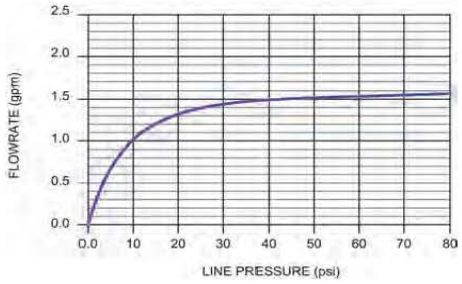
DIMENSIONS

No	mm	In
A	12.00	.472
B	20.05	.789
C	≈ 13	≈ 1/2



COLOR CODE
Dome: Orange Diffuser: Gray

FLOW RATE CURVE



TECHNICAL DATA

Materials:	Body	Acetal
	O-ring	EPDM
	Washer	EPDM
Working temperature:		150°F
Working pressure:		125 psi

NEOPERL Inc., Waterbury, CT ● Tel: (203) 756-8891 ● Fax: (203) 755-5717 ● www.neoperl.com

04/03 - Information subject to change without notice

APPENDIX D – EEM'S CONSIDERED BUT NOT RECOMMENDED

Appendix D.1 – Clinic

Daylight Sensing Light Dimming: Also called "daylight harvesting", uses sensors to determine the amount of day lighting in a room and dims the room lighting as much as possible while still maintaining pre-determined room light levels. The first and second floor offices in this building have sufficient daylight to consider daylight harvesting but upon a brief analysis, the estimated costs to implement this system outweighs the benefits.

Rationale: Installed cost – per room- of a daylight sensor which includes an occupancy sensor is $400 for parts and an estimated 3 hours for a qualified electrician to install (probably not suitable for a handyman or maintenance staff person to perform the installation) at $134/hr. The total savings, calculated inside AkWarm-C is less than $100/year. Using a total cost of $800/room, the payback is probably acceptable.

The key reason this EEM is not recommended is that daylight harvesting systems are complex and require certain levels of maintenance and this kind of expertise is typically only found in urban areas.

.

Appendix D.2 – Tribal Council Office

Daylight Sensing Light Dimming: Same as above.
Replacement of north entry door: The infiltration from this door should be reduced. The best approach is to replace it with a pre-hung, insulated door and seal it in with expanding foam and door trim. Weather stripping is the next best alternative, and this was recommended in the ECM's. Huslia's budget for these retrofits would not allow replacement of this door.

Appendix D.3 –Dakli Building

Daylight Sensing Light Dimming: Same as above.
Replacement of south entry door: Same as D.2 above.
Additional insulation in ceiling and floor and furring in interior walls: This would not fit into Huslia's budget for EEM retrofits.

Appendix D.4 – Old Environmental Office

No EEM's were considered for this building.

Appendix D.5 – Community Hall

Additional insulation in ceiling and floor and furring in interior walls: This would not fit into Huslia's budget for EEM retrofits.

Appendix E – Specifications supporting EEM's (manufacturer's cut sheets)

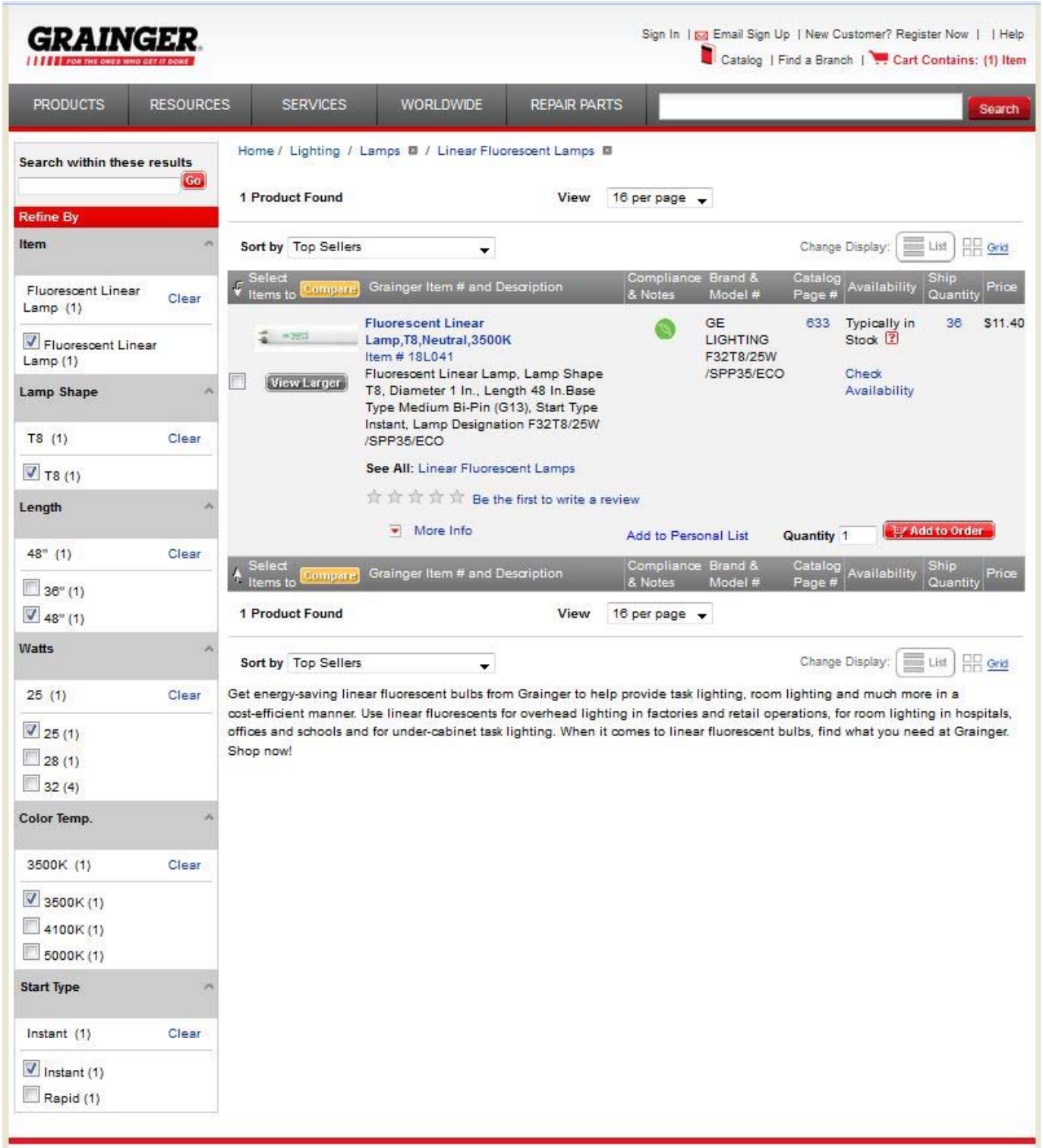
This appendix includes additional information and sample manufacturer's cut sheets for each product recommended in the EEM's in this report. The products selected here are only recommendations, equivalent products may be selected by the building owner or engineer who designs the recommended retrofits described by each EEM.

Appendix E.1 - Lighting

Sample florescent lamps, CFL's and other lighting recommended in the EEM's in this report are found below. It is always recommended that when a retrofit lighting project is undertaken in a building, that the ballasts be replaced along with the lamps. There are three reasons for this: the first is that new lamps need to be matched to the ballast that is driving the lamps, or they can cause old ballasts to fail, second, there is a labor efficiency obtained if the technician changes the ballast when he already has the fixture open and lamps removed. The third reason is that the lighting EEM's in this report recommend replacing existing 32 watt T8 lamps with either 28 watt or 25 watt high efficiency T8 lamps; these lower wattage lamps operate most efficiently on a different ballast from a 32 watt lamp and pre-mature failure may occur with incorrect ballasts.

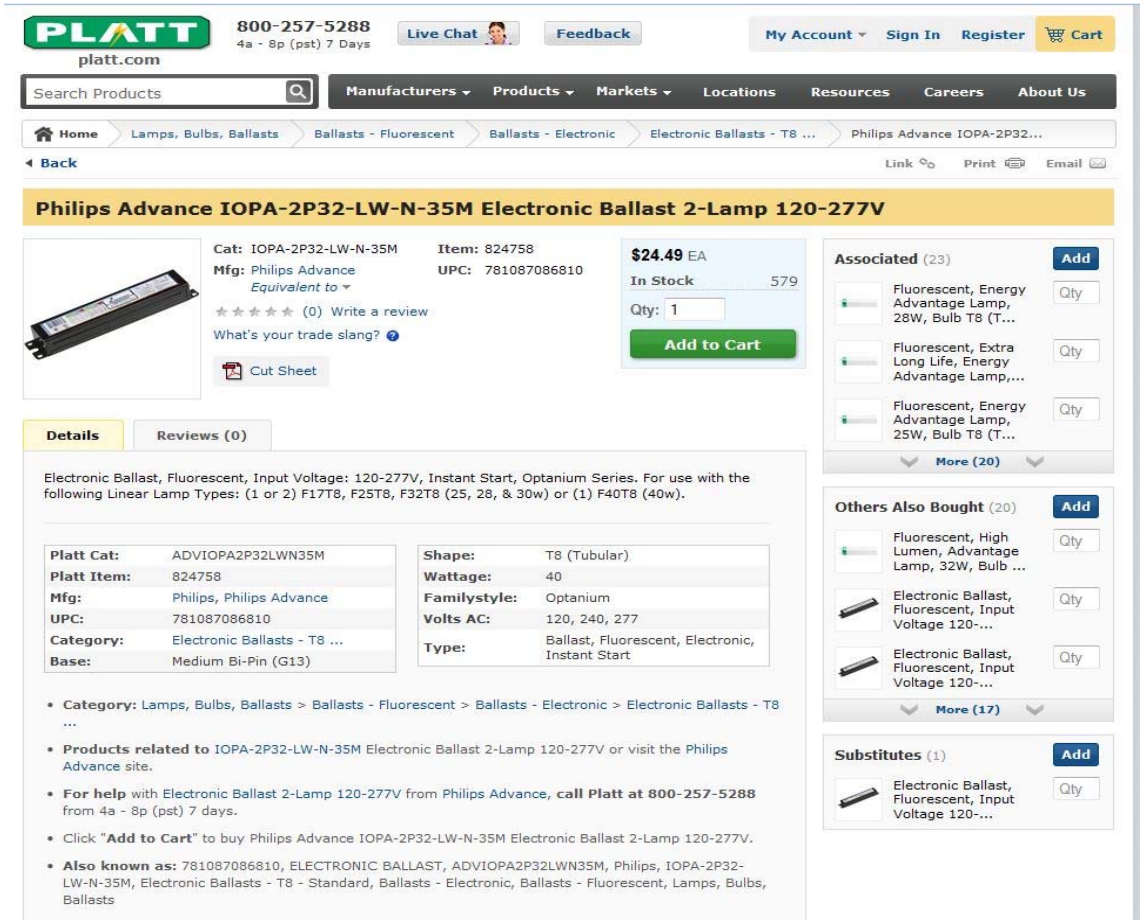
Programmed start ballasts are recommended when occupancy sensors are used. If occupancy sensors are not used, a Rapid Start (versus an Instant Start) ballasts provides a "soft start" for the lamp and will prolong lamp life.

T8-25 watt lamps (case pricing, 28 watt lamps similar pricing)

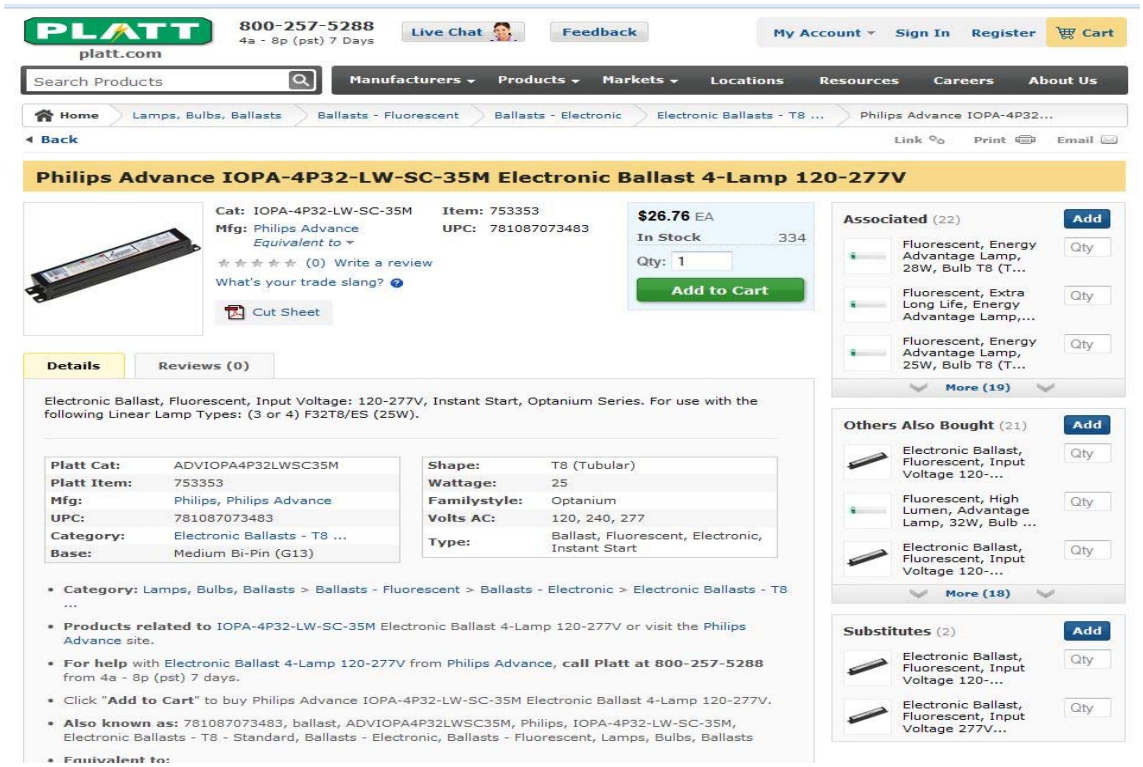


T8-25 watt ballast prices

2 lamp



4-lamp



Appendix E.2 – Lighting Controls

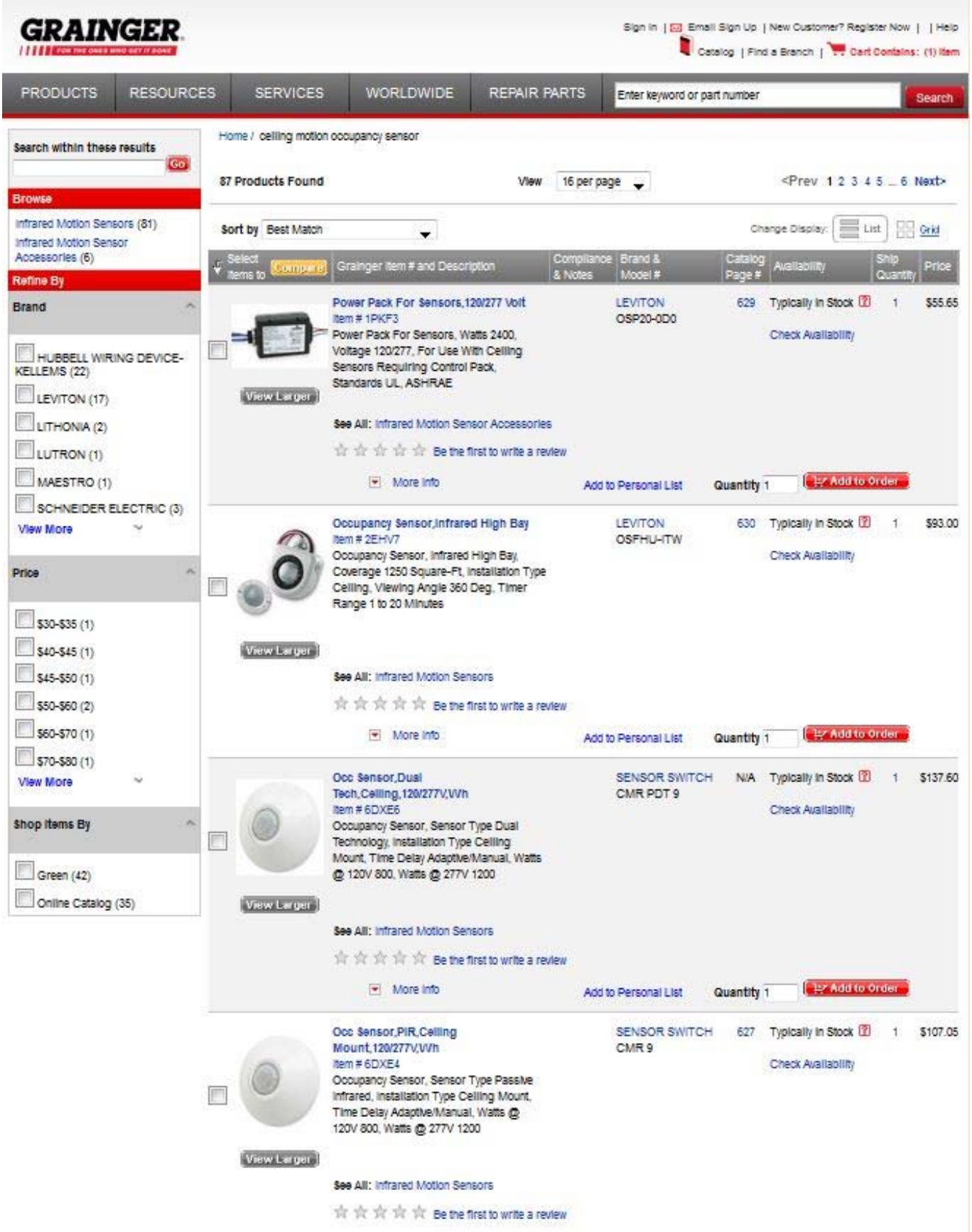
Lighting controls include occupancy sensors, lighting management systems and daylight harvesting. Each is described below, and followed by sample products.

Occupancy sensors

Occupancy sensors sense the presence of occupants, turn the lights on at a pre-determined level, and then turn the lights off after a programmed time period (typically from 2.5 to 30 minutes) of no occupancy. Line of sight, motion sensing **occupancy sensors** can be installed in existing duplex switch boxes, as well as on ceilings. **Dual technology sensors** are typically ceiling mounted in rooms, lavatories, corridors, vehicle bays and storage areas where obstacles may interfere with line-of-sight sensors. The second technology in these sensors activates lighting based on sound or changes in position, and work even when a person is fully obscured by an obstacle. **Zoned occupancy controls** are typically recommended for long corridors, large vehicle bays and large storage areas with multiple switches and lighting zones. Zoned controls are designed to activate and de-activate lighting by zone, by row, or even by fixture, based on the location of the occupant. **Step-Dim occupancy sensors** turn on a portion of room lights (usually 1/3 or 2/3) upon occupancy, and allow the occupant to manually turn on the rest of the lights. Step-dim occupancy sensors require that the lighting is wired to accommodate the step function. Occupancy sensors can reduce power consumption by 25-60%. Paybacks on occupancy sensors range from 1 to 5 years, depending on the light fixture consumption and occupancy of the room. Sample switch mounted, ceiling mounted, single technology and dual technology occupancy sensors follow.

When occupancy sensors are added to a room, the recommended ballast is a program start ballast. An instant start or rapid start ballast will detrimentally affect lamp life when used with an occupancy sensor.

High bay, dual technology ceiling mounted and single technology (PIR) ceiling mounted occupancy sensors



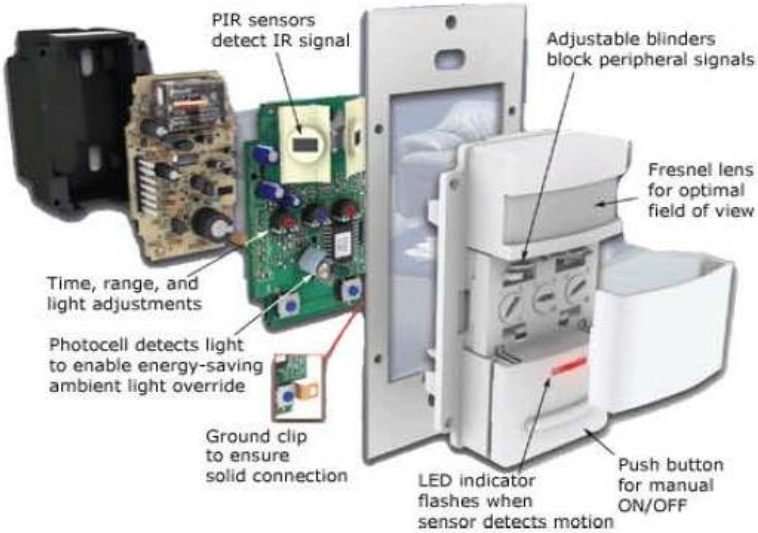
Switch mounted single and dual technology occupancy sensors

LEVITON

Occupancy Sensor Home

Buy Sensors

Decora Wall-Switch Infrared Occupancy Sensors



Convenient switch and occupancy sensor combo in sleek Decora style unit. Advanced passive infrared technology provides highly accurate monitoring in a variety of commercial applications. The OSSMT Multi-Tech unit combines passive infrared and ultrasonic technologies to provide maximum sensitivity with immunity to false triggering.

Specifications and Features

Ambient light override prevents lights from turning on when there is ample natural light

- ODS0D-ID (Self-Adjusting)
- ODS0D-TD (Self-Adjusting)
- ODS10
- ODS15 (Self-Adjusting)
- OSSMT
- PR150
- PR180

Manual override turns light on at any time regardless of override setting

- All Units

Dual pushbuttons provide manual ON/OFF switching for 2 separate banks from a single unit

- ODS0D-ID
- ODS0D-TD

Exclusive automatic "walk-through sensing increases energy savings by shutting lights within 2-1/2 minutes after momentary occupancy

- ODS0D-ID
- ODS0D-TD
- ODS15
- OSSMT

Unit beeps to indicate load is going to be switched off automatically

- ODS0D-ID
- ODS0D-TD
- ODS10

Choice of "Conference Room" or "Classroom" modes for maximum performance and energy savings in a variety of installations

- ODS0D-ID

Manual delayed-off-time settings: 5, 10, and 20 minutes, with 30-second test mode

- ODS0D-ID
- ODS0D-TD

Manual delayed-off-time settings: 10, 20, and 30 minutes, with 30-second test mode

- ODS10
- IPP15

Manual delayed-off-time settings: 15 seconds to 15 minutes

- PR150
- PR180

Manual delayed-off-time settings: 30 seconds to 30 minutes

- OSSMT
- OSS10

Manual delayed-off-time settings: 30 seconds, 30 minutes, 10 hour, 2 hours

- OSSNL

Three-position service switch with off, auto, on

- ODS0D-ID
- ODS0D-TD
- ODS15

Single-pole and 3-way wiring

- OSSMT
- IPP15
- PR180

Elegant Decora styling complements any interior, uses Decora wall plates

- All Units

Fits in standard wallbox; units may be ganged

- All Units

Night Light mode or "Guide Light" feature

- OSSNL
- OSS10

Night Light dim feature

- OSSNL
- OSS10

Adjustable integral blinders with 180-degree to 32-degree field-of-view

- ODS0D-ID
- ODS0D-TD
- ODS10
- ODS15
- OSSMT
- OSSNL
- OSS10
- IPP15

Manual ON/Auto OFF operation for CEC Title 24 compliance

- ODS0D-ID
- ODS0D-TD
- ODS10
- ODS15
- OSSMT
- OSS10
- IPP15

Ideal for Use In:

ODS0D-ID/ODS0D-TD - Classrooms, multimedia and conference rooms, day care centers, office, lounges

ODS10-ID - Enclosed areas: small offices, conferences rooms, storage rooms, copy rooms, closets

ODS15-ID - Commercial areas: small offices, conference rooms, classrooms, stockrooms, lounges, restrooms, warehouses

PR150-1L - Wide variety of residential applications

PR180-1L - Large rooms, home offices, and a variety of light commercial and residential applications

OSSMT - Private and executive offices, conference rooms, storage areas, restrooms, classrooms, lounges, and training areas

OSSNL/OSS10 - Hotel restrooms, hospital restrooms, conference rooms, class rooms, small offices, lounges, storage areas, and bathrooms

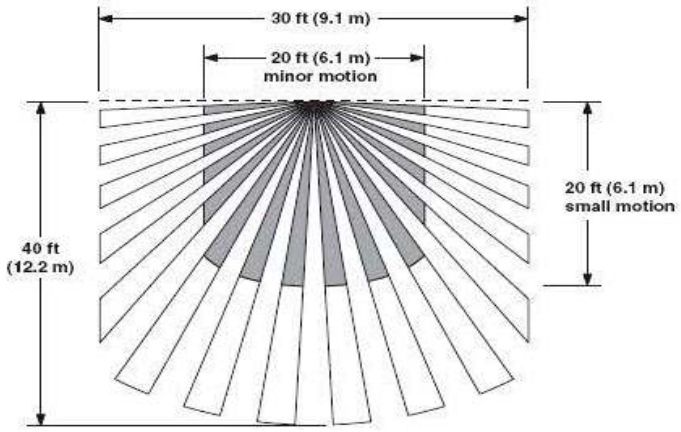
IPP15 - Kitchen, bathrooms, laundry rooms and garages

Testing & Code Compliance

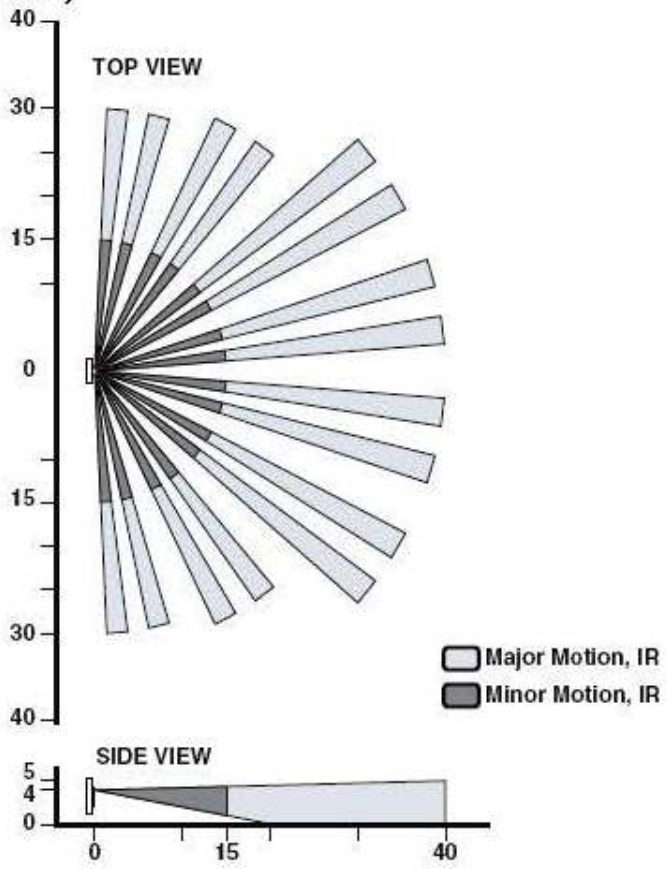
- UL Listed; Cat. No. ODS0D-ID is CUL/US Certified
- CSA Certified
- CEC Title 24 compliant (ODSXX, OSS10, OSSMT and IPP15 models only) and meets ASHRAE Standard 90.1 requirements
- Backed by a Limited Five-Year Warranty; Limited Two-Year Warranty on PRIXX models.

Dimensions

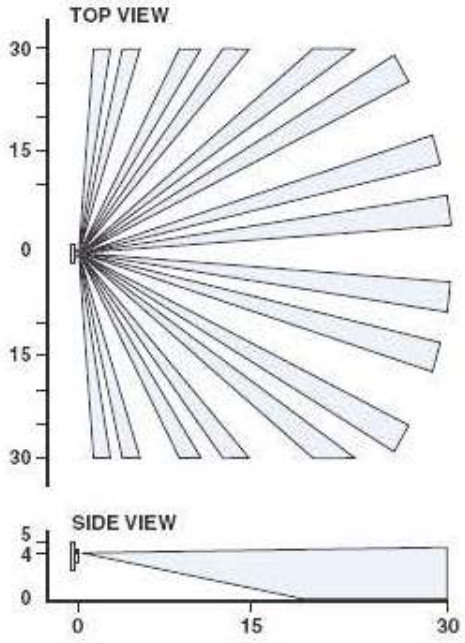
OSSMT Field of View (in feet)



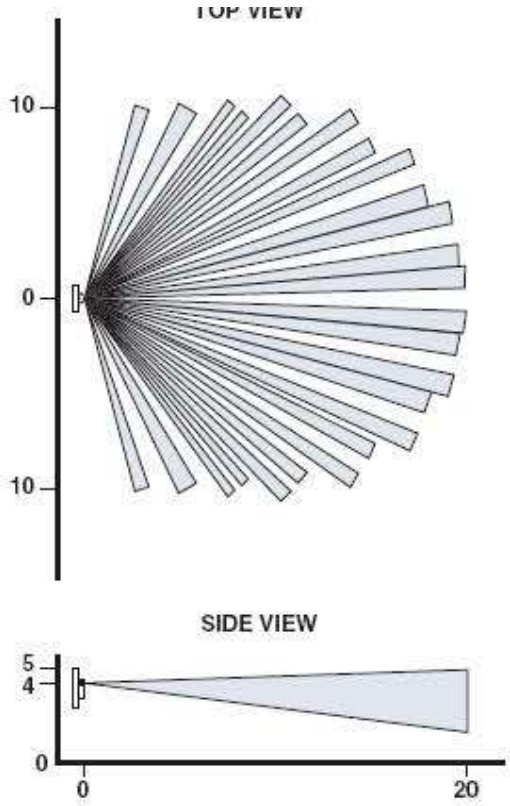
OSSXX-ID/ODSXX-ID/ODS0D-TD Field of View (in feet)



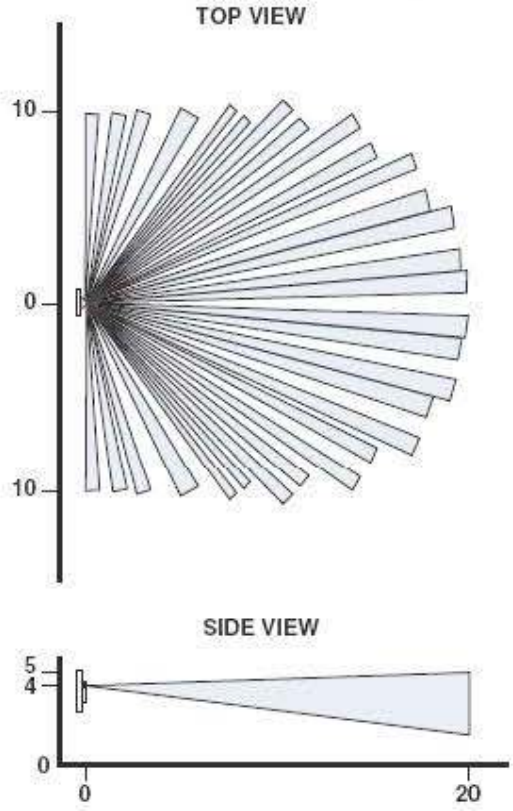
IPP15 and IPP0R Remote Field of View (in feet)



PR150-IL Field of View (in feet)



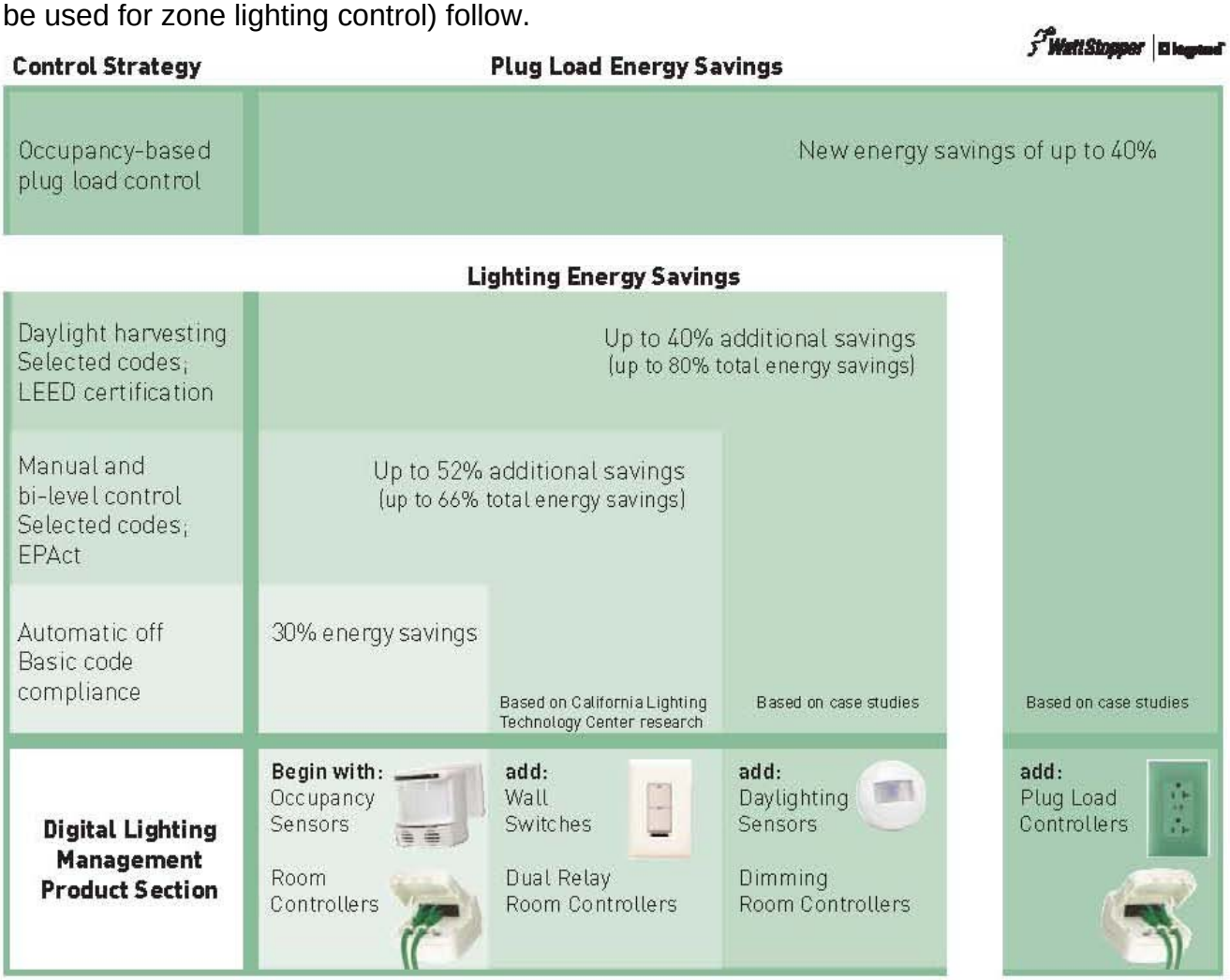
PR180-IL Field of View (in feet)



E.3 - Lighting Management Systems

Lighting Management Systems today have the capability to manage lighting based on a wide variety of parameters including building usage, daylight conditions and occupancy. They are retro-fittable, and can be stand alone or integrated into a building's HVAC, alarm or other control systems. Additionally, they can be easily re-configured as a building's usage or occupancy pattern changes.

Sample lighting management systems and a sample high bay occupancy sensor (which could be used for zone lighting control) follow.



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WattStopper

PUTTING A STOP TO ENERGY WASTE®

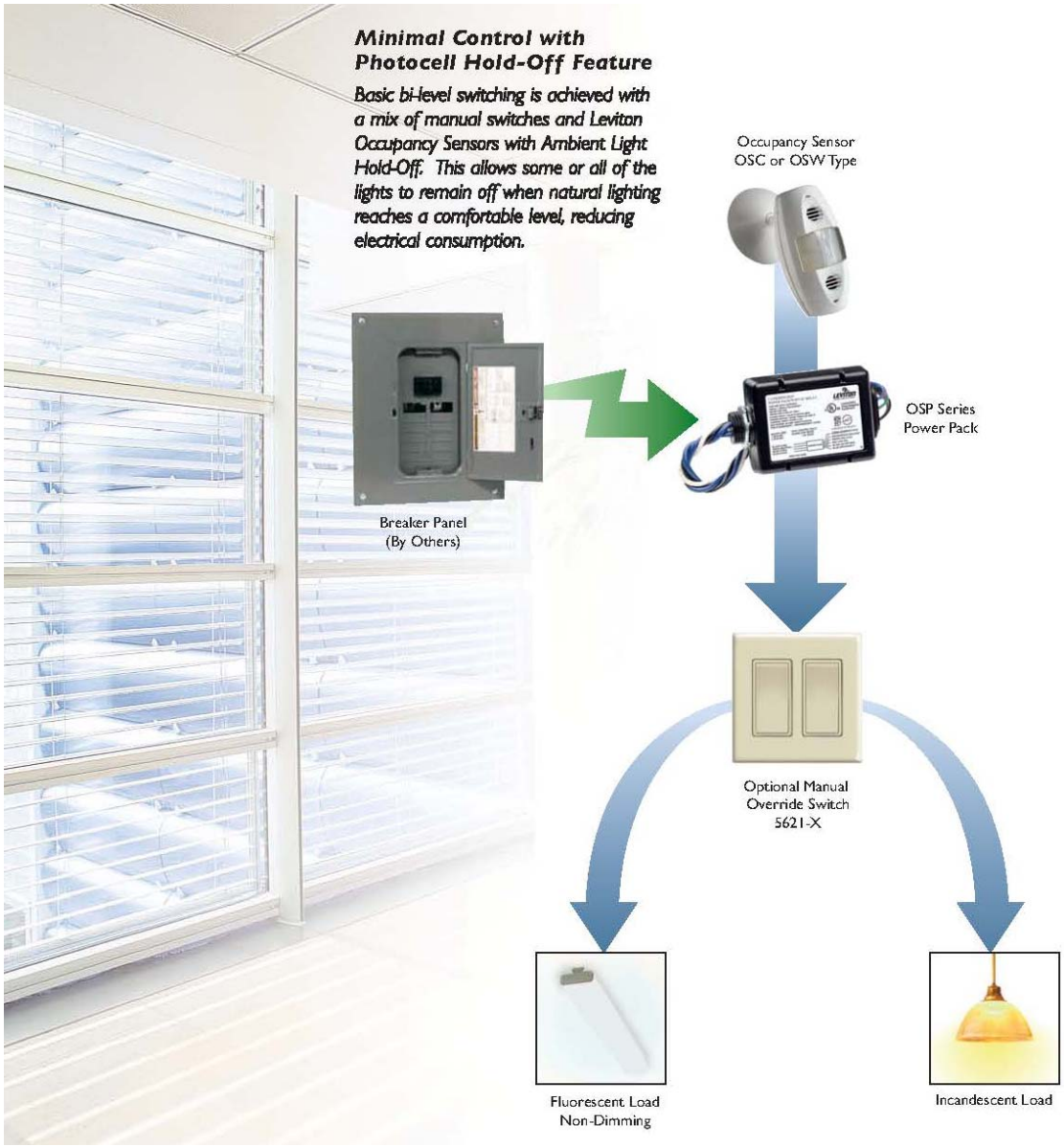
legrand

E.5 - Daylight harvesting

When a room has sufficient daylight entering from windows, controls can be added to the room lighting such that as daylight increases, the controls dim or turn off the room lights to maintain a pre-set level of room light. Daylighting controls require dimming ballasts and most manufacturers recommend “burning in” new lamps (i.e. running them at full output, without daylight controls active) for a period of 12 hours before activating the daylight controls.

Ideally, a building has been designed with daylighting in mind so that window orientation and occupant seating is optimized.

Retrofitting daylight harvesting in an existing building is feasible in certain rooms, during certain times of year, particularly in the Arctic, where the hours of daylight can vary dramatically throughout the year. See Appendix G for hours of daylight in a number of Alaskan locations. The figures in Appendix G and spot light-level readings in each building were used to calculate the savings potential for daylight harvesting in the buildings audited. A retro-fittable Leviton system is shown below.



Appendix E.4 – Exit Signs

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Call 1-800-624-4488 7 a.m. to 6 p.m. CST

Shop By Category | Enter Keyword or Product # | Search | Cart (0)

Sale Click here for our Sale & Clearance Items

Specials & Promos ▸ Sign Up For Email

Voltage
- 120.0 (8)
- 277.0 (8)

Housing
- White Thermoplastic (7)
- Black Thermoplastic (1)

Face Type
- Single or Double (6)
- Single (2)

Letter Color
- Red (7)
- Green (1)

Lighting > Exit Signs

LED Exit Signs

Sort by: lowest price

STOCK CODE: EX-ILXREMWH

LED Exit Sign - White Thermoplastic - Red Letters - 120/277 Volt and Battery Backup - Exitronix ILX-R-EM-WH

6 reviews

$14.29 ea

Quantity: 1

+ Add To Cart

Add to Favorites

More Product Details >>

EXITRONIX

- Brand : Exitronix
- Part No. : ILX-R-EM-WH
- Wattage : 2 Watt
- Voltage : 120/277
- Chevrons : Field Selectable
- Width : 11.3 in.
- Height : 7.4 in.
- Depth : 2.2 in.
- Emergency Operation : 90+ Minutes
- Face Type : Single
- Housing : White Thermoplastic
- Letter Color : Red
- Letter Size : 6 in.
- Mounting : Universal
- Warranty : 1 Year
- Case Quantity : 6

Compare Products

STOCK CODE: EX-VEXUBPWB

LED Exit Sign - White Thermoplastic - Red Letters - 120/277 Volt and Battery Backup - Exitronix VEX-U-BP-WB-WH

2 reviews

$16.79 ea

Quantity: 1

+ Add To Cart

Add to Favorites

More Product Details >>

EXITRONIX

- Brand : Exitronix
- Part No. : VEX-U-BP-WB-WH
- Wattage : 2 Watt
- Voltage : 120/277
- Chevrons : Field Selectable
- Width : 12.25 in.
- Height : 7.4 in.
- Depth : 1.75 in.
- Emergency Operation : 90+ Minutes
- Face Type : Single or Double
- Housing : White Thermoplastic
- Letter Color : Red
- Letter Size : 6 in.
- Mounting : Universal
- Warranty : 5 Years
- Case Quantity : 6

Compare Products

STOCK CODE: EX-VEXUBPLB

LED Exit Sign - White Thermoplastic - Red Letters - 120/277 Volt Only - Exitronix VEX-U-BP-LB-WH

$19.72 ea

Quantity: 1

+ Add To Cart

Add to Favorites

More Product Details >>

EXITRONIX

- Brand : Exitronix
- Part No. : VEX-U-BP-LB-WH
- Wattage : 2 Watt
- Voltage : 120/277
- Chevrons : Field Selectable
- Width : 12.25 in.
- Height : 7.4 in.
- Depth : 1.75 in.
- Face Type : Single or Double
- Housing : White Thermoplastic
- Letter Color : Red
- Letter Size : 6 in.
- Mounting : Universal
- Warranty : 5 Years
- Case Quantity : 6

Compare Products

STOCK CODE: EX-VEXUBPWBBL

LED Exit Sign - Black Thermoplastic - Red Letters - 120/277 Volt and Battery Backup - Exitronix VEX-U-BP-WB-BL

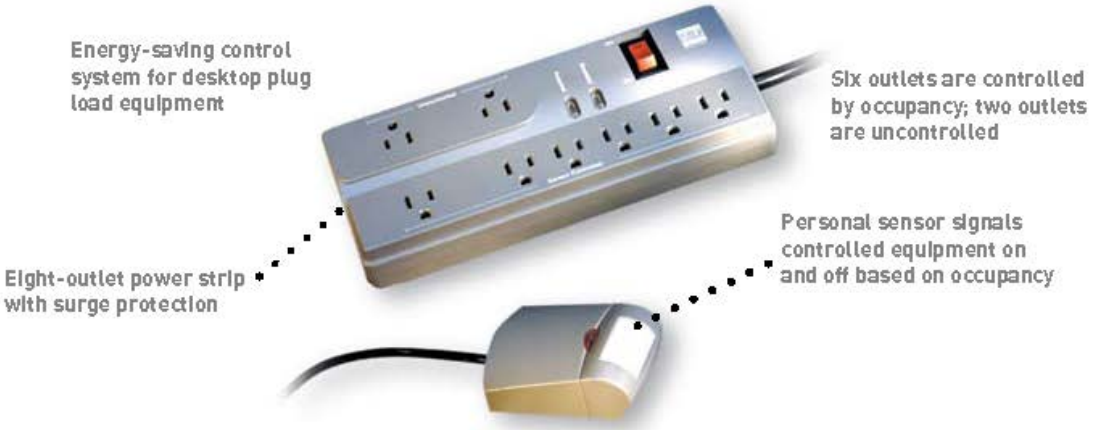
$24.29 ea

Quantity: 1

Appendix E.6 – Plug Load Management Devices (PLMD's)

OCCUPANCY SENSORS | Plug Load Controls

Isolé IDP-3050 Power Strip with Personal Sensor



PROJECT

LOCATION/TYPE

Product Overview

Description

The Isolé IDP-3050 is an energy-saving control system that provides maximum surge and noise suppression while keeping plug load equipment off when there is no occupancy. It consists of an eight-outlet power strip and a personal occupancy sensor.

Operation

The IDP-3050 turns plug load devices on and off based on occupancy. The personal sensor connects to the eight-outlet power strip with the attached cable. The power strip contains six outlets controlled by occupancy and two outlets that are uncontrolled. The IDP-3050 automatically turns all controlled devices on when the workspace is occupied, and off when the workspace has been unoccupied for the user-defined time delay. Uncontrolled devices remain on regardless of occupancy.

Surge Suppression

The power strip provides a high degree of surge suppression that protects connected equipment against threats like power surges, lightning strikes and voltage spikes. It features a resettable circuit breaker and two LEDs that indicate that the outlet is wired and grounded properly and the surge protection is functioning.

Application

The IDP-3050 is ideal for controlling task lighting and computer monitors. Additional devices for the controlled outlets include space heaters, fans and other equipment that can be turned off during unoccupied periods. Devices such as CPUs and fax machines should be plugged into the uncontrolled outlets. Applications include workstations, open office cubicles, offices and engineering stations.

Features

Power Strip

- Eight outlets; six controlled, two uncontrolled
- Surge and noise suppression protects desktop equipment
- Ground protected for safety; will not operate without a grounded outlet
- Two LEDs to indicate: 1) correct wiring and grounding; 2) surge protection is functioning
- Installation requires no hardwiring
- Flat offset plug for wire management
- One uncontrolled outlet and one controlled outlet are wall-transformer-enabled
- Plugs into a standard three-prong outlet

Personal Sensor

- Uses latest passive infrared (PIR) technology to detect occupancy
- User-adjustable time delay of 30 seconds to 30 minutes
- Multi-level Fresnel lens for superior occupancy detection
- 120° coverage, up to 300 square feet
- ASIC technology reduces components and enhances reliability
- Instantaneous response time

WattStopper
www.wattstopper.com
800.879.8585

Realize energy savings by turning plug loads off

Why keep plug loads operating when no one is there to use them? Isolé ends the energy waste by turning plug loads on and off based on occupancy.

The **Isolé IDP-3050** consists of an eight-outlet power strip with surge protection and a personal occupancy sensor that utilizes the latest passive infrared (PIR) technology. When the sensor detects occupancy, it turns on controlled outlets. When the space becomes vacant, the sensor turns off these outlets automatically after the preset time delay expires.

Plug loads account for an increasing percentage of the total energy consumed by buildings—up to 15 to 20% in homes and commercial buildings. According to the EPA, "energy consumption by office equipment represents the fastest growing use of electricity in the country."

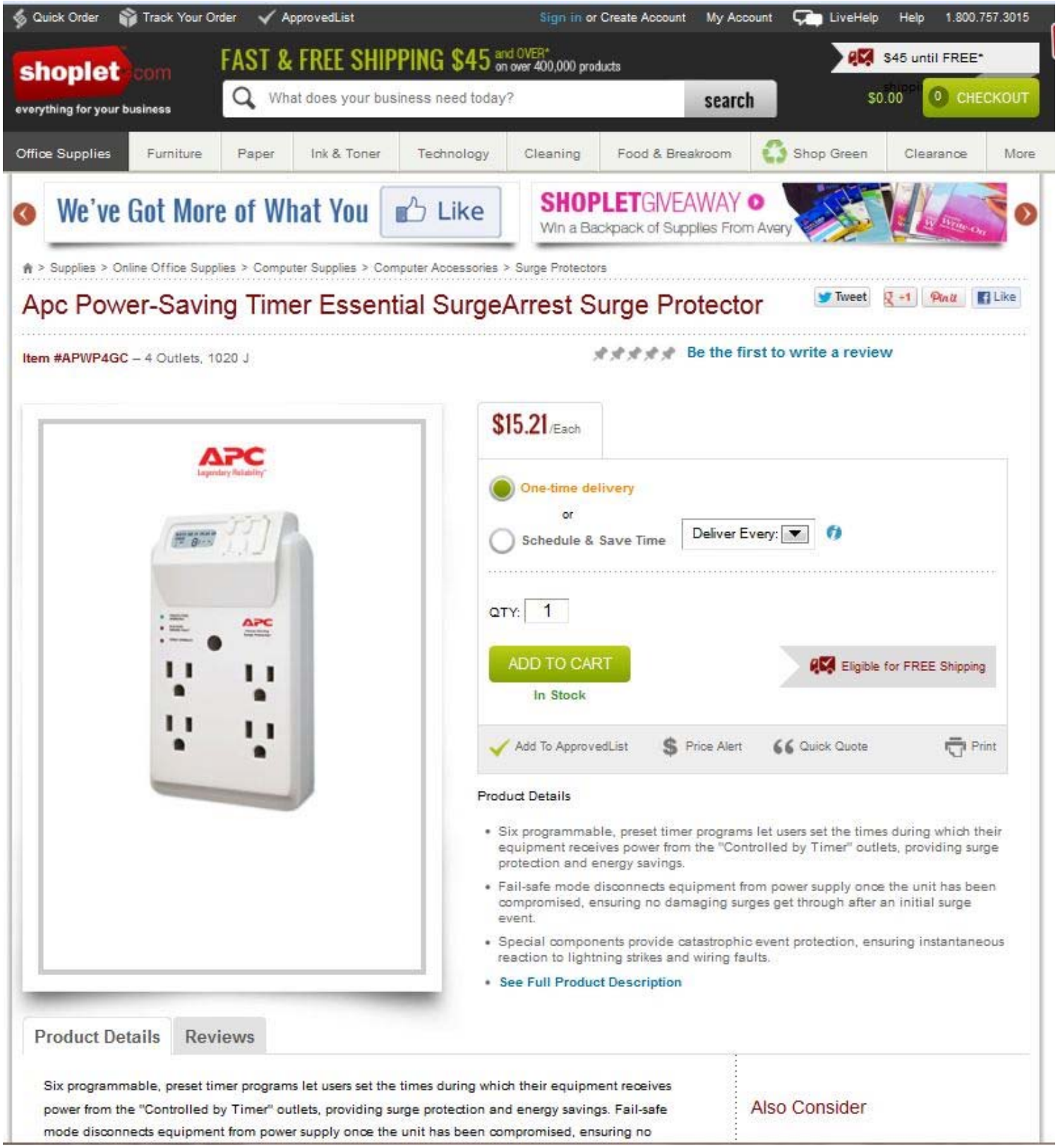
How much energy can users save?

A single workspace can consume 1,500 kWh each year with an average cost of $175 (and growing)! Add up the cost of every workspace and the amount is staggering. Isolé can dramatically cut this cost with energy savings of up to 50%.

Essential machines (hard drives, faxes) use uncontrolled outlets to remain operating continuously.

Equipment that isn't needed when the workspace is unoccupied (e.g., monitors, task lighting, printers) plug into controlled outlets that respond to the occupancy signals.

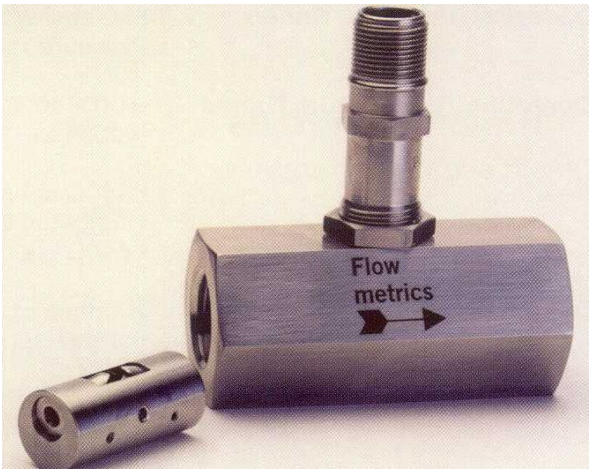
Digital timer for large copy/printers, TV's and anything with a "sleep" cycle – schedule to turn devices completely off during unoccupied hours

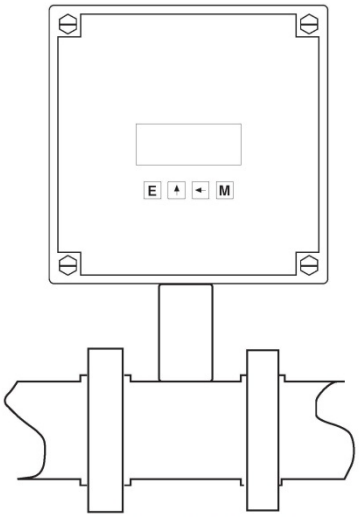


Appendix E.7 – Cumulative fuel oil flow meter

Sensor must be calibrated at factory for #1 diesel from .1 to 7 gph. Square plastic display is NEMA rated, round is explosion proof (not required). Display can be mounted directly on sensor. Sensor has female ½" NPT, factory can install 3/8" or other adapter, as required. Meter has flow rate and totalizer.

Battery or Loop Powered Ratemeter & Totalizer





915-BATRT-M mounted with flowmeter

Flowmetrics, Inc.
"Where Quality is Measurable"
9201 Independence Avenue
Chatsworth, CA 91311
(818) 407-3420
(800) 356-6387
Fax (818) 700-1961
Email: information@flowmetrics.com

Tangential Turbine Flowmeter – FMT Series

Special Features:

- Well suited to meet a variety of process media
- Capable of measuring extremely low flow rates as .001 GPM in liquids and .001 ACFM in gases
- High output and low drag magnetic pickoffs
- Zero drag modulated carrier pickoffs*
- Bearings to suit specialized applications
- NIST traceable calibration

*Modulated carrier pickoff requires a pre-amplifier – please refer to the PA/PC/PS/LS Brochure

General:

The Flowmetrics Tangential turbine flowmeter is a unique volumetric device. This uses a dual orifice design to direct a stream of fluid tangent to a low mass/balanced rotor and a precision bearing to provide maximum sensitivity. This arrangement permits the measurement of very low flow rates in either liquid or gas service under a variety of operating conditions with high degree of precision and reliability. This geometry also eliminates the need for flow straighteners and allows for greater repeatability.

The unit produces an electrical output with pulse frequency proportional to the flowrate. These pulse can be fed into digital data display, frequency to DC analog, totalizing or into one of many recording equipments available from Flowmetrics, Inc., to provide full fluid flow measurement capability.

Flowmetrics, Inc.

"Where Quality is Measurable"

9201 Independence Avenue
Chatsworth, CA 91311
USA

http://www.flowmetrics.com

(800) 356 6387 . (818) 407-3420
FAX (818) 700-1961

June 14, 2013

Mr. Jim Fowler
Energy Audit of Alaska
Tel: 206 954 3614 /Fax:
E-mail: jim@jim-fowler.com

Our Ref: Quote # 1306221

Dear Jim,
We are pleased to quote the following flow meter & display, which will accurately Diesel #1 Fuel

1. P/N: FMT-8-7NX1-0.070-LD1L Price/each: US$ 880

Turbine Flowmeter (FMT Series):

- Process Connection: ½ " NPT (Female)
- Calibration Range: 0.50 – 3 GPH for Diesel # 1 Fuel at ambient conditions
- Accuracy: +/- 0.5% Reading
- Materials of Construction: 316 Stainless Steel except with 440c stainless steel ball bearing
- Magnetic pickup coil

2. P/N: 915BATRTM5A4 Price/each: US$ 434

Digital Display:

- Battery powered
- Displays Rate and Total simultaneously
- Mounted integral to flowmeter in a NEMA-4x enclosure

Delivery: 1 - 2 Weeks ARO
F.O.B. Factory
Quoted prices are firm for 60 days

Thank you for the opportunity to quote your requirements. Please do not hesitate to contact our office if you have any questions. We look forward to being of further assistance.

Very truly yours,

Irfan Ahmad
Sales/Application Manager
irfan@flowmetrics.com

Appendix E.8 – Programmable, retro-fitable setback DanFoss Thermostatic Control valves

MAKING MODERN LIVING POSSIBLE

living eco®

Installation and User Guide
Installations- og Brugervejledning

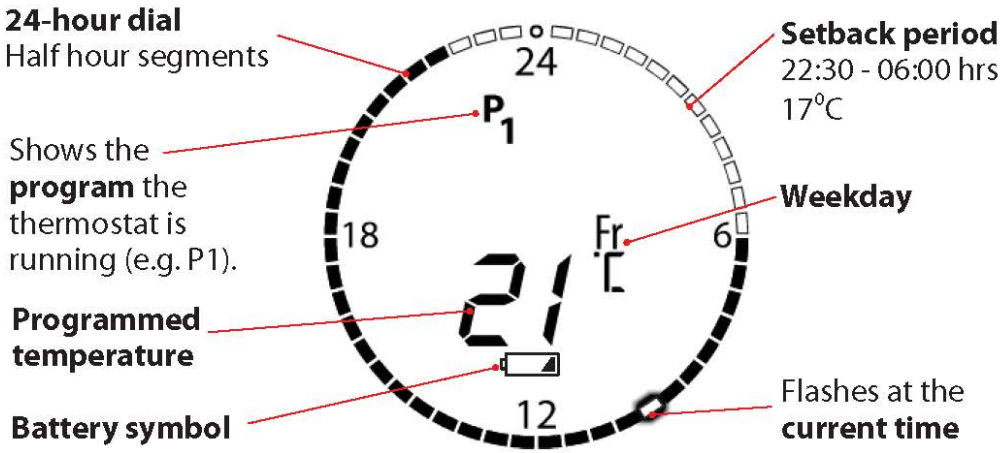
Danfoss Heating Solutions

2.1 Thermostat display

UK

DK

The black dashed circle on the display shows a 24-hour dial. The black segments represent periods of comfort temperature, 21°C (default setting), and the 'empty' segments represent setback periods, where the temperature is 17°C (default setting). The display also shows the set temperature and current program.



2.2 Thermostat buttons

The thermostat has two arrow buttons ∨ ∧ which allow you to navigate the display, menus and set the temperature.

Use ● to select and confirm.

Appendix F – Audited Huslia buildings - Benchmark Utility data

Fuel oil and electric consumption data for the 24 month period from May 2011 through April 2012 was obtained from the Tribal council and the City Administrator. The raw data is shown in tables below.

	ELECTRIC (kWh)							
	Clinic	Tribal Office	Dakli Building	Community Hall	Old Environmental Office	Head Start Building	Washeteria /WTP	City Office
May-11	1,780	734	97	103	meter turned off, no data until May 2013	550	4,929	323
Jun-11	1,500	788	121	80		105	1,965	289
Jul-11	1,390	747	87	133		101	1,863	264
Aug-11	1,493	756	106	129		87	2,090	279
Sep-11	1,620	810	99	113		567	1,804	324
Oct-11	1,989	723	178	179		699	5,388	752
Nov-11	1,996	1,099	414	156		1,029	7,047	367
Dec-11	1,991	855	324	268		660	6,002	402
Jan-12	2,408	1,605	365	165		1,136	6,239	333
Feb-12	1,676	1,031	240	142		1,017	5,579	306
Mar-12	1,980	902	235	239		1,094	5,910	309
Apr-12	1,944	704	226	107		999	5,618	286
May-12	1,577	628	200	142		169	5,489	214
Jun-12	1,503	680	247	158		220	1,811	146
Jul-12	1,628	658	175	95		120	1,735	125
Aug-12	1,797	811	218	143		90	1,801	127
Sep-12	1,650	674	175	89		549	1,905	133
Oct-12	1,797	789	200	310		703	4,345	219
Nov-12	2,131	887	353	213		645	5,669	213
Dec-12	2,446	957	376	250		582	5,693	233
Jan-13	2,425	904	302	251		593	6,122	264
Feb-13	2,059	847	238	152		652	5,794	246
Mar-13	2,136	810	267	200		463	5,844	237
Apr-13	2,203	675	247	198		425	5,846	222
	45,119	**20,074**	**5,490**	**4,015**	**0**	**13,255**	**106,488**	**6,613**
Sq. Feet	2657	1624	810	1374	775	1,453	2,096	1336

FUEL OIL (gallons)

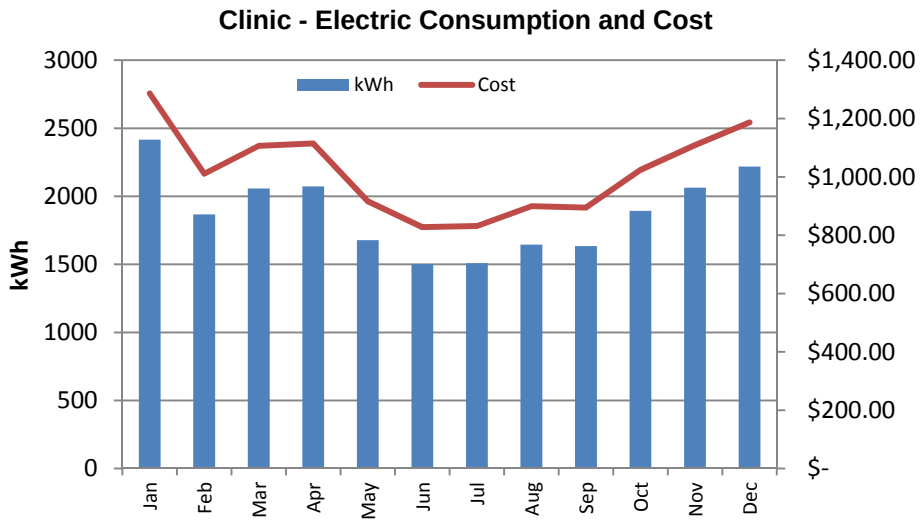
Jim: Average of 2 years deliveries, normalized into seasonal curves fo each year. 2011 seas was 2600 gal; 2012 season was 3400 gal

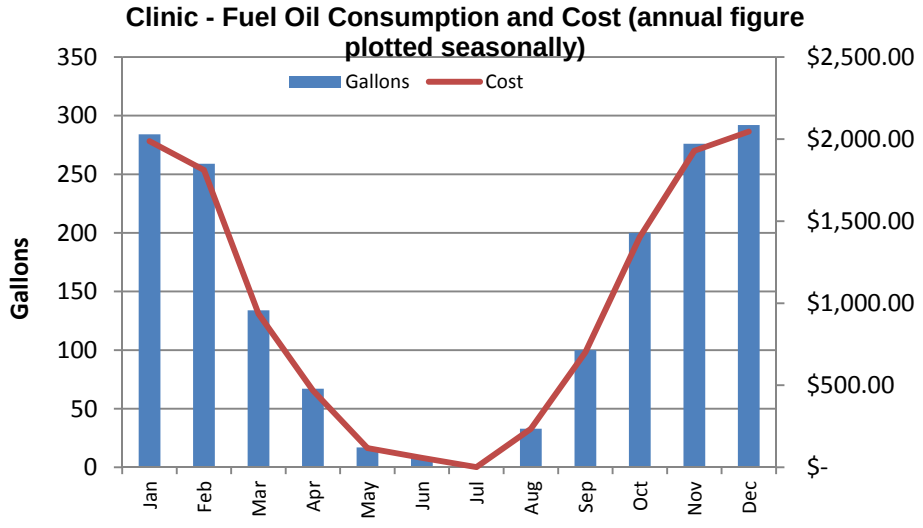
	Clinic	Tribal Office	Dakli Building	Community Hall	Old Environmental Office	Head Start Building	Washeteria/ WTP	City Office
May-11	0	0	0	0			26	0
Jun-11	0	0	0	0			13	0
Jul-11	0	0	0	0			13	0
Aug-11	0	0	0	0			52	0
Sep-11	0	0	0	0			156	0
Oct-11	914	0	0	0			312	0
Nov-11	189	0	0	0			416	0
Dec-11	377	0	0	0			455	0
Jan-12	564	0	0	0			442	0
Feb-12	0	0	0	0			403	0
Mar-12	0	0	0	0			208	0
Apr-12	0	58	0	0	not used since mid-2011		104	0
May-12	0	0	75	0			34	0
Jun-12	0	0	25	50			17	0
Jul-12	0	0	0	0			17	0
Aug-12	0	0	0	0			68	0
Sep-12	664	83	130	0			204	0
Oct-12	0	30	0	75			408	0
Nov-12	400	0	0	50			544	431
Dec-12	0	204	150	110			595	0
Jan-13	0	56	56	130			578	0
Feb-13	0	0	110	0			527	397
Mar-13	5	0	0	100			272	0
Apr-13	228	0	0	0			136	312
	3,340	**431**	**545**	**515**	**0**	**0**	**6,000**	**1,139**
	2657	1624	810	1374	775	1453	2096	1336
2 year average								
Diesel								
EUI	83.0	35.0	88.8	49.5	0.0	0.0	377.9	56.3
ECI	$4.40	$0.93	$2.36	$1.31	$0.00	$0.00	$10.02	$2.98

Use only 1 year of data here

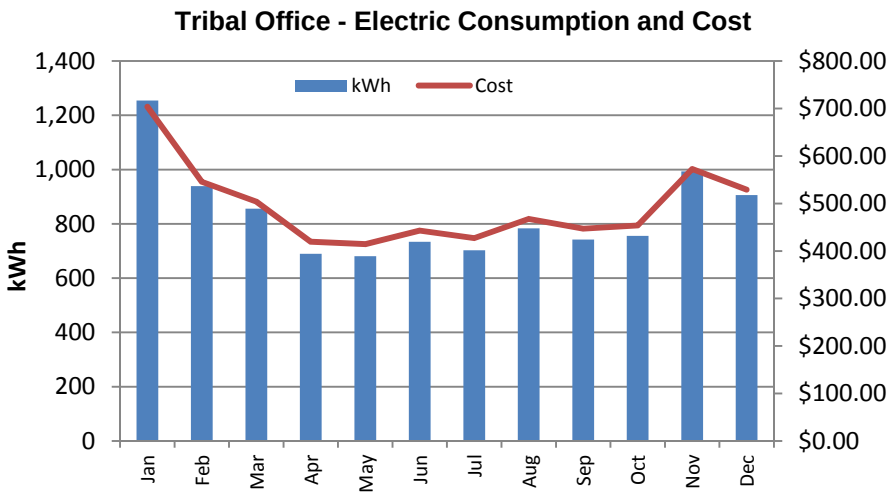
Only 1 year of data available

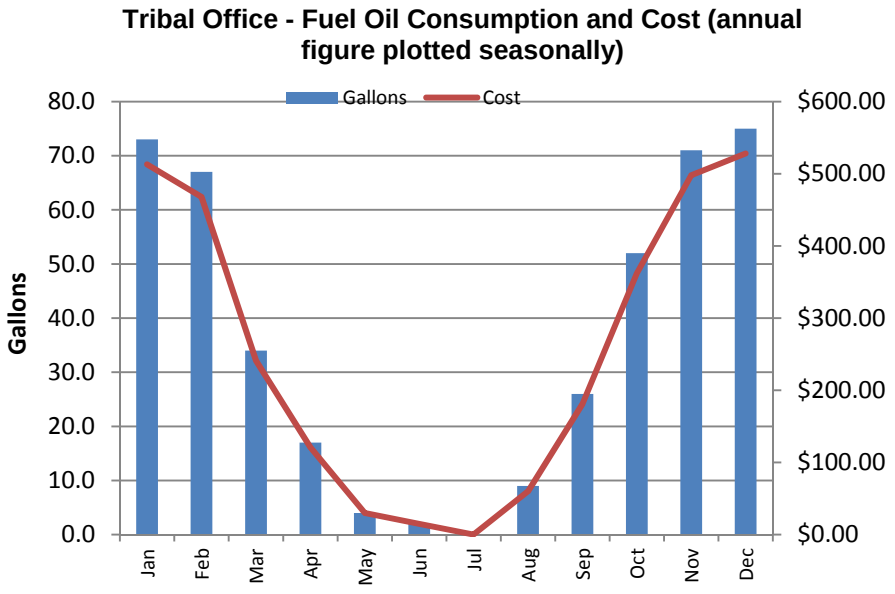
Appendix F.1 – Clinic – Benchmark energy consumption data



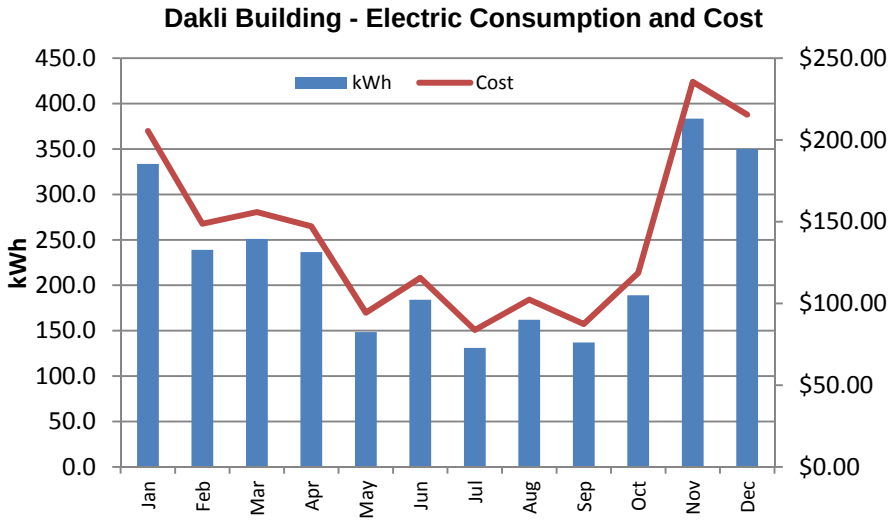


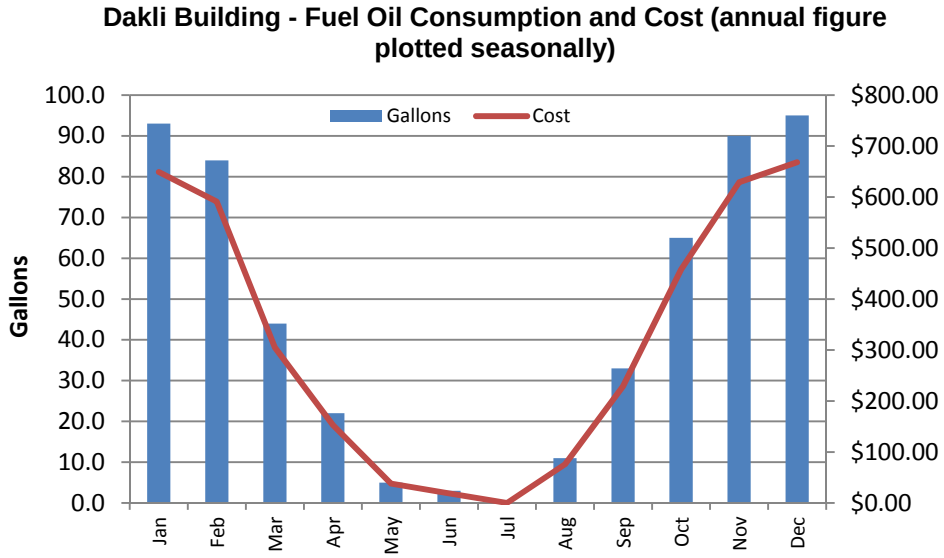
Appendix F.2 – Tribal Office– Benchmark energy consumption data





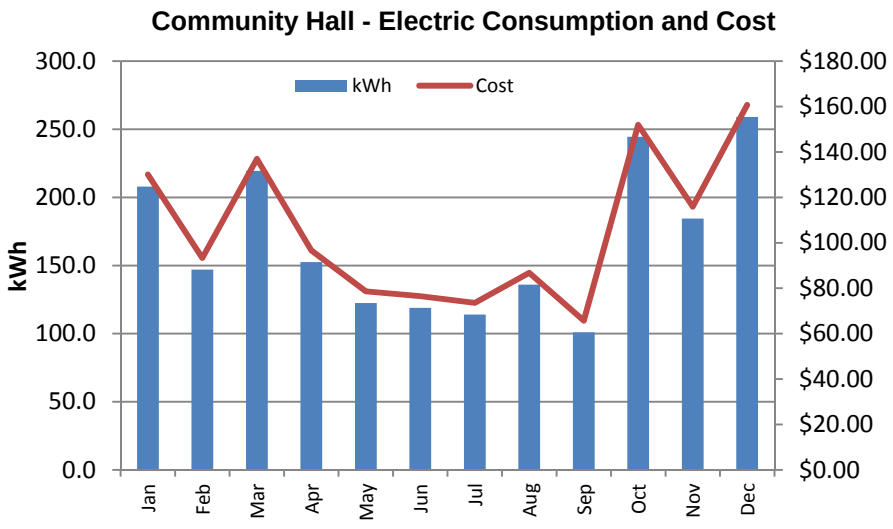
Appendix F.3 – Dakli Building – Benchmark energy consumption data

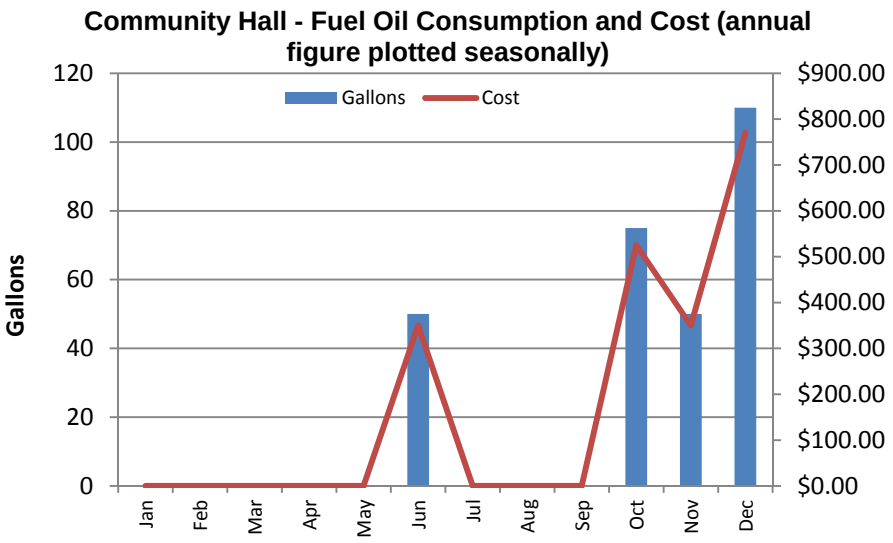




Appendix F.4 – Old Environmental Office – No Benchmark data

Appendix F.5 – Community Hall – Benchmark energy consumption data





Appendix G – Hours of Daylight

CITY	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Anchorage	5:39	7:46	10:24	13:22	16:52	18:43	19:11	17:07	14:16	11:26	8:32	6:08
Barrow	0:00	4:05	9:20	14:13	19:44	24:00	24:00	24:00	14:45	11:03	5:52	0:00
Bethel	5:48	7:50	10:26	13:20	16:08	18:34	19:01	17:01	14:13	11:26	8:35	6:14
Fairbanks	4:00	6:55	10:07	13:35	17:01	20:33	21:25	18:11	14:39	11:19	7:51	4:43
Juneau	6:30	8:15	10:34	13:13	15:43	17:48	18:10	16:30	14:01	11:30	8:55	6:53
McGrath	4:57	7:23	10:15	13:28	16:35	19:29	20:04	17:35	14:27	11:23	8:13	5:31
Nome	4:11	7:00	10:08	13:35	16:57	21:21	22:09	18:05	14:36	11:20	7:56	4:51
Portage	5:48	7:50	10:25	13:20	16:08	18:34	19:01	17:01	14:13	11:27	8:35	6:14
Prud. Bay	0:00	4:46	9:29	14:05	19:04	24:00	24:00	21:31	15:31	11:06	6:20	0:00
Seward	6:00	7:58	10:28	13:19	16:01	18:20	18:45	16:52	14:10	11:28	8:42	6:26
Sitka	6:50	8:27	10:39	13:10	15:32	17:27	17:48	16:16	13:55	11:31	9:05	7:11
Wasilla	5:22	7:36	10:20	13:24	16:22	19:02	19:32	17:19	14:20	11:25	8:24	5:52
Yakutat	6:11	8:04	10:30	13:17	15:55	18:08	18:32	16:44	14:07	11:28	8:46	6:35

Appendix H – Equipment Schedules

ALL SCHEDULES COMPILED FROM PLANS OR ON-SITE NAMEPLATE OBSERVATION, WHERE ACCESSIBLE e= estimated

CLINIC

UNIT HEATER AND HEAT RECOVERY

SYMBOL	MFGR/MODEL	FAN CFM/MBH	MOTOR DATA HP/VOLTS/PH	REMARKS
HRV-1	Venmar CES HRV600i	400-750cfm 2-stage	.25/115/1 .25/115/1	Heat recovery ventilator with hydronic heating coil in supply duct; with remote, dial adjustable thermostat; unit was turned off during survey, maint. Person was new on job, did not know about HRV
KSH-1	Kickspace heater, Beacon Morris W42 Twin-Flow	53/4.278 MBH	.034(30.7w)/115/1	each has local, manual, low voltage thermostat
KSH-2				

EXHAUST FAN SCHEDULE

SYMBOL	MOTOR MFGR/MODEL	CFM	MOTOR DATA HP/VOLTS/PH	REMARKS
EF-1, 2	Greenheck SP-218	140	113w/120/1	In each toilet room
EF-3	Greenheck SP-5	45	46w/120/1	Janitor room, on Occ sensor switch
EF-4	Greenheck CSP-218	140	113w/120/1	in Server room, exhasts to crawl space; runs continuosly
EF-5	Greenheck SP-5	45	46w/120/1	Morgue (used as storage)

RADIATOR SCHEDULE

SYMBOL	MFGR/MODEL	MBH	SIZE	REMARKS
RP-1	Linear Radiant Ceiling panel, /Airtex HEF-2 or equiv	.389MBH	24"x48" ceiling	(3) panels in lobby
RP-2				(1) panel in front bathroom
FT-1	unknown finned tube radiator	.64 MBH/ft	121 feet	81' around bldg perimeter, 40' in crawlspace

PUMP SCHEDULE

SYMBOL	MFGR/MODEL	GPM	MOTOR DATA HP/VOLTS/PH	REMARKS
CP-1, 2	Taco 0013	15	.17/115/1	Main glycol circ for room heat
CP-3	Taco 006	2	.025/115/1	DWH circ to indirect HWG

CP-4	Taco 007	3	.04/115/1	cold water re-circ back to main
BP-1	Marathon	25	.5/115/1	Potable water booste pump

BOILER SCHEDULE

SYMBOL	MFGR/MODEL	EFFICIENCY	MOTOR DATA HP/VOLTS/PH	REMARKS
B-1	Weil McLain WGO-5	87%	700w/115/1	175 MBH input, 152 MBH output

HOT WATER HEATER SCHEDULE

SYMBOL	MFGR/MODEL	GALLONS		REMARKS
HWG-1	Amtrol WH41LDW	41	indirect	130 F set point, dedicated CP on timer, but timer manually over-ridden

PLUMBING FIXTURES

SYMBOL	FIXTURE	GPF	QUANTITY	REMARKS
	W.C.	1.6	2	manually operated
	Kitchenette sink	e2.6	1	manually operated
	Janitorial utility sink		1	
	Shower	low flow	1	
	Lavatory	e2.6	7	manually operated

PLUG LOAD SUMMARY

SYMBOL	FIXTURE	QUANTITY	ESTIMATED CONSUMPTION	REMARKS
	Personal printers	7	85w	
	Desktop computers with LCD monitor	6	150w	
	Laptop	3	50w	
	commercial coffee makers	1	1200w	
	Flat Screen TV - video conference	1		
	Server, UPS, Hubs, ethernet switches	1	est 1000 w	
	Full size refrigerator	1	400 kWh/yr	<5yrs old, energy star
	Welch Allyn Medical equipment w/laptop	1		Medical equipment
	Welch Allyn MicroTynp	1		Medical equipment
	Protocol ProPaq12EL	1		Medical equipment
	Prescription dispenser	1		Medical equipment
	Triac centrifuge	1		Medical equipment

	Siemens DCA Vantage analyzer	1	1.25A/115/1	Medical equipment
	Adec dental unit (chair) 2122	2	335w	dental equipment
	Adec overhead light 6300	2	300w	dental equipment
	Planmeca Xray machine	2		dental equipment
	Optilux UV hardening tool	1		dental equipment
	Quala Sweep 5200 ultrasonic	1		dental equipment
	Assistina 301	1		dental equipment
	Statim 5000	1		dental equipment
	Ritter M9 UltraClave	1	12A/115/1	dental equipment
	Air Techniques Peri-Pro	1	5A/115/1	dental equipment
	DeVillbiss Oxygen station	1	4.1A/115/1	dental equipment
	Stacked washer/dryer - GE DBVH512EFOWW	1	6 kW/240v	
	VacStar vacuum pump	1	1900w/115/1	dental vacuum system
	HydroMiser compressor	1	33w/220/1	dental air system
	microwaves	1	1000w	

TRIBAL COUNCIL OFFICE

COOLING AND HEATING UNITS SCHEDULE

SYMBOL	MFGR/MODEL	MBH	MOTOR DATA HP/VOLTS/PH	REMARKS
H-1	Toyostove Laser 30	15 MBH	e35w/120/1	87% AFUE (derate due to condensation), 3 stage, internal programmable thermostat (not programmed)

BOILER SCHEDULE

SYMBOL	MFGR/MODEL	EFFICIENCY	MOTOR DATA HP/VOLTS/PH	REMARKS
B-1	Weil McLain WGO-3	86%	.14/115/1	Gas fired, cast iron, 115 MBH input, 100 MBH output; 2009, Beckett burner, 180F setpoint, 210 upper limit; Beckett AFG Burner; 2003

PUMP SCHEDULE

SYMBOL	MFGR/MODEL	GPM	MOTOR DATA HP/VOLTS/PH	REMARKS
CP-1	Taco 007-F5	e3	.04/115/1	Zone circulation pump

EXHAUST FAN/HEAT RECOVERY UNIT SCHEDULE

SYMBOL	MOTOR MFGR/MODEL	CFM	MOTOR DATA HP/VOLTS/PH	REMARKS
EF-1	Toilet Room exhaust	e100	e85w/120/1	On switch
EF-2	Stove hood (microwave)	e85	e85w/120/1	runs continuously when kitchen is in use

HOT WATER HEATER SCHEDULE

SYMBOL	MFGR/MODEL	GALLONS	NUMBER OF ELEMENTS	ELEMENT SIZE
HWG-1	Amtrol	30	indirect	149 F set point

PLUMBING FIXTURES

SYMBOL	FIXTURE	GPF	QUANTITY	REMARKS
	W.C.	1.6	1	manually operated
	Kitchen sink	e2.6	1	manually operated
	Utility sink		1	
	Lavatory	e2.6	1	manually operated

PLUG LOAD SUMMARY

SYMBOL	FIXTURE	QUANTITY	ESTIMATED CONSUMPTION	REMARKS
	Desktop computers with LCD monitor	4	125W	
	Personal printers	4	85w	
	Large copy/fax/printer	1		
	Laptop	1		
	Fax	1		
	Kitchenaid mixer	2		
	Kenmore Electric 5-burner stove/oven combi model 790-98052000	1		used 3 hrs/day, 3 of 5 burners + 2 ovens
	Sears chest freezer 253-16542105	1	500 kWh/yr	2011
	Amana chest freezer C101DW AO	1	600 kWh/yr	1994, empty and turned off but typically used year round
	Sears lg chest freezer 253-16082106	1	600 kWh/yr	2009
	Kenmore 106-70939901 FS refrig	1	400kWh/yr	2010
	Kenmore 795-71052-111 FS refrig	1	450KWh/yr	
	commercial coffee makers	1		

	Kenmore microwave 721-86012010	1	1500w	
	Air cleaner	1		
	Butcher Boy Meat band saw	1	1.5/115/1	used 2x/yr for a few hours

DAKLI BUILDING

BOILER SCHEDULE

SYMBOL	MFGR/MODEL	EFFICIENCY	MOTOR DATA HP/VOLTS/PH	REMARKS
B-1	Weil McLain Gold series	85%	.14/115/1	Gas fired, cast iron, e115 MBH input, 100 MBH output; 2005, Beckett burner, 180F setpoint, 210 upper limit

HOT WATER HEATER SCHEDULE

SYMBOL	MFGR/MODEL	GALLONS	NUMBER OF ELEMENTS	ELEMENT SIZE
No DHW in this building				

PUMP SCHEDULE

SYMBOL	MFGR/MODEL	GPM	MOTOR DATA HP/VOLTS/PH	REMARKS
CP-1	Grundfos UPS 15-58	e3	87w/115/1	Zone circulation pump
CP-2	Grundfos UPS 15-58	e3	87w/115/1	potable water re-circ back to water main; operates 8-10 months/year

PLUMBING FIXTURES

SYMBOL	FIXTURE	GPF	QUANTITY	REMARKS
	W.C.	3.5	1	manually operated
	Lavatory	e2.6	1	manually operated

PLUG LOAD SUMMARY

SYMBOL	FIXTURE	QUANTITY	ESTIMATED CONSUMPTION	REMARKS
	Laptop	3	50w	
	Personal printer	6	85w	
	Desktop PC with LCD screen	2	125w	
	Commercial coffee machine	1	1200w	
	Medium sized	1		

	copy/fax/scan			
	Microwave	1	750w	
	Radio	1		

COMMUNITY CENTER

COOLING AND HEATING UNITS SCHEDULE

SYMBOL	MFGR/MODEL	MBH	MOTOR DATA HP/VOLTS/PH	REMARKS
	Toyostove Laser 73	15/27/40	76w/120/1	89% AFUE (derate due to condensation), 3 stage, internal thermostat, setback programmable but not programmed; setpoint 70, reads 80
	Wood Stove	n/a		

PLUG LOAD SUMMARY

SYMBOL	FIXTURE	QUANTITY	ESTIMATED CONSUMPTION	REMARKS
	TV with VCR (video games)	1	25w	
	Bingo display board	1	125	
	Boom box	1		

Lighting

CLINIC

LIGHTING SCHEDULE

FIXTURE TYPE	DESCRIPTION	LAMPS		MOUNTING	
		NUMBER	WATTS	TYPE	HEIGHT
Entry	Incandescent surface mount		60	wall	8'
Exterior Wall pack	HPS wall pack		35	wall	12
T8-3	Florescent, T8 lamps, electronic ballast	3	32	Toffer	Ceiling
T8-2	Florescent, T8 lamps, electronic ballast	2	32	Troffer	ceiling

TRIBAL OFFICE

LIGHTING SCHEDULE

FIXTURE TYPE	DESCRIPTION	LAMPS		MOUNTING	
		NUMBER	WATTS	TYPE	HEIGHT
T8-2	Florescent, T8 lamps, electronic ballast	2	32	surface	ceiling
CFL A-type	surface mount		11	surface	8'
Surface	Incandescent surface mount		60	ceiling	8'

DAKLI BUILDING

LIGHTING SCHEDULE

FIXTURE TYPE	DESCRIPTION	LAMPS		MOUNTING	
		NUMBER	WATTS	TYPE	HEIGHT
T8-2	Florescent, T8 lamps, electronic ballast	2	32	surface	ceiling
CFL A-type	surface mount		11	surface	8'
Surface	Incandescent surface mount		75	ceiling	8'

COMMUNITY CENTER

LIGHTING SCHEDULE

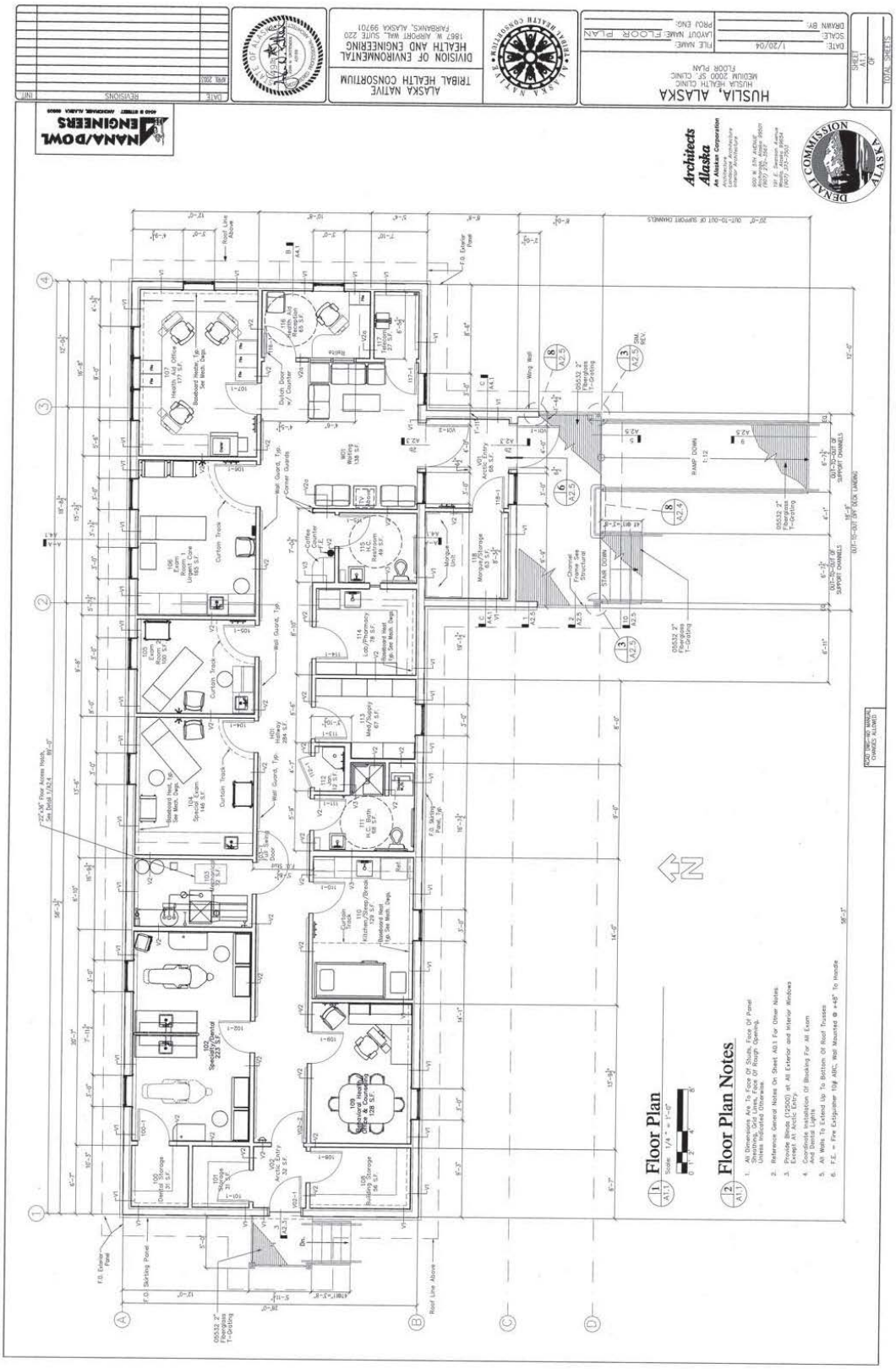
FIXTURE TYPE	DESCRIPTION	LAMPS		MOUNTING	
		NUMBER	WATTS	TYPE	HEIGHT
Entry	Incandescent bulb	1	75	wall	8'
Exterior	Par 30 Flood, incandescent	2	75	wall	12
T8-4	Florescent, T8 lamps, electronic ballast	4	32	surface	ceiling
T8-2	Florescent, T8 lamps, electronic ballast	2	32	surface	ceiling
Surface	CFL screw-in	1	15	surface	ceiling

Large Motors

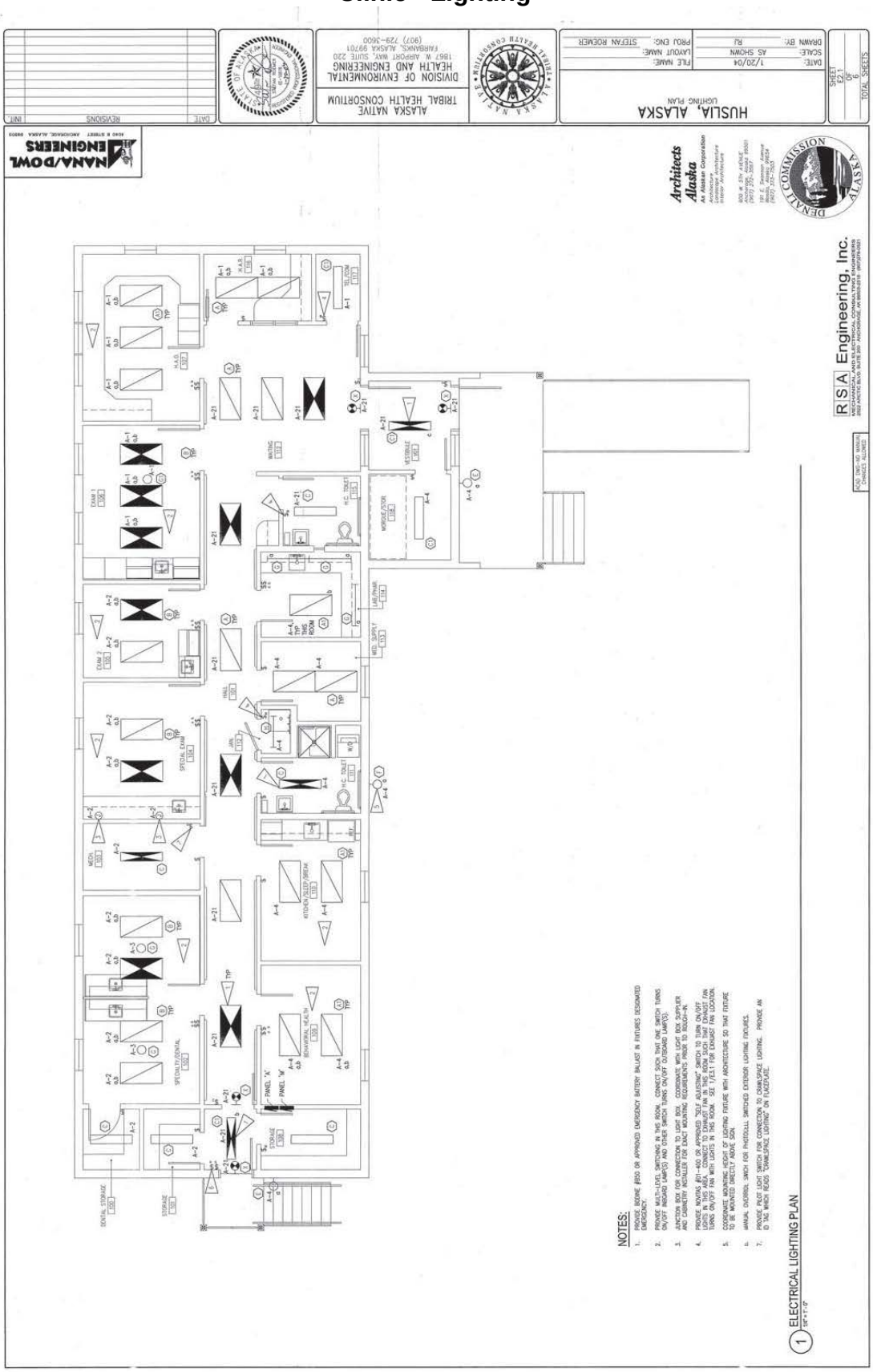
LARGE MOTOR SCHEDULE							
Motor use & location (5 HP or larger)	**HP/Volts/Ph**	**Existing Efficiency**	**Premium Efficiency**	**Estimated annual usage (hrs)**	**Annual Savings**	**Burn-out payback (yrs/cost)**	**Replacement payback (yrs/cost)**
The largest motor in these facilities is the 1 HP motor used to power the dental compressed air system and a ½ HP fresh water booster pump, otherwise there are no motors larger than ¼ HP. No motors are suitable for replacement with premium efficiency versions.							

APPENDIX I – FLOOR AND LIGHTING PLANS AND SCHEMATICS

Appendix I.1 – Clinic – Floor Plan



Clinic - Lighting



Clinic - Lighting Schedule

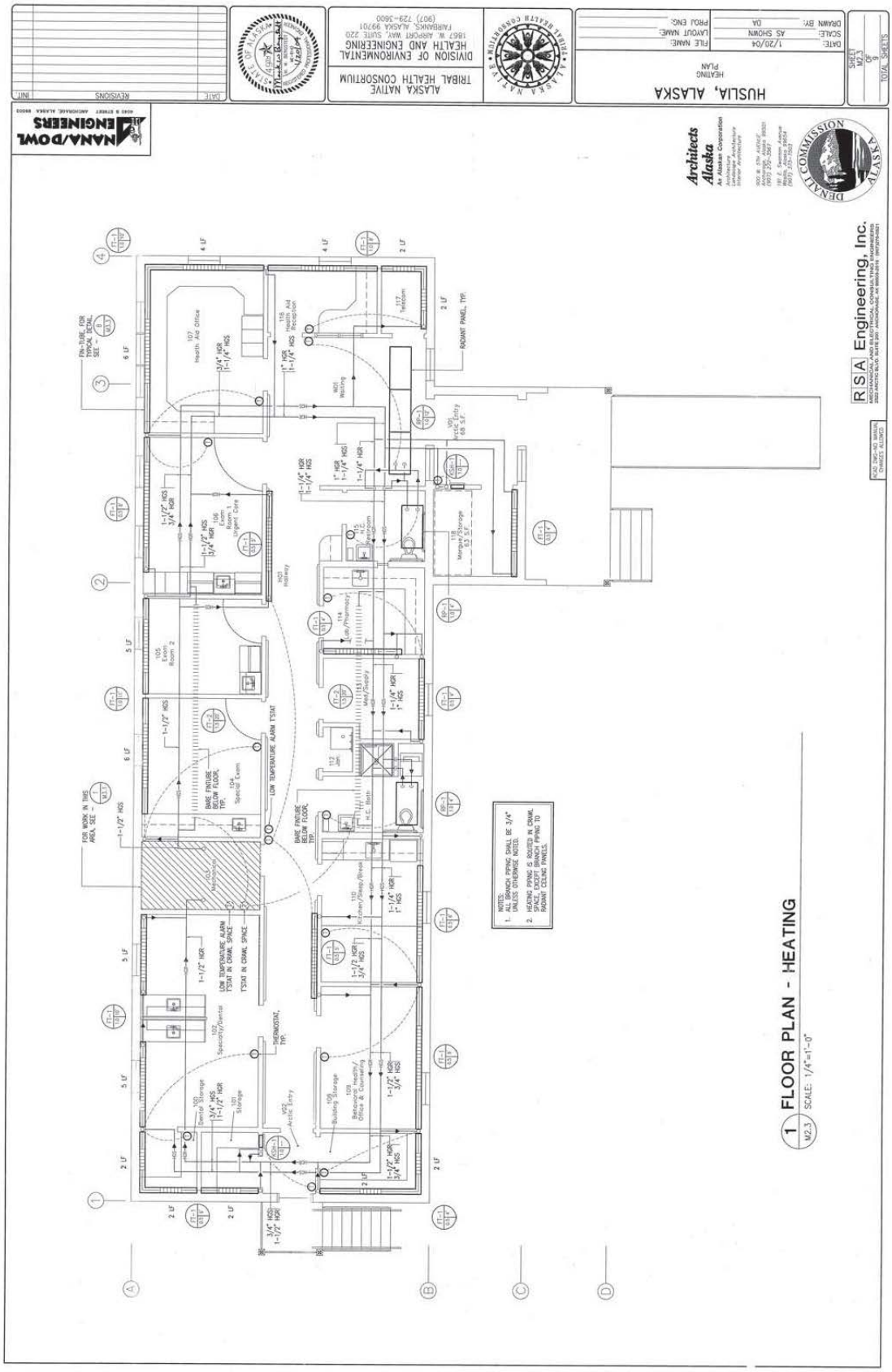
FIXTURE SCHEDULE

TYPE	LOCATION	MANUFACTURER AND CATALOG NUMBER (OR APPROVED EQUAL)	DESCRIPTION	MOUNTING		LAMPS		
				TYPE	HEIGHT	NO.	WATTS	
A	AS SHOWN	LITHONIA #2SP-G-2-H-32-A12125-120-GEB10	2'X4' FLUORESCENT STATIC TROFFER WITH .125" THICK PRISMATIC LENS, WHITE STEEL HOUSING, AND 120V ELECTRONIC BALLAST.	RECESSED	CEILING	2	32 T8	1 2
A1	AS SHOWN	LITHONIA #2SP-G-3-H-32-A12125-120-GEB10	SAME AS TYPE 'A' ONLY 3 LAMPS.	RECESSED	CEILING	3	32 T8	1 2
B	AS SHOWN	LITHONIA #2SRT-G-3-32-FW-A-12125V-120-GEB10-RIF	2'X4' CLEANROOM TROFFER WITH 125" THICK PRISMATIC LENS, STEEL HOUSING, GASKETED ALUMINUM INSET, RADIO INTERFERENCE FILTER, AND 120V ELECTRONIC BALLAST.	RECESSED	CEILING	3	32 T8	1 2
C	AS SHOWN	LITHONIA #AW-2-32-AR-120-GEB120	1'X4' FLUORESCENT WRAPAROUND FIXTURE W/ HIGH-IMPACT FLAT BOTTOM PRISMATIC DIFFUSER, WHITE HOUSING, AND 120V ELECTRONIC BALLAST.	SURFACE	CEILING	2	32 T8	1 2
C1	AS SHOWN	LITHONIA #AW-4-32-AR-120-GEB120	SAME AS TYPE 'C' ONLY 4 LAMPS.	SURFACE	CEILING	4	32 T8	1 2
D	CRAWLSPACE	GE #GE 5740-7	STANDARD KEYLESS PORCELAIN CEILING MOUNTED LAMPHOLDER WITH WIREGUARD AND 19W SCREWIN COMPACT FLUORESCENT.	SURFACE	CEILING JOIST	1	19 CFL	
E	EXTERIOR	LITHONIA #TWL-35S-PE-LPI	7"X11" HID WALLPACK FIXTURE W/ CAST ALUMINUM HOUSING, INJECTION MOLDED POLYCARBONATE REFRACTOR, DARK BRONZE ENAMEL FINISH INTEGRAL PHOTOCELL & 120V HPF BALLAST.	WALL	8'-0"	1	35 HPS	
F	EXTERIOR	LITHONIA #TWP-150S-PE1-LP1	SAME AS TYP 'E' EXCEPT 15"X16" AND 150W HPS LAMP.	WALL	ABOVE SIGN COORD. ARCH.	1	150 HPS	
G	DENTAL	SKYTRON #ST23	23" SINGLE HEAD FULLY ADJUSTABLE EXAM FIXTURE WITH POLYMESTER HOUSING, OPTICLE OVERLAY TECHNONOLOGY, 5 LIGHT SOURCES, AND POSITIONING HANDLE.	SURFACE	CEILING	5	50 HAL	
G1	TRAUMA	SKYTRON #ST2323	SAME AS TYPE 'H' ONLY 2 HEAD.	SURFACE	CEILING	10	50 HAL	
H	JANITOR	LITHONIA #C-2-25-120-GEB10-WGCUN	3' FLUORESCENT STRIP FIXTURE WITH WHITE BAKED ENAMEL FINISH, WIREGUARD, AND 120V ELECTRONIC BALLAST.	SURFACE	CEILING	2	32 T8	
X	AS SHOWN	LITHONIA #LQM-S-W-3-R-120-EL-N	LED EXIT SIGN W/ WHITE HOUSING, EXTRA FACEPLATE FOR DOUBLE-FACE CONVERSION & NICKEL-CADMIUM BATTERY.	WALL	7'-6"	-	LED	

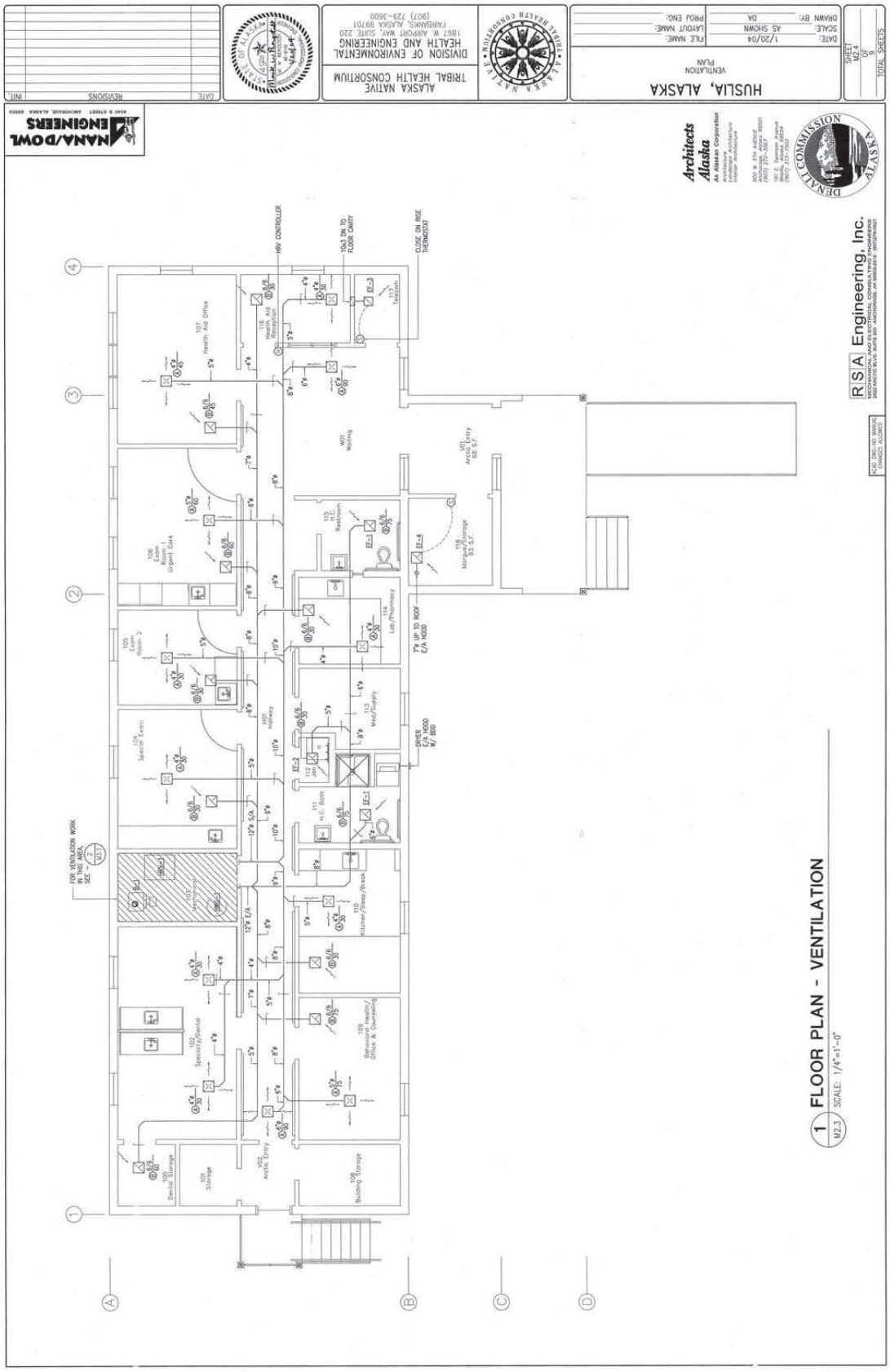
NOTES:

1. SEE PLANS FOR NUMBER OF FIXTURES W/ EMERGENCY BALLASTS.
2. PROVIDE DUAL BALLASTS FOR ALL FLUORESCENT T8 FIXTURES.

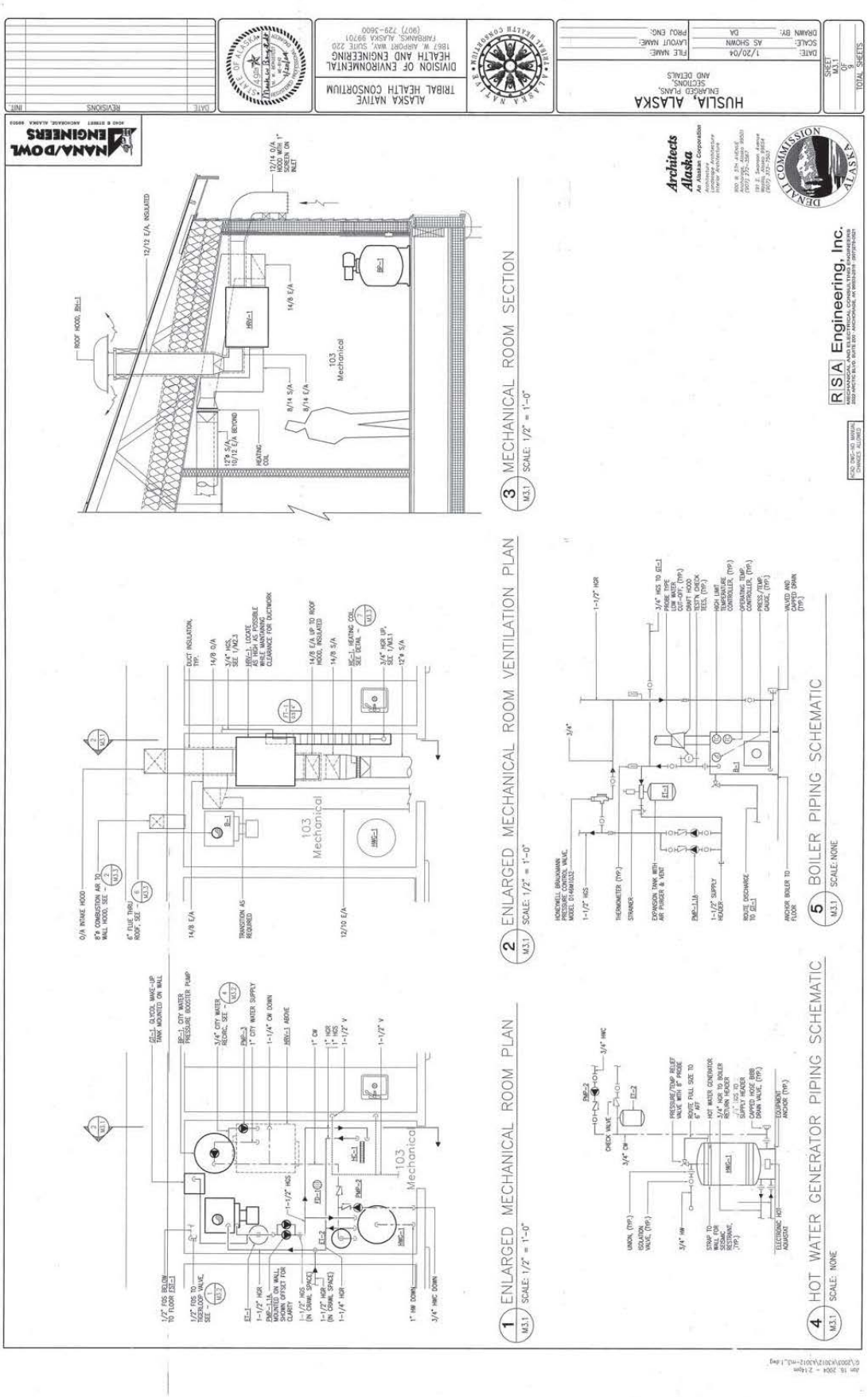
Clinic - Heating Plan



Clinic - Ventilation Plan

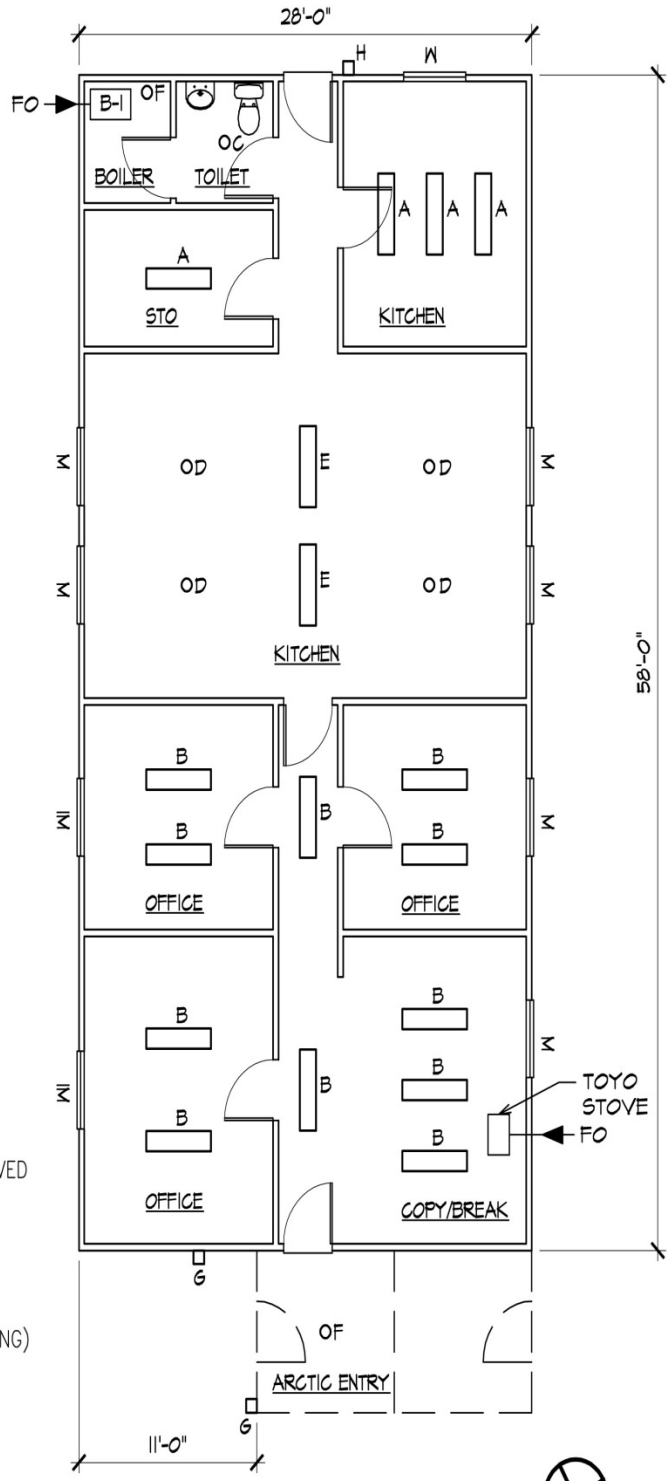


Clinic – HVAC Schematics



Appendix I.2 - Tribal Council Office

Floor Plan



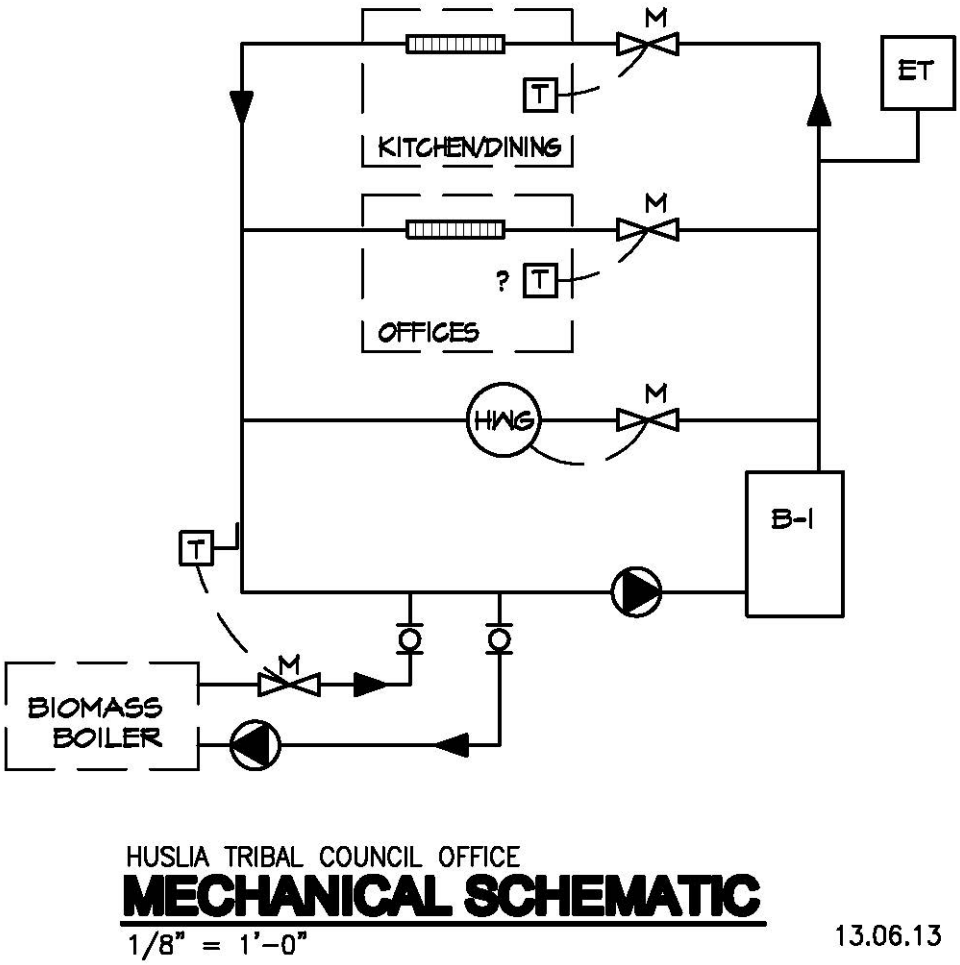
LEGEND

A T8-4 LAMP, ELECT. BALLAST, 2 LAMPS REMOVED
B T8-2 LAMP, ELECT. BALLAST
C INCANDESCENT 6 BULB FIXTURE
D INCANDESCENT 2 BULB FIXTURE
E T12-2 LAMP, MAGNETIC BALLAST
F CFL (1) BULB FIXTURE
G DOUBLE FLOOD INCANDESCENT (BULBS MISSING)
H SINGLE INCANDESCENT (1) BULB

W 3'-10 x 3'-10 TRIPLE VINYL
W1 3'-10 x 3'-10 DOUBLE ALUMINUM

HUSLIA TRIBAL COUNCIL OFFICE
FLOOR & LIGHTING PLAN
1/8" = 1'-0"
13.06.13

Tribal Council office – HVAC schematic

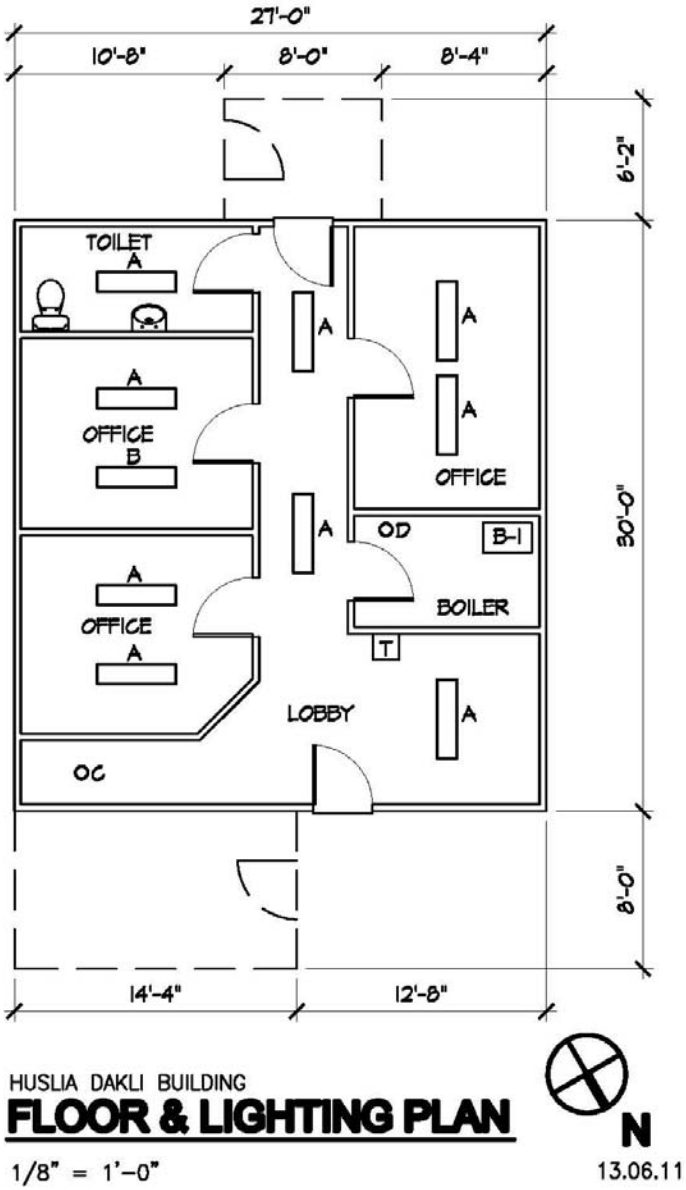


Appendix I.3 –Dakli Building- Plans and Schematics

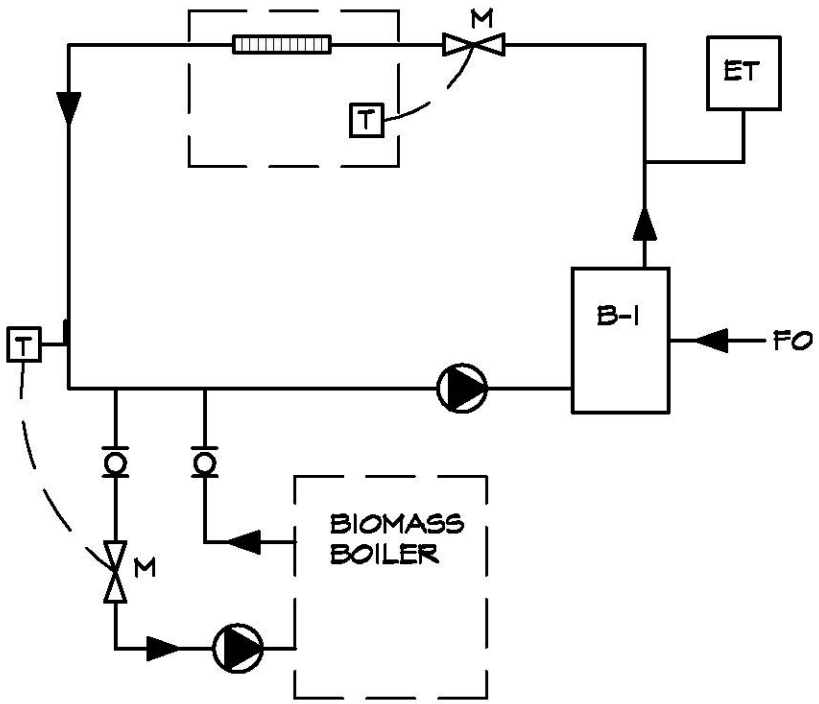
Floor & Lighting Plan

LEGEND

A T8–2 LAMP, 32 WATT, ELECT. BALLAST
B T8–4 LAMP, 32 WATT, ELECT. BALLAST
C CFL SCREW–IN, 11 WATT
D INCANDESCENT 60W



Dakli Building - HVAC Plan

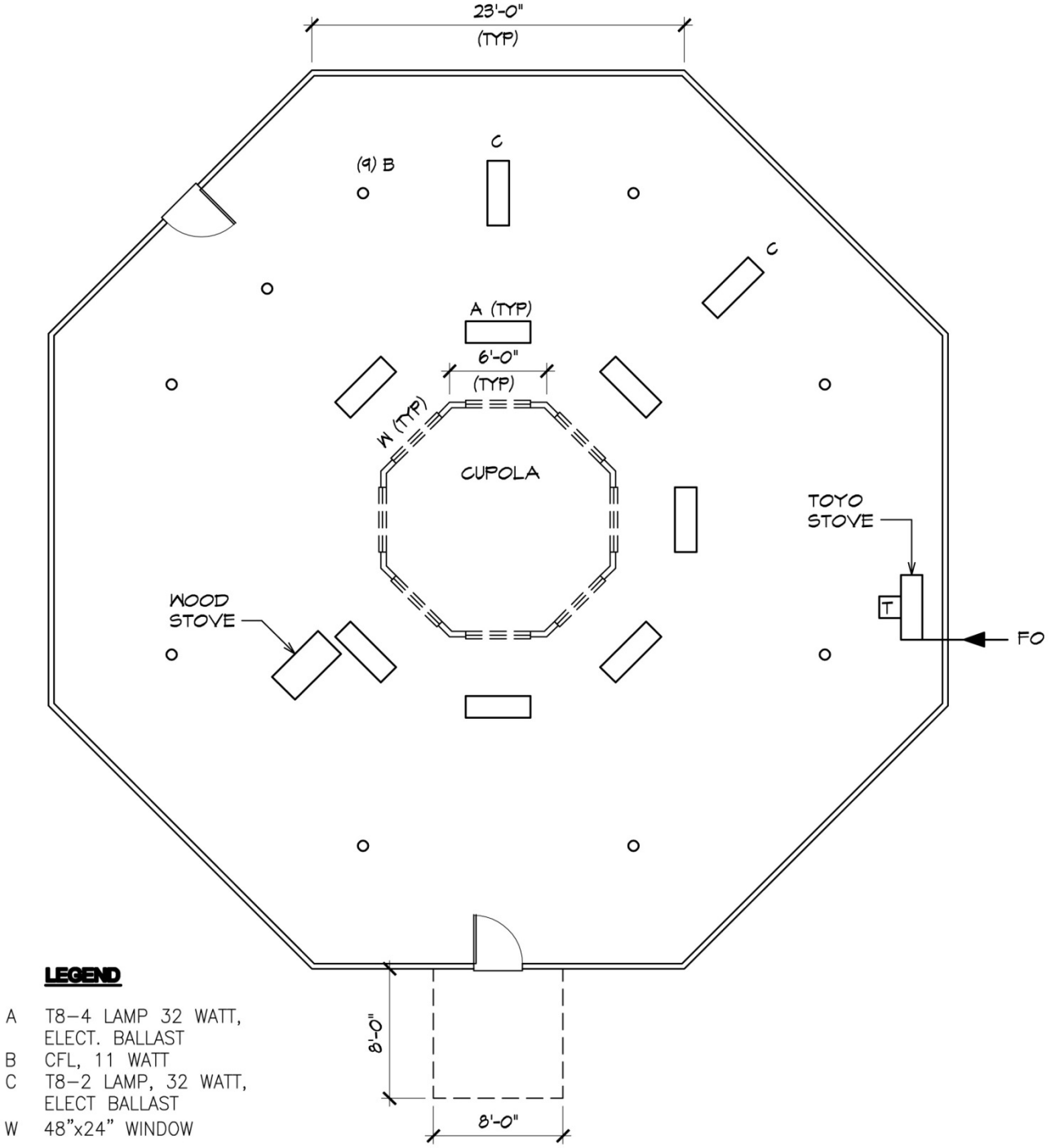


HUSLIA DAKLI BUILDING
MECHANICAL SCHEMATIC
1/8" = 1'-0"

13.06.11

Appendix I.4 – Old Environmental Office – No plans or schematics

Appendix I.5 – Community Center - Plans and Schematics



LEGEND

A T8–4 LAMP 32 WATT, ELECT. BALLAST
B CFL, 11 WATT
C T8–2 LAMP, 32 WATT, ELECT BALLAST
W 48"x24" WINDOW

HUSLIA COMMUNITY CENTER

LIGHTING & MECHANICAL PLAN

1/8" = 1'–0" 13.06.11

Appendix J – Monthly Energy Checklist

CHECKLIST - MONTHLY WALK-THROUGH OF EACH BUILDING	check
Manual Thermostat set points	
Programmable Thermostat settings and times for each day of the week	
Are windows and doors open because it's too hot in the building – what is the inside and outside temperature?	
Is it too cold in the building?	
Are timers used or over-ridden (DWH circulation, fresh water re-circulation, etc.)	
Are motor control switches on "Hand" instead of "Auto"?	
Are redundant hydronic circulation pumps alternated monthly?	
Are motor control switches on "Hand" instead of "Auto"?	
Are circulation pumps alternated monthly	
Check airflow from ventilation ducts, are they in-taking and supplying	
Clean heating coils and refrigerator condenser coils every 6 months	
Do filters need to be changed?	
Are lights or plug loads left on at night? (add a digital timer power strip – see Appendix E)	
Upload monthly consumption data to building monitoring spreadsheet and review trend	
Are ventilators and/or HRV's on and providing fresh air?	
Is weather stripping around doors and windows in good condition?	

Appendix K – Basis for Estimating Costs used for EEM paybacks

Installed costs for the recommended EEM's in this audit include the labor and equipment required to implement the EEM retrofit, but design and construction management costs are excluded. Cost estimates are typically +/- 30% for this level of audit, and are derived from and one or more of the following:

- The labor costs identified below
- Means Cost Data
- Industry publications
- The experience of the auditor
- local contractors and equipment suppliers

Labor rates used:

Certified Electrician $134/hr
Assume $8000 per 60 hr. work week, which includes travel and lodging. Also assume there is sufficient work to amortize the entire $8000 across 60 hours. This level of work includes changing street light heads, running new wires for ceiling or fixture mounted occupancy and/or daylight harvesting sensors, etc.

Common mechanical work $ 40/hr
Includes installing switch mounted occupancy sensors which do not require re-wire or pulling additional wires, weather stripping doors and windows, replacing ballasts, florescent lamps and fixtures, exterior HID wall packs with LED wall packs, replacing doors, repairing damaged insulation, etc.

Certified mechanical work $134/hr
Assume $8000/60 hr. work week including travel and lodging. Also assume there is sufficient work to amortize the entire $8000 across 60 hours. Work includes boiler replacement (unless it's a drop-in replacement with no new piping, wiring or venting), new or modified heat piping and/or ducting, adding or modifying heat exchangers, etc.

Non-professional engineering and technical work and logistics 50% or $75/hr
Includes identifying, sourcing, ordering, coordinating shipping and receipt of ordered parts, staging for work, etc. Depending on the size and complexity of the total building retrofit project, either a markup on the installed retrofit costs of 50% is used, or an estimate of hours required, at a rate of $75/hr.

	Parts w/shipping	Common Mechanical/electrical	Certified Mechanical	Certified Electrical	Technical/ Logistics
RATE/HR		$ 40.00	$ 134.00	$ 134.00	$ 75.00
Switch mounted OS	$ 125.00	0.5			
Ceiling mounted OS (per unit) + Power pack (per room) + Labor (per room)	$ 125.00	2			
	$ 70.00				
FLOUR lamp replacement only (parts per lamp, labor per fixture)	$ 2.00	0.4			
FLOUR lamp replacement (per lamp) & Ballast replacement (per fixture)	$ 2.00	1.5			
	$ 50.00				
Drop-in Boiler replacement	$ 6,000.00	40			
New boiler + piping	$ 6,000.00		120		
Zone valve replacement (head only, Taco)	$ 70.00	1			
Utilidor repair	$ -	18.75			
Programmable Setback Tstat retrofit	$200 per AkWarm ($160 parts, 1.0 labor)				
Street light head replacement				4	
Wall pack replacement (25 watt LED)	$ 800.00	2			
Incandescent bulb replacement (9 w LED)	$ 20.00	0.1			
Screw-in base photo sensor	$ 25.00	0.1			
PC replace with Laptop at EOL (incremental)	$ 100.00				
CoolingMiser	$ 200.00	2			
LED Exit signs	$ 36.00	1			
switch mounted digital timers	$ 50.00	0.5			
PLMD	$ 120.00	0.2			
Maintenance Savings for new lamp + ballast (per fixture)	$ 5.00				

See notes following Appendix B.1.a for AkWarm-C nomenclature used.

Appendix L – Building Monitoring

Ongoing Energy Monitoring: Extensive research by a number of organizations has validated the value of building system monitoring as an effective means to reduce and maintain lower energy consumption. A few of these organizations are the Lawrence Berkeley National Laboratories, the California Energy Commission and Texas A & M University.

HVAC "performance drift" is the deterioration of an HVAC system over time, resulting from a number of preventable issues. Performance drift typically results in a 5% to 15 % increase in energy consumption. Lawrence Berkeley National Laboratories identified these common contributors to performance drift:

- Manually over-ridden automatic control settings including programmable thermostats, motor control switches, disabled variable frequency motor drives.
- Timer clocks not used or disabled
- Duct and/or valve leakage or dysfunction
- Pumps, fans or actuators not operating correctly
- Scheduling, resets and/or setbacks not matching building usage
- Degradation of sensors

A study of 60 commercial buildings by the same organization found that 40% had HVAC control problems, 15% had missing equipment and 25% had equipment that was not operating properly. Problems like these should have been identified by this audit; once they are rectified, a monitoring program should be implemented to prevent future performance drift.

In rail-belt communities, there are many monitoring options available to building owners. In rural communities there are only a few options, and all require an "energy champion" in the community.

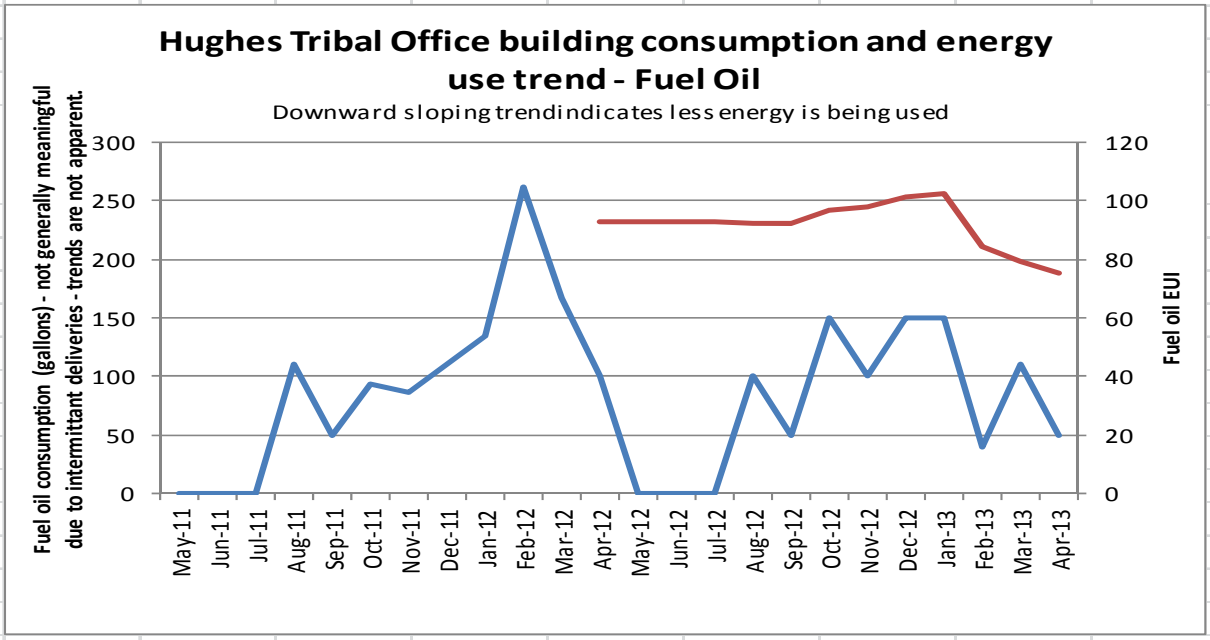
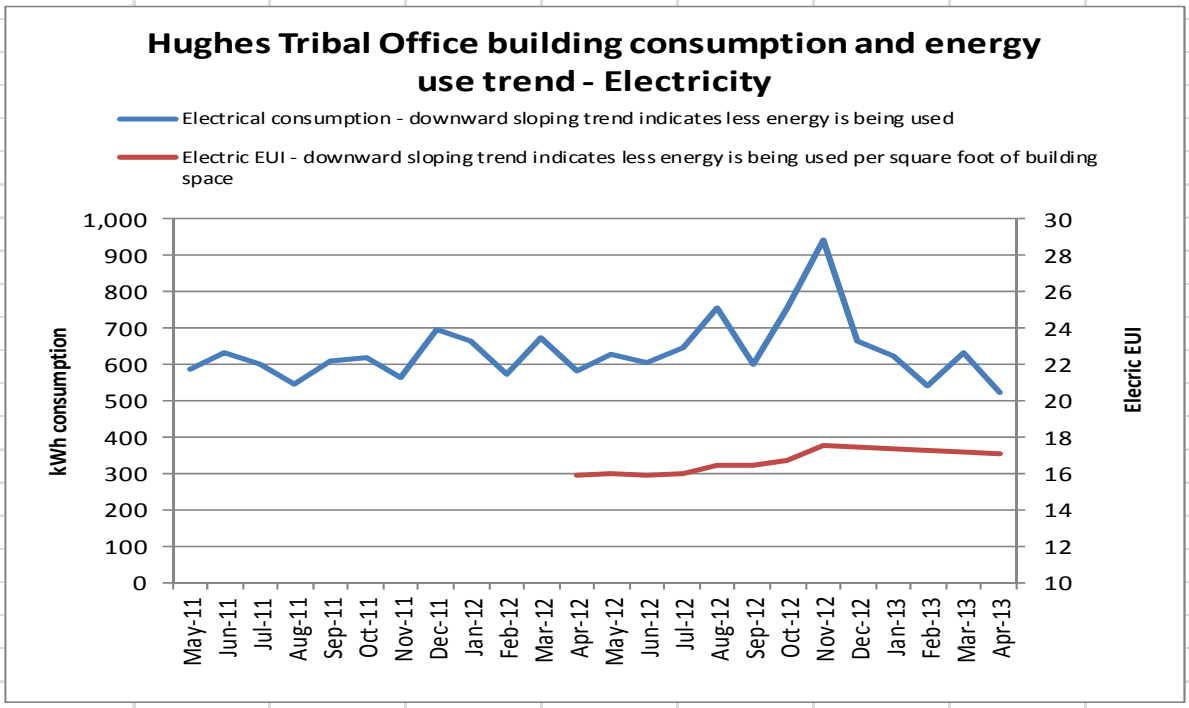
<u>It is recommended to implement a simple energy monitoring program for all city and village owned</u> buildings in this community, by implementing the following steps:

1. Assign or recruit a village "energy champion" team consisting of two people – one person who performs a walk-through of each building on a monthly basis and goes through the checklist in Appendix J, and a second person who updates the consumption trend charts on a monthly basis. The maintenance person is probably best suited for the former position, the city or village manager or bookkeeper is probably best suited for the latter position.
2. Each month the bookkeeper or the energy champion updates the trend charts with the current billing information for electric consumption for each building.
3. The energy champion records the current month's fuel oil consumption from the newly installed cumulative flow meter (see ECM's) for each building, and enters the consumption into the trend charts.
4. The energy champion reviews the charts prior to his monthly walk through of each building, looking for anomalies, changes in the trend, or differences from the prior year's consumption.

5. Having identified an undesirable change in the trend or an anomaly, the energy champion will consult with the maintenance person to identify and rectify the cause.
6. The trend charts should be posted in a conspicuous location in each building.

An Excel spreadsheet (Excel 2003) with pre-programmed trend charts, graphs and instructions for use are available from the Denali Commission.

Consumption and Trend Monitoring – sample Trend Charts



EUI = Energy Use Index; this is measure of the building's efficiency - how much energy it uses per square foot