Tribal Renewable Energy - Final Report

DOE Award Number: **EE0002508**

Recipient Organization: **Chickaloon Native Village**

Project Title: **Uk'e koley (*No Footprints*) Project**

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Reporting Period: January 1, 2010 to December 31, 2013
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Executive Summary

Chickaloon Native Village was awarded a Tribal Renewable Energy Feasibility Grant from the US Department of Energy to conduct a feasibility study to assess the energy uses, loads, and efficiencies for all of our current Tribally owned and operated buildings and rental housing units, to determine if it makes economic and environmental sense to install renewable energy systems on each building to lower our carbon footprints and to decrease our dependence on fossil fuels.

Through this award an Energy Audit and Renewable Energy Strategy Report for 14 Tribally-Owned Buildings of the Chickaloon Village Traditional Council was produced. This document included energy, heating and pollution audits; tips on how each location might be more energy efficient with the existing infrastructure; renewable energy assessment for the Tribal buildings; economic analysis of the costs of retrofitting Tribal buildings; and a conceptual design for retrofitting Tribal buildings. Also an Energy Efficiency Upgrade Cost Assessment was calculated including a cost benefit analysis of adding renewable energy systems to heat several Tribal buildings at one site. Finally, the third main result of this award was the Tribal capacity building and subsequent management of the Tribal alternative energy systems already in place, including securing a net metering agreement between the regional electric cooperative and the Tribe. This agreement required the electric cooperative to credit the Tribe for any power produced by one of the Tribe's existing solar arrays and used by the grid.

Project Overview

Chickaloon Native Village (CNV) is a federally-recognized Alaska Native Tribe that has long been devoted to being a good steward to the environment, understanding that it is our responsibility to take care of the land that has been loaned to us for the short time we are here. The Uk'e Koley Project (meaning *no footprint*) conducted a feasibility study to assess the potential of producing green energy to heat and power Tribally-owned buildings.

The long-term **energy vision** for Chickaloon Native Village is to produce enough clean, renewable energy to power and heat all existing buildings and rental housing units, and become a green energy supplier to the regional utility company. The long-term **energy goal** is to protect, enhance and restore our ancestral lands, water and air and ensure respectful, healthy development by reducing our reliance on fossil fuels.

The **project goal** was to conduct a feasibility study to assess the energy uses, loads, and efficiencies for all of our current Tribally owned and operated buildings and rental housing units, to determine if it makes economic and environmental sense to install renewable energy systems on each building to lower our carbon footprints and to decrease our dependence on fossil fuels.

The development of a feasibility study was a first step away from reliance on fossil fuels, which will lead to a reduction of fossil fuel use and its associated negative impacts, such as climate change due to increased greenhouse gases in the atmosphere, disease from breathing fossil fuel exhausts, and oil spills and contamination of soil and water associated with fossil fuel storage and transportation.

The feasibility assessment and energy audit was conducted at five (5) Tribal locations, some with multiple Tribally-owned buildings at a single location for a total of 14 buildings. The buildings included in the feasibility study were: a health and social services department, government building, Tribal school, low-income housing units, greenhouse, and multiple Tribal program offices. The following is a list of the locations and brief descriptions of the buildings:

21117 E. Meyers Ave, Sutton, Alaska.
This location included: 1200 square feet four-season greenhouse that was already powered, in part, by a small wind turbine and three small solar panels. The wind turbine and solar panels produce approximately 1500 watts of electricity. This building was heated by a wood burning stove. The electricity was supplied by Matanuska Electric Association (MEA) who used hydropower and natural gas to generate their energy. The greenhouse used $585.00 in electricity in 2009.

1368 square feet administration offices for housing, accounting, and administration staff. This building was heated by propane supplied by Amerigas, Inc totaling over $4700.00 in 2009. The electricity was supplied by (MEA). This building used approximately $1800.00 in electricity 2009.

3400 square feet large metal building/shop: 2400 square feet shop for the housing/facilities program and 1000 square foot environmental office building. This building was heated by oil supplied by Fisher's Fuel, Inc. totaling nearly $9000.00 in a calendar year. The electricity was supplied by (MEA). This building used approximately $1800.00 in electricity in 2009.

16166 North Glenn Hwy, Sutton, Alaska.
This location included: 2688 square feet office, meeting and program space including: 1344 square feet of Tribal Government conference/meeting space and 1344 square feet of health and social service office space. This building was heated by oil supplied by Fisher's Fuel, Inc. totaling nearly $3200.00 in a calendar year. The electricity was supplied by (MEA). This building used approximately $1700.00 in electricity in 2009.

9109 N. Glenn Hwy, Sutton, Alaska.
This location included: 2688 square feet of space for the education department. 1744 square feet of this was home to Ya Ne Dah Ah (*Ancient Teachings*) School, the first Tribally operated school in Alaska catering to children pre-K thru 12th grade. The remaining square footage houses other educational programs such as higher education, vocational rehabilitation, and direct employment. The education department has a large, working solar panel that produces two (2) kilowatts. Not only does this solar panel have a positive impact on our environment by supplying the education building with clean, renewable energy, lessening greenhouse emissions and other detrimental effects on our environment but it has also been used as a great educational tool for the Ya Ne Dah Ah students teaching them the importance of being good environmental stewards. This building was heated by oil supplied by Fisher's Fuel, Inc. totaling nearly $3900.00 in a calendar year. The electricity was supplied by (MEA). This building used approximately $2900.00 in electricity in 2009.

9255 North Glenn Hwy, Sutton, Alaska.
This location included: 1175 square feet building used to house our Ahtna Language Program, a program dedicated to the revitalization of our endangered traditional Ahtna Language, as well as some miscellaneous administration space. This building was heated by oil supplied by Fisher's Fuel, Inc. totaling nearly $1000.00 in a calendar year. The electricity was supplied by (MEA). This building used approximately $750.00 in electricity in 2009.

280 square feet building that housed our Indian Child Welfare Act (ICWA) program; a program dedicated to protecting the rights of our Tribal children who are displaced from their families. This building was heated by oil supplied by Fisher's Fuel, Inc. totaling nearly $650.00 in a calendar year. The electricity was supplied by (MEA). This building used approximately $300.00 in electricity in 2009.

608 square feet building housing our transportation department: this building was heated by oil supplied by Fisher's Fuel, Inc. totaling nearly $1950.00 in a calendar year. The electricity was supplied by (MEA). This building used approximately $800.00 in electricity in 2009.

17983 East All Elks Rd, Sutton, Alaska.
This location is the site of our low-income housing development for Alaska Native/American Indians. The location included six units: Unit A: a 864 square feet single family dwelling. Unit B: a 1120 square feet single family dwelling. Unit C: a 1120 square feet single family dwelling Unit D: a duplex with two 728 square feet units. Unit

E: a duplex with two 864 square feet units. Unit F: a duplex with two 902 square feet units. These buildings were heated by oil supplied by Fisher's Fuel, Inc. The electricity was supplied by (MEA). The tenants were responsible for paying heat and electric so we did not know the cost of the utilities for these buildings.

The major finding and conclusion of this project is the determination that renewable energy systems are economically and environmentally a wise option for CNV Tribal buildings. The CNV project managers and contractors have completed plans to retrofit Tribal buildings to reduce energy dependence on expensive fossil fuels by using renewable energy sources. Project managers have overseen the completion of all 34 activities associated with the four grant objectives: 1) conduct an energy audit of Tribal buildings, 2) determine the renewable energy systems best suited for Tribal buildings, 3) write plan to install renewable energy systems in Tribal buildings, 4) build capacity of Tribe through training of project manager.

Objectives

Objective One: Was to conduct an energy audit documenting current energy consumption and heating loads including a pollution audit to measure carbon dioxide emissions associated with the existing energy systems.

This objective developed a clearer understanding of our Tribal energy uses and a greater understanding of the Tribe's energy consumption and the environmental impacts of our Tribe's energy usage.

The activities associated with objective 1 included: hiring the project manager and project contractors, facilitating project activities and meetings, submitting quarterly reports, attending the DOE annual conference in Denver, conducting the energy and heating audits, assessing a pollution audit based on the energy consumption audit, documentation of recommendations to improve energy efficiency with the existing infrastructure, and presentations to the Tribal Council and to Tribal staff members.

Objective Two: Was to determine the energy systems best suitable for our needs based on the availability of natural renewable energy resources in our region.

This objective developed a clear understanding of the renewable energy potential at each of our Tribal locations and a clear understanding of the types of renewable energy systems best suited for our Tribal needs.

The activities associated with objective 2 included: determination of which locations would be best suited for upgrades and renewable energy systems, review of literature to identify the best natural resources in these Tribal-building locations to generate renewable energy, documentation of the best sources of energy generation systems for this region, assess the renewable energy potential at each Tribal-building, present on findings to the Tribal Council, document the cost benefit analysis of adding renewable energy systems to the proposed locations, and submit quarterly and year-end reports.

Objective Three: Was to develop a written plan to install renewable energy systems in CNV's Tribally-owned buildings.

This objective created a full understanding of how to retrofit our Tribal buildings with renewable energy systems, an understanding of the costs for retrofits, and a development plan to fund the planned retrofits.

The activities associated with objective 3 included: development of a Tribal Village Energy Plan Map to provide a visual of proposed energy development, create a budget for renewable energy system purchase, installation and maintenance, collaborate with the local utility companies and other groups to apply for any necessary permits for renewable energy system installation, present to Tribal Council and participate in Council prioritization of renewable energy project locations, write a step-by-step plan to retrofit priority locations with renewable energy systems, write a development plan for financing the priority projects, compile all energy system information into one document including the plan for installation, maintenance and development, and submit quarterly and final reports.

Objective Four: Was to train the CNV Uk'e koley Project Manager through formal and informal methods to build the capacity of the Tribe to manage green energy systems.

This objective expanded the capacity of our Tribal staff to become knowledgeable about energy efficiency measures and proficient in the development, installation, operation, and maintenance of renewable energy systems. The project manager was to be trained to a level that they would have the ability to manage all future renewable energy developments of the Tribal government.

The activities associated with objective 4 included: attendance of the Mat-Su College Renewable Energy System Design Certificate Program courses, and on-the-job learning through collaboration with and assistance to project contractors on all aspects of the energy audits, potential renewable energy assessment, energy system research, and plans for development, installation, and maintenance.

Description of Activities Performed

Progress in Fiscal Year 2010

In November 2009 of FY 2010 Rick Harrison, Tribal Vice Chairman, attended the DOE conference in Denver and returned with recommendations including ideas about the possible uses of geothermal energy for facility heating and wind energy for electricity, as well as suggestions about induction lighting. There were delays this fiscal year due to a very delayed award letter from DOE, so plans were made to get back onto schedule. Later in the fiscal year, once the award funding was finalized, Chickaloon Native Village Tribal citizen, Jim Shaginoff, was hired as the Project Manager. Jim had extensive experience and training as an Instrument Technician, Electrical Technician and Communications Technician. Jim had already completed Solar Systems at Mat-Su College prior to the inception of this project. In January 2010, before the award letter arrived, he enrolled in the Renewable Energy System Occupational Endorsement

Certification Program and attended class as a volunteer of the Uk'e koley (*No Footprints)* Project until he was officially hired in June 2010. He has completed an Introduction to Renewable Energy receiving three (3) credits toward the certificate.

A Request for Proposals was advertised for a consultant to conduct an energy and heating audit and a contractor was chosen (Alaska-based business YourCleanEnergy) following Chickaloon Villages policies and procedures for hiring contractors. Eight of the 14 buildings were audited for energy, heating and pollution in FY 2010, with the remaining building audits scheduled for completion by November 2010. Quarterly reports were written and submitted to DOE throughout the fiscal year, once the grant award was finalized.

Progress in Fiscal Year 2011

In early December 2010 an Energy Audit and Renewable Energy Strategy Report for 14 Tribally-Owned Buildings of the Chickaloon Village Traditional Council was completed. This document included energy, heating and pollution audits; tips on how each location might be more energy efficient with the existing infrastructure; renewable energy assessment for the Tribal buildings; economic analysis of the costs of retrofitting Tribal buildings; and a conceptual design for retrofitting Tribal buildings. The report was submitted to the Tribal Council in December and the Project Manager gave a power point presentation about the report's main findings to the Council and the all interested staff members in December.

The Project Manager worked closely with the YourCleanEnergy contractors to learn from them and completed all courses of the Mat-Su College Renewable Energy System Occupational Endorsement Certification Program by May 2011 with straight A grades. The following were the required courses for the certificate program:

- Introduction to Renewable Energy Re A100
- Industrial Safety for Renewable Energy RE A101
- Applied Physics for Renewable Energy RE A102
- Introduction to Diesel Engines RE A106
- Introduction to Solar Photovoltaic Systems RE A110
- Power Generation Systems RE A200
- Power System Management RE A201
- Renewable Energy Project Development RE A203
- Renewable Energy Practicum RE A295

The Project Manager and the Environmental Stewardship Director collaborated to write several grant proposals this fiscal year. One proposed to hire an Energy Project Technician to complete the Mat-Su College Renewable Energy System Occupational Endorsement Certification Program and assist the Energy Project Manager in installing and maintaining energy efficiency and renewable energy developments on Tribal buildings. A second proposal was for funding to install 2 MET towers, hire an assistant, and install a solar thermal and wood pellet boiler system. Unfortunately the proposals were not funded.

As part of capacity building, learning and project development the Project Manager attended a DOE Energy Efficiency and Renewable Energy Workshop, an International Wind-Diesel Workshop, a Solar Thermal/Battery Workshop, a Remote Wall and Residential Energy Efficiency Workshop, an Energy Efficiency and Net Zero Energy Workshop. Also the Project Manager toured Eklutna 47MW power plant, researched renewable energy information on the internet, assisted and observed wind turbine replacement at the Mat-Su College, interviewed a person established in the renewable energy field as part of the learning process, and researched solar light pipe for some of the Tribal buildings (for example for the shop building he recommend using Orion light pipes with the Intelite and Compact Modular technology).

The Project Manager attended the 2010 DOE Program Review in Denver, Colorado and presented on the progress of the project. It was an educational opportunity to learn about other Tribal projects around the country and network with other Tribes and groups working toward similar goals.

The Project Manager developed recommendations for proposed energy development in the form of electricity generation at two Tribal sites using wind turbines without batteries. The Project Manager presented his findings and recommendations to the Tribal Council. Quarterly reports were written and submitted to DOE throughout the fiscal year.

Progress in Fiscal Year 2012

In this fiscal year the Project Manager created a document that detailed a cost benefit analysis of adding renewable energy systems to heat several Tribal buildings at one site. Specifically the document described a proposed project to build and install a Combined Wood Pellet Boiler and Solar Thermal System that would provide heat for both a 3,200 square foot Tribal shop/office building and a 1,160 square foot Tribal administrative building. This proposed project included the construction of a building addition to house the boiler system, the purchase and installation of the solar thermal and pellet boiler, and addressed monitoring and evaluation of the project. This project would be used as a demonstration project for the community to learn about solar thermal and wood pellet boiler systems and to encourage the use of local renewable resources for heating.

In place of the Program Manager, Brian Winnestaffer, a Chickaloon Village Traditional Council staff member, attended the 2011 DOE Program Review in Denver, Colorado and presented on the project's progress. The meeting was a great educational and networking opportunity for folks in the tribal energy program. Brian presented on the Uk'e koley Project developments in the last year and attended many other presentations. Learning what other tribes were doing for their programs allowed for collaborative discourse that benefited all involved. Hearing tribes asking for advice on energy projects and getting immediate answers from the experts in the crowd was remarkable. Getting to meet people in other parts of the country and hear about their successes was very inspiring and this information was brought back to Chickaloon Village to be shared with those interested in energy projects.

Some of the highlights of the 2011 DOE Program Review were hearing about the many wind turbine projects that were being studied and installed across the nation, but more importantly to Chickaloon, in Alaska. The All Alaska Presentation Day was also very informative and allowed for another great opportunity to network with people from such a diverse state.

The Uk'e Koley Project experienced a delay in the second quarter with the Project Manager retiring due to medical issues. Michael Williams was hired to replace Jim Shaginoff as the Project Manager, with a starting date of April 2, 2012. Due to the delay we requested a one-year extension of the grant time period. We were granted a one-year extension, which made the project end date March 31, 2013.

The Project Manager developed an energy efficiency plan based on the recommendations of the CVTC Energy Audit and Renewable Energy Strategy Report. The Project Manager also began the process of getting the two current renewable systems net-metered with the local utility. The new Project Manager worked with Jim Shaginoff (the retired Project Manager) to repair and maintain the solar tracker on CVTC's solar array, which had a burned out tracker motor. The Project Manager worked with the CVTC Facilities Director to identify the buildings in the most need of energy efficiency retrofits. Additionally the Project Manager continued site evaluations to determine the most feasible renewable systems to install.

The Project Manager began a monitoring program to track production of the 2.2 kW solar array located at the Ya Ne Dah Ah Tribal School. He also gathered information on permitting in the Sutton Special Use District including height restrictions, setbacks and special use permits, and information from local electrical utility (Matanuska Electrical Association) on grid tied net metering. The Project Manager also applied for funding for combined biomass/solar thermal system, developed a proposal for Energy Efficiency Upgrades, and began writing a funding strategy.

For Tribal capacity building the Project Manager attended three 40-hour renewable energy design and installation courses offer by Solar Energy International. The courses included PV 101(Grid Direct Photovoltaic Systems), PV 203 (Battery Based Photovoltaic Systems), WP 101 (Small Wind Systems) and ST 101 (Solar Thermal Systems). The completion of these courses qualified the Project Manager to receive Solar Energy Internationals Certificate of Renewable Energy Applications. The Project Manager also attended energy efficiency course offered by the Alaska Housing Finance Corporation and completed three 2-hour courses.

Additionally the Project Manager led a tour of the Tribal renewable energy systems for a group and discussed the Tribal energy systems as well as ideas for future projects. He attended the 2012 Mat-Su Solar Tour to see real world examples of what renewable systems are working in our area and to better understand the challenges faces installing systems in South Central Alaska, attended Business of Clean Energy Alaska Conference, and attended Renewable Energy Alaska Project's Renewable Energy Fair.

Quarterly reports were written and submitted to DOE throughout the fiscal year.

Progress in Fiscal Year 2013

This fiscal year the Project Manager continued monitoring the solar array located at the Ya Ne Dah Ah Tribal School, finished a preliminary design for installing solar panels at the Chickaloon Village Health Building, and worked extensively and successfully to set up net metering for the solar array located at the Ya Ne Dah Ah Tribal School, which was finally completed this fiscal year! The Project Manager met with Borough Assemblyman Warren Keogh to discuss the impact of the new Mat-Su Borough tall tower ordinance on wind energy systems, and completed an Energy Efficiency Upgrade Cost Assessment with information from one of the previous years' documents that detailed a cost benefit analysis of adding renewable energy systems to heat several Tribal buildings at one site.

The Project Manager completed the following courses of the Mat-Su College Renewable Energy System Occupational Endorsement Certification Program with straight A grades: Introduction to Solar Photovoltaic; Introduction to Solar Thermal; Introduction to Small Wind; Building Science Basics.

Project Manager filed a statement of interest for a biomass feasibility study with the Alaska Energy Authority. We received notification that we were awarded the grant on January 11, 2013. With this award a contractor with the Alaska Wood Energy Development Task Group conducted a wood heat pre-feasibility study. It was a necessary step toward securing a grant through the Alaska Energy Authority for the planned solar thermal/ wood pellet heating system. The Project Manager wrote and submitted an EPA Environmental Education Grant proposal for teaching renewable energy lessons in the classroom and in the community, which was not funded. The Project Manger submitted a technical assistance application for the DOE Strategic Technical Assistance Response Team (START) program, however we did not get accepted for this program.

The Project Manager submitted a Department of Energy grant proposal for a community scale renewable energy project. This grant would enable us to install 50 kilowatts of solar panels, which would reduce our electrical use by about 90%. A cost match of 50% of the entire project cost was required with the opportunity to request a cost share reduction of up to 40%, which we applied for. Partnerships with Palmer Job Corps and Renewable Energy Systems, along with in kind contributions, enabled us to achieve close to 20% match for the project and should help with the cost share reduction request. The proposed project would construct three solar arrays; a 22 kW array at the YNDA School, a 23 kW array at the gravel pit and a 5 kW array at the Health Building.

For Tribal capacity building the Project Manager attended Mat-Su College Renewable Energy classes REA 100- Introduction to Renewable Energy (3.0CR) and REA 102- Physics for Renewable Energy (3.0 CR). He received A grades in both classes. The Project Manager also participated in the Mat-Su Solar Tour and visited multiple renewable energy projects in Nevada and California to learn about them during a personal trip. He attended the DOE Tribal Energy Review Conference in Anchorage on October 15-17, 2012 and the DOE Tribal Energy Review in Denver on November 12-16, where he presented on the project's progress.

The Project Manager attended the Business of Clean Energy in Alaska conference, which was excellent as it brings government and business together to have them layout the policies and investment strategies that are driving the renewable energy industry.

A budget modification and request for a no-cost extension of the grant deadline were submitted and approved for the extension of the grant until Dec 31, 2013.

Quarterly reports were written and submitted to DOE throughout the fiscal year.

Conclusions and Recommendations
No patents resulted from this award.

The following are the main products and results of the award. An Energy Audit and Renewable Energy Strategy Report for 14 Tribally-Owned Buildings of the Chickaloon Village Traditional Council was written. This document included energy, heating and pollution audits; tips on how each location might be more energy efficient with the existing infrastructure; renewable energy assessment for the Tribal buildings; economic analysis of the costs of retrofitting Tribal buildings; and a conceptual design for retrofitting Tribal buildings (see Appendix A).

An Energy Efficiency Upgrade Cost Assessment was calculated a detailed a cost benefit analysis of adding renewable energy systems to heat several Tribal buildings at one site (see Appendix B).

The last main result of this award was the capacity building and subsequent management of the Tribal alternative energy systems already in place. Through this award two Project Managers (Jim Shaginoff and Michael Williams) attended courses of the Mat-Su College Renewable Energy System Occupational Endorsement Certification Program and earned straight A grades. Jim Shaginoff was able to complete the certification program. Michael Williams was not able to complete the program due to the classes not being offered in consecutive semesters. As a result of this increased Tribal staff member knowledge and capacity, the Project Managers were able to maintain the existing solar systems and wind turbine at Tribal facilities. The most lucrative result of this knowledge and system maintenance was that Michael Williams successfully established net metering on the largest existing solar panel system of the Tribal facilities. This required developing and securing a net metering agreement between the regional electric cooperative and the Tribe. This agreement requires the electric cooperative to credit the Tribe for any power produced by one of the Tribe's existing solar arrays and used by the grid.

This award was a crucial part of developing Tribal alternative energy systems and even though none of the major grant proposals for alternative energy project implementation and/or installation were awarded, we continue to submit proposals to the grant agencies.

Lessons Learned

A significant lesson learned during the time of this award is that small, Tribal alternative and renewable energy programs have a difficult time competing for the grant awards, compared to large, well-established Tribal programs. As a result, our Tribe must work very hard to develop examples of high-quality performance even if it is on a 'micro-scale' compared to the larger Tribal energy programs.

Another lesson learned is about the critical importance of networking with others to help develop access and knowledge of grant awards and other opportunities. Due to networking, Michael Williams had the opportunity to attend three, free or very low cost, 40-hour renewable energy design and installation courses offer by Solar Energy International. The courses included PV 101(Grid Direct Photovoltaic Systems), PV 203 (Battery Based Photovoltaic Systems), WP 101 (Small Wind Systems) and ST 101 (Solar Thermal Systems). The completion of these courses qualified the Project Manager to receive Solar Energy Internationals Certificate of Renewable Energy Applications.

Appendix A

Energy Audit and Renewable Energy Strategy Report

ENERGY AUDIT

&

RENEWABLE ENERGY

STRATEGY REPORT

FOR

14 Tribally-Owned Buildings
of the
Chickaloon Village
Traditional Council

Sutton, Alaska USA 99674

FINAL REPORT COMPLETED DECEMBER 3, 2010

BY: ANDY BAKER, P.E.

LEE BOLLING, E.I.T.

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EXECUTIVE SUMMARY

The following executive summary is organized by building. The calculations were made with the current price of heating oil = $3.05/gal and electricity = $0.15/kwh; and with heating oil price escalated from current prices at 8%/yr and grid electricity escalated at 4%/yr. Any further increase in energy costs will lower payback periods accordingly.

Shop & Environmental Dept. Building				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Existing make-up air vent is closed in the winter, restricting combustion air required by code. Install P trap style air intake duct, to bring in make-up air.	Shop Bldg 1.2.3	$380	N/A	N/A
Install zone valves on each of the four hydronic zone loops, including a thermostat for each zone.	Shop Bldg 1.2.4	$1,100	N/A	N/A
Replace 4 two bulb 60W incandescent fixtures with equivalent light output 13W CFLs.	Shop Bldg 1.3.1	$40	$116	0.3
The weather-stripping on the existing south facing exterior door and north facing exterior door is old and in need of replacement. Replace weather-stripping on both doors to ensure a proper air seal when door is closed.	Shop Bldg 1.1.1	$200	$100	2 yrs
Add bottom bulb seals to south exterior overhead garage door to ensure tight seal with floor.	Shop Bldg 1.1.2	$150	$75	2 yrs
Existing conduit that carries the fuel lines from the fuel tank to the oil boilers is un-sealed and air is leaking through. Seal conduit with spray foam to stop air flow and heat loss.	Shop Bldg 1.2.1	$50	$25	2 yrs
Replace 17 four tube T12 light fixtures with three tube T8 fixtures with electronic ballasts.	Shop Bldg 1.3.2	$2,193	$495	4.4
Existing gravity damper on Weil McLain boiler exhaust stack is leaky and sticks open. Replace with inline automatic damper to reduce heat loss.	Shop Bldg 1.2.2	$275	$50	5.5 yrs
Replace 4 two tube T12 light fixtures with two tube T8 fixtures with electronic ballasts.	Shop Bldg 1.3.3	$288	$48	6.0
Add R-38 custom cut fiberglass insulation in white poly-bags to underside of existing R9 roof insulation. Also, add R-19 custom cut fiberglass insulation in white poly-bags to existing R9 wall insulation. Insulation comes pre-cut for the roof and wall cavities along with metal banding, screws and tape for installation.	Shop Bldg 1.1.3	$20,500	$2,500	8.2 yrs
Replace six 400W metal halide lights with eight Seesmart LED highbay lights.	Shop Bldg 1.3.4	$7,085	$597	11.9
Replace existing 12'x12' and 14'x16' overhead garage doors with new 2" thick Thermo Core (R-17.5) doors, each with 3 double pane windows for solar gain and natural light.	Shop Bldg 1.1.4	$8,230	$92	89 yrs

Administration Building				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) light sockets 2) wall hole penetration 3) leaky wood frame glass door Items were marked with blue tape during blower door test.	Admin Bldg 2.1.1	$200	$100	2 yrs
The weather-stripping on existing west facing exterior door is leaky and in need of replacement. Replace weather-stripping to ensure a proper air seal when door is closed.	Admin Bldg 2.1.2	$100	$50	2 yrs
Add 2" XPS rigid insulation to plywood crawlspace walls of addition (and original bldg if necessary) and insulate rim joists. Properly seal the crawlspace to stop air leakage. Costs and payback for addition only. It is recommended that insulation in the original building crawlspace be assessed. Payback will be similar for both.	Admin Bldg 2.1.3	$2,000	$800	2.5 yrs
Existing bathroom fan is leaking air. Install a gravity damper to stop heat loss.	Admin Bldg 2.1.4	$200	$50	4 yrs
Replace existing: 1) 70"x50" wood frame double pane window and 2) 72"x80" wood frame door with double pane glass with a new vinyl frame, double pane, argon filled, low-e window and door.	Admin Bldg 2.1.5	$2,250	$150	15 yrs

Health & Social Services Building				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) light sockets 2) interface between kitchen addition foundation wall and original foundation wall inside kitchen crawlspace Items were marked with blue tape during blower door test.	H&SS Bldg 4.1.1	$200	$100	2 yrs
The following wood frame, double pane windows were found to be leaking air at the edges of their frames: 1) seven 22"x76" windows located in the top floor meeting room, 2) one 84"x58" window located in the top floor meeting room, 3) one 27"x39" window located on the bottom floor, and 4) one 21"x47" window located on the bottom floor. Seal the air leaks of these window frames to reduce air infiltration and heat loss.	H&SS Bldg 4.1.2	$500	$250	2 yrs
The weather-stripping on the: 1) existing south facing exterior door, 2) west facing bottom floor exterior door, and 3) east facing exterior door is leaking air and in need of replacement. Replace weather-stripping on all three doors to ensure a proper air seal when door is closed.	H&SS Bldg 4.1.3	$300	$150	2 yrs
Add 4" XPS rigid insulation over existing un-insulated west concrete block wall. (Cost only includes cost of insulation and does not include exterior flashing or sheathing or siding)	H&SS Bldg 4.1.4	$1000	$230	4.4 yrs
Replace 14 two tube T12 light fixtures with two tube T8 fixtures with electronic ballasts.	H&SS Bldg 4.3.1	$1,008	$168	6 yrs
Add additional spray foam or rigid to existing foundation walls that already have 2" spray foam. (Cost only includes cost of insulation and does not include exterior flashing or sheathing or siding)	H&SS Bldg 4.1.5	$1,400	$130	10.8 yrs
Replace all wood frame, double pane windows discussed in item 4.00 with new vinyl frame, double pane, argon filled, low-e windows.	H&SS Bldg 4.1.6	$3,900	$300	13 yrs

Ya Ne Dah Ah School Building				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Stop existing water leak that is surfacing in the crawlspace, and completely dry the space. Seal and insulate the penetrations associated with the 4 vents and one exhaust fan in the crawlspace. $100 material cost 30 man hours x $30/hr = $900	School Bldg 5.1.1	$1,000	$800	1.3 yrs
The existing attic hatch is leaking air and is un-insulated. Repair weather-stripping on attic hatch to stop air flow and insulate with R-38 insulation	School Bldg 5.1.2	$100	$50	2 yrs
Install an arctic entry in front of the main exterior door to reduce heat loss and create staging area for students to remove shoes and jackets, etc.	School Bldg 5.1.3	$10,000	$500	20 yrs

Ahtna Language Building				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) ceiling light sockets 2) electrical breaker box 3) penetrations in ceiling Items were marked with blue tape during blower door test.	Language Bldg 6.1.1	$200	$100	2 yrs
Air seal window frames and add plastic membrane to interior side of window to reduce air leakage and heat loss.	Language Bldg 6.1.2	$500	$250	2 yrs
The weather-stripping on the following doors is leaking air: 1) rear exterior door, 2) front entry door, and 3) east facing exterior door. Replace weather-stripping on all three doors to ensure a proper air seal when door is closed.	Language Bldg 6.1.3	$300	$150	2 yrs
The following interfaces between the wall top and ceiling is leaking air: 1) interface between exterior walls and ceiling, and 2) interface between partition wall that separates the office space and storage space and the ceiling. Caulk and seal these seams to stop air leakage and heat loss.	Language Bldg 6.1.4	$400	$200	2 yrs
Remove decommissioned oil furnace along with unneeded fuel line and cap leaky exhaust stack to stop unnecessary air leakage and heat loss.	Language Bldg 6.1.5	$200	$50	4 yrs
Bathroom fan is leaking air because it most likely does not have a damper. Install a new damper on the existing bathroom fan.	Language Bldg 6.1.6	$200	$50	4 yrs

Transportation Building				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) electrical outlets and Ethernet outlet, 2) electrical panel, and 3) old inlet and outlet to Toyostove (removed) in the rear office addition. Items were marked with blue tape during blower door test.	Transportation Bldg 7.1.1	$200	$100	2 yrs
The weather-stripping on the existing exterior door is leaking air and in need of replacement. Replace weather-stripping on the door to ensure a proper air seal when door is closed.	Transportation Bldg 7.1.2	$100	$50	2 yrs
Replace 8 two tube T12 light fixtures with two tube T8 fixtures with magnetic ballasts.	Transportation Bldg 7.3.1	$576	$96	6 yrs

Indian Child Welfare Program (ICWAP) Building				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Replace 4, 100W incandescent light bulbs with equivalent light output 24W CFLs.	ICWAP Bldg 8.3.1	$46	$71	0.6 yrs
Air seal the following: 1) light fixtures in ceiling 2) window frame gaskets 3) electrical outlets and electrical breaker box, and 4) fuel line penetration Items were marked with blue tape during blower door test.	ICWAP Bldg 8.1.1	$100	$50	2 yrs
Air is leaking along the interface between the floor and the exterior walls, marked with blue tape during site visit. Seal this interface to stop air infiltration.	ICWAP Bldg 8.1.2	$200	$100	2 yrs
The weather-stripping on the existing exterior door is leaking air and in need of replacement. Replace weather-stripping on the door to ensure a proper air seal when door is closed.	ICWAP Bldg 8.1.3	$100	$50	2 yrs
Air seal window frames and add plastic membrane to interior side of window to reduce air leakage and heat loss.	ICWAP Bldg 8.1.4	$100	$50	2 yrs

Residential Buildings - Unit A, B, C, D, E & F				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
The following sources of air leakage were found in Unit A: 1) No outside air damper on bathroom fan, 2) Attic hatch seal, 3) Hole associated with clothes washer plumbing, 4) Window frame in back room, 5) Penetrations under the kitchen sink leading to the crawlspace. All items were marked with blue tape during the blower door test. Install a new damper to the bathroom fan and air seal the items above.	Unit A 9.1.1	$400	$200	2 yrs
Replace existing 4 tube T12 fixture with 3 tube T8 fixture in Unit A, B & C.	Unit A, B, C 9.3.1	$387	$87	4.4 yrs
Install blown in cellulose insulation in the roof of Unit A to obtain R-38 minimum.	Unit A 9.1.2	$2,160	$472	4.6 yrs
Install 4" of XPS rigid insulation (R-20) to interior side of crawlspace wall of Unit A.	Unit A 9.1.3	$2,400	$366	6.6 yrs

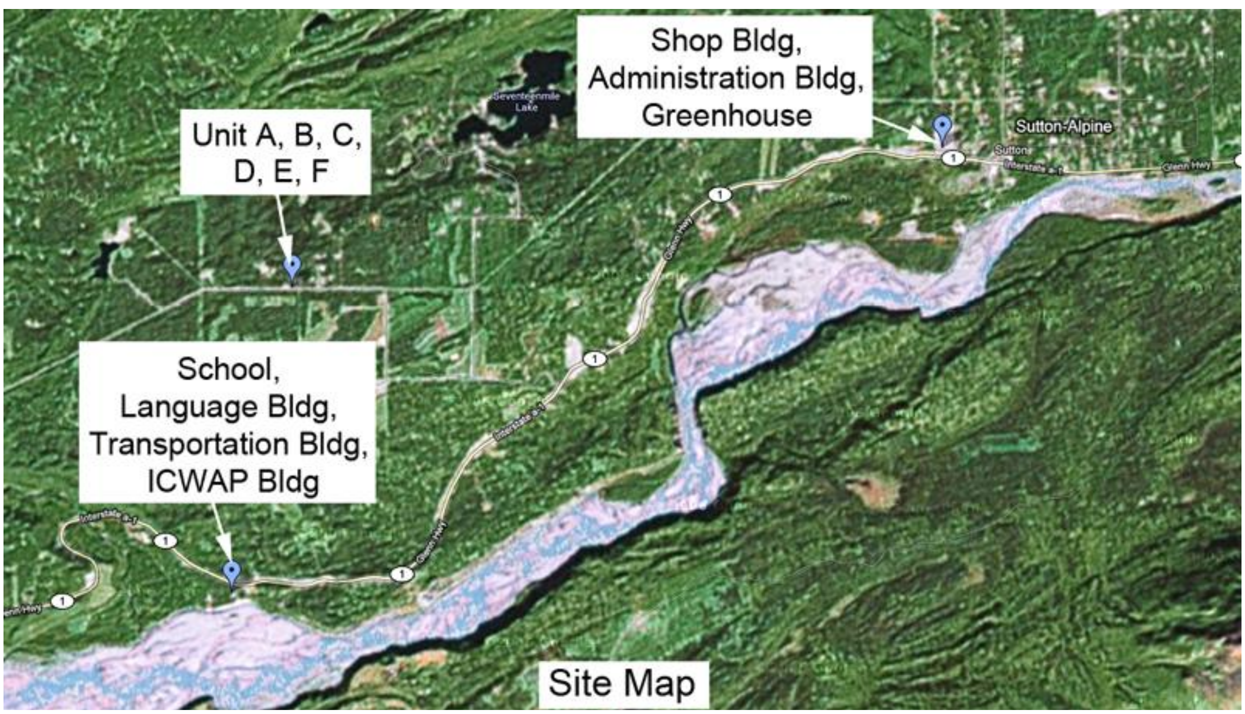
ACRONYMNS

ACH50 = Air changes per hour at - 50 Pa
AFUE = Annual Fuel Utilization Efficiency
BTU = British Thermal Unit (Common unit for thermal energy or heat energy)
CVTC = Chickaloon Village Traditional Council
DHW = Domestic Hot Water
EPS = Extruded Polystyrene Insulation (ex. Bead-Board insulation)
gal = Gallon
ICF = Insulated Concrete Form
ICWAP = Indian Child Welfare Act Program
kWh = Kilowatt-Hour (Common unit for electrical energy)
MEA = Matanuska Electric Association
MMBTU = One million BTUs
Pa = Pascal (unit of pressure)
XPS = Expanded Polystyrene Insulation (ex. rigid Blue-Board insulation)

INTRODUCTION

The Chickaloon Village Traditional Council (CVTC) secured YourCleanEnergy LLC to complete a comprehensive energy audit and renewable energy assessment of 14 tribally-owned buildings located in Sutton, AK. The energy audit will also include quantifying carbon dioxide emissions of existing heating equipment. The combined square footage of all 14 buildings is 21,499 sq. ft. The 14 buildings to be audited are shown below.

Buildings in CVTC Energy Audit			
	Building	**sq. ft.**	**Location**
1	Shop & Environmental Dept. Building	3,400	21117 E. Meyers Ave., Sutton, AK
2	Administration Office Building	1,368	21117 E. Meyers Ave., Sutton, AK
3	Greenhouse Building	1,200	21117 E. Meyers Ave., Sutton, AK
4	Trial Government & Health and Social Services Building	2,688	16166 N. Glenn Hwy, Sutton, AK
5	Ya Ne Dah Ah School & Education Dept. Building	2,688	9109 N. Glenn Hwy. Sutton, AK
6	Ahtna Language Program Building	1,175	9255 N. Glenn Hwy, Sutton, AK
7	Transportation Dept. Building	608	9255 N. Glenn Hwy, Sutton, AK
8	Indian Child Welfare Act Program (ICWAP) Building	280	9255 N. Glenn Hwy, Sutton, AK
9	Unit A - Single Family House	864	17983 East All Elks Rd., Sutton, AK
10	Unit B - Single Family House	1,120	17983 East All Elks Rd., Sutton, AK
11	Unit C - Single Family House	1,120	17983 East All Elks Rd., Sutton, AK
12	Unit D - Duplex with two 728 sq ft units	1,456	17983 East All Elks Rd., Sutton, AK
13	Unit E - Duplex with two 864 sq ft units	1,728	17983 East All Elks Rd., Sutton, AK
14	Unit F - Duplex with two 902 sq ft units	1,804	17983 East All Elks Rd., Sutton, AK
	14 buildings with a combined sq ft of:	**21,499**	



Note: Site map from Google Earth.

Goals for Energy Management

CVTC would like to reduce heating and electric bills by increasing energy efficiency in their buildings, and evaluate several alternatives for generating renewable energy on site. They would like to consider implementing the improvements that have the fastest payback and greatest benefit.

Scope of Services

The following scope is for conducting a comprehensive energy audit and renewable energy assessment for the CVTC's 14 tribally owned buildings, as outlined in the 8/26/10 proposal submitted to CVTC by Your Clean Energy LLC. Andy Baker, PE, and Lee Bolling, EIT, of Your Clean Energy LLC will conduct the site visit and do all work in consultation with the Village.

Scope for energy audit of all 14 tribally-owned buildings:

1. Provide introduction to the purpose, function and history of the building. Establish goals and scope of the energy audit and recommended priority of actions to improve energy efficiency.
2. Evaluate trends of grid electricity, heating oil, and propane costs and estimate future escalation rates to be used in financial evaluation.
3. Evaluate electrical energy usage and loads in the building, including lighting, appliances, HVAC, process equipment. Provide table listings to document quantities and types of existing lighting, appliances, and HVAC equipment.
4. Evaluate existing building envelope performance including wall and roof insulation, windows, doors, loading docks, air leakage, ventilation and make-up air supply. Provide details from existing as-built drawings to document building envelope features; and provide cost effective recommendations for improving these features where reasonable and possible.
5. Perform blower door test to determine air leakage of each building.
6. Evaluate the heating system of the building, i.e. boiler or furnace, and identify cost effective recommendations for improving these units.
7. Quantify carbon dioxide emissions from heating oil and propane heaters, boilers or furnaces.
8. Provide an Executive Summary which lists recommended items for improvement and the associated Capital Investment Required, and Annual Savings and Payback given projected escalation of heating fuel and grid electricity.
9. Review available construction documents of the buildings. Document existing building features which are recommended for improvement with color photos and text overlay to clearly show what existing features look like and what can be done to increase energy efficiency.
10. Provide deliverable report with all energy audit data, graphs, color photos, tables in a simple easy to read format that begins with a detailed Executive Summary of recommended improvement items.

Scope for renewable energy assessment of all 14 tribally-owned buildings:

1. SOLAR HOT WATER - Size a collector array, to meet the estimated loads for domestic hot water and space heating using the Polysun simulation program and onsite Solar Pathfinder measurements. Size a solar storage tank based on collector array size and show schematic integration of the solar storage in to the domestic hot water system. Discuss potential for seasonal sand bed thermal storage.

2. SOLAR PV – Evaluate roof mounted solar PV panels, calculate estimated energy return using Solar Pathfinder Assistant software. Estimate payback assuming net metering to MEA grid at predicted escalation rate.

3. WIND POWER - Evaluate available wind power potential using local wind data. Recommend additional data collection strategy using a MET Tower if necessary. Determine an appropriate wind turbine and tower system for the site. Estimate payback assuming net metering to MEA grid at predicted escalation rate.

4. COMPARATIVE EVALUATION OF RENEWABLE ENERGY SOURCES – Present above data, evaluation and recommendations in report form, along with 20 year life cycle and net present worth cost comparison of the renewable energy resources available (solar hot water, solar PV and wind) against grid electricity, heating oil and propane.

ENERGY AUDIT METHODOLOGY

The energy audit for each building is based on the following three components. A general discussion of each component is provided so that the methodology of the energy audit can be understood.

- Recommendations for Building Envelope
- Recommendations for Mechanical Equipment
- Recommendations for Lighting and Electrical Appliances

RECOMMENDATIONS FOR BUILDING ENVELOPE

Heat loss through the building envelope typically occurs two ways: (1) conductive heat loss through the roof, walls and foundation, controlled by the building's insulation, and (2) heat loss associated with warm air leaking out from the building, caused by a leaky building envelope.

Building Insulation: The insulation for each building was determined from visual inspection and from conversations with CVTC staff. The CVTC carpenter, Kevin Johns, was a great resource for determining building insulation type and thickness due to the fact that he had built many of the residential building units and had worked on many of the other buildings in this audit. The minimum insulation values of the Alaska Building Energy Efficiency Standard (BEES) are used as a comparison for the buildings in this energy audit. BEES differs for various regions throughout the state. Sutton's region and heating degree days (HDD) are shown below along with the BEES minimum insulation requirements.

Community	BEES Climate Region	HDD @ 65F
Sutton	Region 2	10868

Insulation Minimum R-values by component				
BEES Climate Region	Ceiling [a]	Exterior Frame Wall	Floor	Below Grade Wall [b]
Region 2	R-49 or R-38	R-20	R-30	R-15/19

a. The smaller value of R-38 may be used with a properly sized energy-heel truss, which keeps a constant depth of insulation at the edge of the roof where it connects to the exterior wall.
b. The smaller value of R-15 applies to continuous insulation, the second (R-19) to framing cavity insulation; either meets the requirement.

Air Leakage and Blower Door Test: For each building a blower door test was completed to determine air leakage rates. The blower door test draws air out of the building, creating a negative pressure of 50 Pa inside the building, and air leakage into the building is measured. A negative pressure of 50 Pa (Pascal) is equivalent to a 20 mph wind blowing on all exterior surfaces of the building. During the blower door test, blue marking tape was placed at all air leakage points inside the building that could be found. It is recommended that air leaks found at these markings be sealed as possible. It is further recommended that sealing air leaks in the upper portion of the building envelope be made a priority so that heat loss due to the "stack effect" can be reduced first. Air leakage is a major cause of heat loss in the building.

In order to compare the air infiltration of each building, the Air Changes per Hour at -50 Pa (ACH50) was calculated. The ACH50 is based on the number of times the entire volume of air inside the building is exchanged with fresh air during the blower door test. This allows the buildings to be compared because the volume of the building is taken into account.

RECOMMENDATIONS FOR MECHANICAL EQUIPMENT

The mechanical equipment, such as boilers, toyostoves, propane heaters, furnaces and domestic hot water (DHW) heaters, in each building was investigated and potential energy improvement options were explored. Many of the buildings already utilize direct vent, oil fired, toyostoves with an AFUE of 87%, which is a great unit for efficiently heating with heating oil. The Annual Fuel Utilization Efficiency (AFUE) accounts for the units average efficiency during it's typical operation.

RECOMMENDATIONS FOR LIGHTING AND ELECTRICAL APPLIANCES

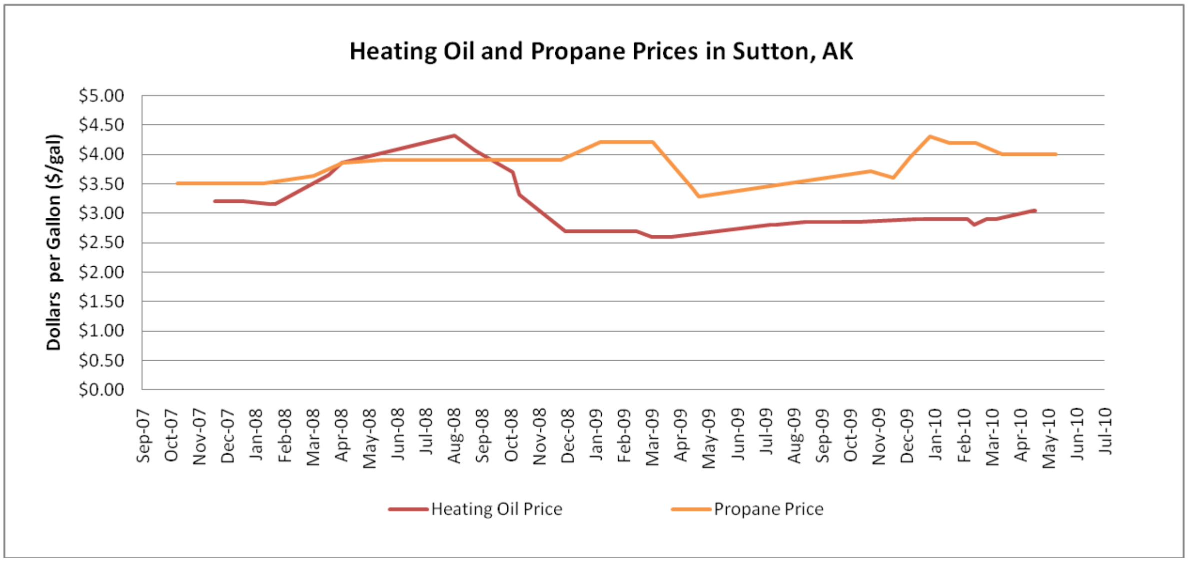
The lighting and major electric appliances of each buildings were investigated and potential energy improvement options were explored. It was noted that much of the incandescent lights throughout the buildings are already being replaced by new, energy-efficient, compact fluorescent lights (CFLs). This is a great energy saving strategy due to the fact that replacing a 60W incandescent bulb with an equivalent lumen output 13W CFL has a payback of 4 months, based on 40 hours per week operation and $0.15/kWh electricity.

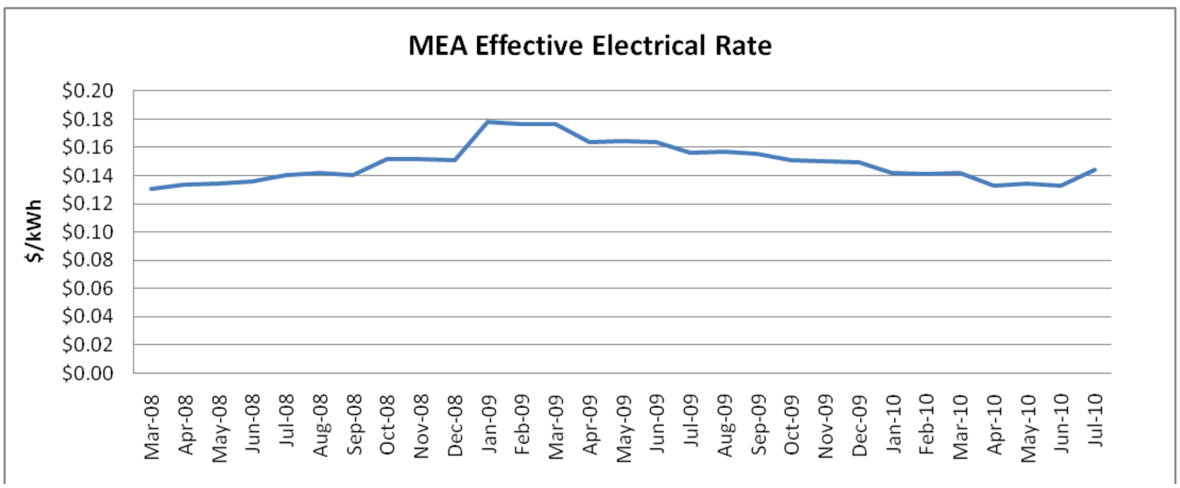
Significant energy savings can also be made by replacing old T-12, magnetic ballast, fluorescent light fixtures with new energy efficient T-8 light fixtures with electronic ballasts.

For almost all of the lighting payback calculations, the labor to replace new energy efficient lighting was not included. This is because CVTC has in-house construction staff that can complete the replacements. The only exception is the recommended LED lighting installation for the Shop Bldg. This project may take additional labor resources to complete and so a labor cost was added. All lighting payback calculations use the current electric rate of $0.15/kWh with an estimated escalation rate of 4% per year.

RECENT HISTORY OF UTILITY ENERGY COSTS IN SUTTON, ALASKA

In order to plan for energy efficiency and renewable energy projects for buildings, it is very useful to see the trend of energy costs from the past four years, in Sutton, Alaska. The majority of the building's in the energy audit use heating oil for building heat, distributed by Fisher's Fuel. The Administration building is the only building that utilizes propane for building heat, distributed by AmeriGas. The Matanuska Electric Association (MEA) is the local power utility, providing grid electricity to all of the buildings.





OBSERVATIONS

Over the past four years, the most notable increase of energy prices in Sutton occurred in 2008 when heating oil increased 35% over 2007 rates to $4.33/gal. Also, electricity rates increased 38% from March 2008 to March 2009, to $0.18/kWh. Since those large peaks, the price or heating oil and electricity has fallen down. However, these prices are beginning to increase again. From April 2009 to April 2010, the price of heating oil has steadily increased 17% to the current price of $3.05/gal. Propane has increased 21% from May 2009 to May 2010, to $3.999/gal. Electricity rates have also started to increase due to MEA's base rate increase of 2.47% effective July 2010, making the effective rate of electricity at $0.15/kWh. **For the purpose of economic evaluation in this report, is anticipated that the unit price of grid electricity will continue to escalate at a minimum rate of 4% per year, and that the unit price of heating oil will escalate at a minimum rate of 8% per year.**

Due to the composite method in which electric utilities bill customers, the effective electricity rate is shown in the figure above instead of just the raw energy ($/kWh) charge that the utility advertizes. The effective electricity rate includes all charges (including Customer Charge, Energy Charge, and Cost of Power Charge) and gives a clearer picture of the retail cost that the customer pays for electricity. The effective electricity rate is the total amount of dollars billed by the utility divided by the total number of kWh used by the customer during that billing cycle. The effective electric rate for CVTC in Sutton is based on the electricity bills for the Health and Social Services building because its power consumption is close to that of the other buildings in the audit.

PRICE OF HEATING WITH HEATING OIL, PROPANE AND ELECTRICITY

An important question that faces any building owner is what is the most cost effective fuel to heat their building with. In order to answer this question, one must know three things in order to calculate the price per one million BTUs ($/MMBTU), which is a way to measure any fuel on a common basis:

1) the price of the fuel in Sutton, AK ($/gal),
2) the energy content of the fuel (BTU/gal), and
3) the efficiency at which the fuel is burned to produce usable heat (efficiency of boiler or toyo stove).

The energy content of heating oil, propane and electricity are shown below, along with the typical efficiencies at which the fuels are burned at the CVTC buildings. As you can see from the table, heating oil has 45% more energy content than propane, giving more energy per gallon of heating oil compared to one gallon of propane. When the typical efficiencies of the building's mechanical equipment is considered, the cost of heating with heating oil is $28.45/MMBTU, which significantly less than heating with electricity ($42.26/MMBTU) or propane ($54.45/MMBTU).

Fuel	Energy Content	Current price (Oct 2010)	Typical Efficiency	Price per Million BTUs
Heating Oil	134,000 Btu/gal	$3.05/gal	80%	**$28.45/MMBTU**
Electricity	3,413 Btu/kWh	$0.15/kWh	100%	**$42.26/MMBTU**
Propane	91,800 Btu/gal	$3.999/gal	80%	**$54.45/MMBTU**

Currently in Sutton, heating with propane is the most expensive option compared to heating oil and electricity. However, propane is a cleaner fuel buring fuel compared to heating oil. Burning propane produces 20% less CO_2 emissions than burning an equivalent amount of BTUs of heating oil. This is a savings of 34 lbs of CO_2 per million BTUs. So although propane may be a more expensive fuel source in this area, the carbon emission associated with burning propane are less than heating oil.

Fuel	Energy Content	CO_2 Emissions per gal	CO_2 Emissions per MMBTU
Heating Oil	134,000 Btu/gal	22.384 lb/gal	**167 lb/MMBTU**
Propane	91,800 Btu/gal	12.17 lb/gal	**133 lb/MMBTU**

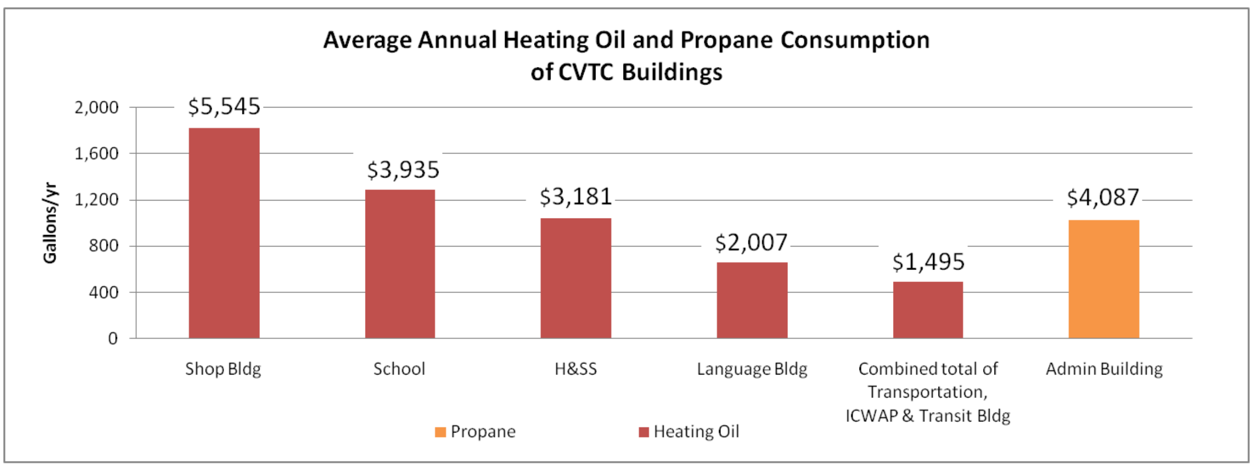
ENERGY CONSUMPTION AND CO_2 EMISSIONS - CVTC OPERATED BUILDINGS

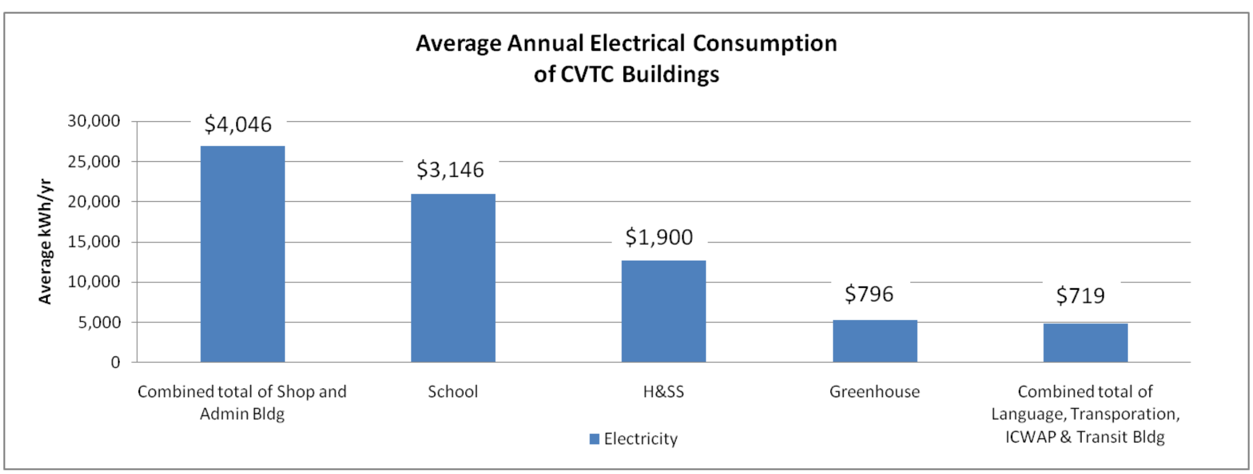
Of the 14 buildings in the energy audit, 8 eight of them have utilities that are paid by the CVTC. The other 6 buildings are residential buildings (Unit A, Unit B, Unit C, Unit D, Unit E and Unit F), which are rented to tenants and which the CVTC does not pay for utilities. The tenants of these rental units pay for their own heating oil and electricity.

The following table and graphs show the combined average annual energy consumption and CO2 emissions for all buildings who's utilities are paid by CVTC, or CVTC operated buildings. These quantities are based on data from 2007 to 2010 heating oil, propane, and electricity bills. Combined, CVTC operated buildings consume on average 5,298 gal of heating oil, 1,022 gal of propane, and 70,712 kWh of electricity every year. The emissions associated with burning heating oil and propane account for 131,028 lbs of CO_2 emitted on average each year.

Energy Consumption of CVTC Operated Buildings				
Fuel	**Average Annual Consumption**	**Current Price (Oct 2010)**	**Average Annual Cost**	**Average Annual CO_2 Emissions**
Heating Oil	5,298 gal	$3.05/gal	$16,159	**118,590 lb**
Electricity	70,712 kWh	$0.15/kWh	$10,607	**N/A**
Propane	1,022 gal	$3.999/gal	$4,087	**12,438 lb**

Note: Includes all building's who's utilities are paid for by the CVTC. Does not include residential rental units. The Transit Bldg is not part of the audit, however its electrical usage is included due to combined metering.

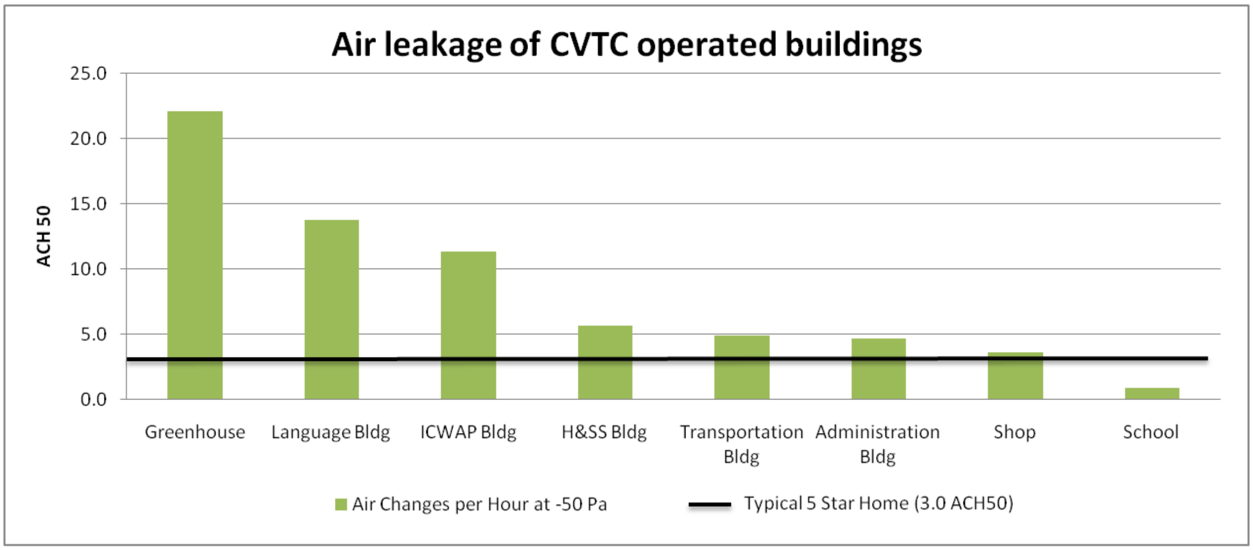




AIR LEAKAGE OF CVTC OPERATED BUILDINGS

The air leakage of each CVTC operated building was quantified using the Air Changes per Hour at -50 Pa, or ACH50. This allows the air leakage of each building to be compared because the ACH50 is based on the volume of the individual building. For comparison, a typical 5 Star residential house has 3.0 ACH50.

The Greenhouse, Language Bldg, ICWAP Bldg have by far the most significant air leakage issues, with many easy air sealing improvements available. The H&SS Bldg, Transportation Bldg, Administration Bldg and Shop have less severe air infiltration, with several air sealing improvements available. The School is the most air tight building of all the CVTC buildings. In order to supply the proper fresh air necessary for the teachers and students, the School utilizes a Heat Recovery Ventilator (HRV). This allows fresh outside are to be brought in with limited heat loss.



1. SHOP & ENVIRONMENTAL DEPARTMENT BUILDING

BUILDING DESCRIPTION

The Shop & Environmental Department Building is a large, steel frame, warehouse type building that houses CVTC's shop and Environmental Dept. The building, referred to in the rest of the report as the Shop Building, was once only a shop space with no offices. Once the need for office space was required, one-third of the eastern side of the shop was converted into two floors of office space, approximately 27' x 40' = 1,080 sq ft per floor. The office space was built within the shop's thermal envelope and the retrofit did not alter any of the buildings original insulation.

The building has excellent solar exposure, with its long 80ft edge facing nearly true south. Unfortunately there is only one window installed in the south facing wall to take advantage of the solar exposure. However, a solar thermal system could be easily integrated into the building's south face to provide building heat to the Shop Bldg's large radiant floor slab. This solar thermal system will be discussed in the renewable energy section of the report.

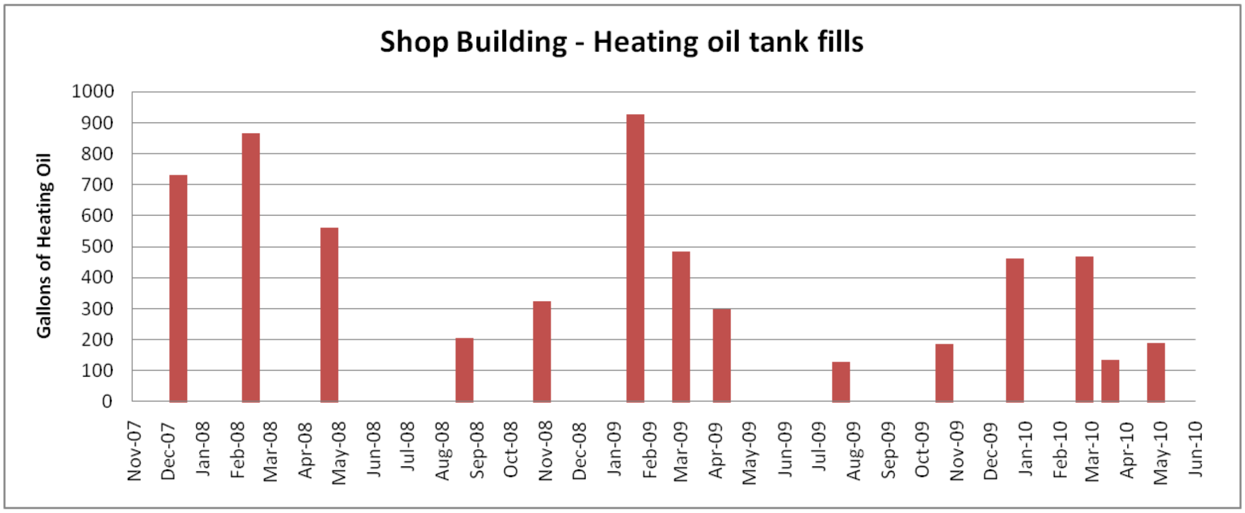
HEATING OIL CONSUMPTION AND CO_2 EMISSIONS

Compared to the other buildings in this energy audit, the Shop Bldg uses the most heating oil with an average of 1,818 gallons per heating year, based on data from 2008 to 2010. Based on the current heating oil price of $3.05/gal, it costs about $5,545 annually to heat the building. On average the Shop Bldg generates 40,694 lbs of CO_2 annually.

Shop Building - Heating Oil Usage		
Heating Year	**Heating Oil (gal)**	**Heating Oil Cost**
2008-2009	2,107 gal	$ 6,138.43
2009-2010	1,528 gal	$ 4,411.57
Average Heating Oil Consumption	1,818 gal	$5,545 @ $3.05/gal
Average CO_2 Emissions	40,694 lbs CO_2*	

* Based on 22.384 lb of CO_2 per gallon of heating oil.

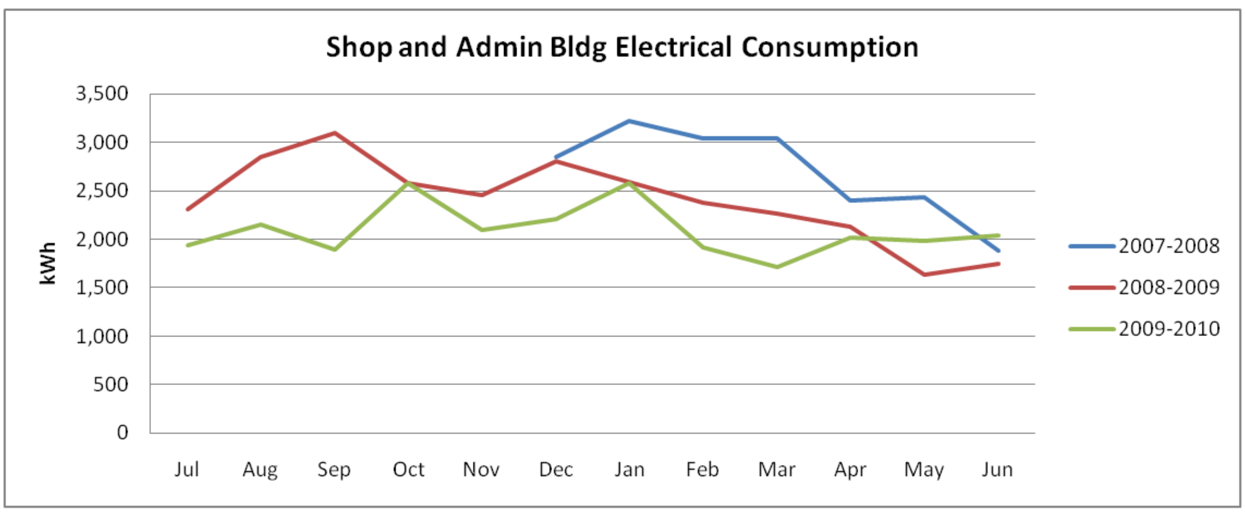
Heating oil is stored in a 1,000 gal fuel tank located behind the Shop Bldg, on the north side. Fuel is routed from the tank to the Weil McLain oil boiler and Toyotomi Oil Miser water heater inside the Shop Bldg. The fuel tank is topped off throughout the year by a heating oil distributer. The fuel tank fills are charted below for the Shop Bldg.



ELECTRICAL CONSUMPTION - SHOP BLDG & ADMIN BLDG

The Shop Bldg and the Administration Building (Admin Bldg) are powered from the same electric meter and therefore share one electric bill. Out of the 14 buildings in this energy audit, the Shop Bldg and Admin Bldg are two of the larger users of electricity. The other two major consumers are the Ya Ne Dah Ah School and Health & Social Services Bldg.

Shop and Admin Building - Electricity Usage		
Heating Year	**Electricity (kWh)**	**Electricity Cost**
2008-2009	28,841 kWh	N/A
2009-2010	25,104 kWh	N/A
Combined average for Shop and Admin buildings	26,973 kWh	$4,046 @ $0.15/kWh



1.1. Recommendations for Building Envelope

Building Insulation: The Shop Bldg is significantly under insulated in the roof, walls, foundation walls and floor slab, compared to the current BEES standards. The building was built when energy was much cheaper than it is today, and it was not insulated to the current insulation standards. Due to its under insulated roof, the building has been experiencing major ice damming issues that have caused water damage on the southeast side of the building.

Shop Building - Building Insulation		
Building Component	**R-Value and Description**	**BEES minimum standard**
Ceiling	R-11, over-the-purlin, foil-faced fiberglass insulation with 3/4" XPS spacer blocks on purlins. Effective insulation value is R-9 due to the purlins pinching the insulation.	R-38/49 [a]
Exterior Frame Wall	R-11, over-the-purlin, foil-faced fiberglass insulation with 3/4" XPS spacer blocks on purlins. Effective insulation value is R-9 due to the purlins pinching the insulation.	R-20
Floor	Slab-on-grade, concrete floor with radiant tubes. Slab thickness and under floor insulation is unknown.	R-30
Below Grade Wall	2" EPS, Bead Board, rigid insulation on exterior sides of the foundation wall. The top 2" of insulation is above grade and has been degraded because there is no metal flashing protecting it from weathering. Effective insulation value of this bead board is R-7.	R-15/19 [b]
Windows	Double pane, vinyl frame, argon filled windows (R-3)	R-3

a, b. Refer to Building Insulation section in Energy Audit Methodology.

Air Leakage and Blower Door Test: Due to the large size of the Shop Bldg, two separate blower door tests were completed. The first test was done on the shop side of the building and the second test was done on the office side of the building. The Shop Bldg was found to be a fairly tight building with only 3.6 ACH at -50 Pa. This was much better than expected, however there are some air sealing improvements identified that can help tighten the building further.

Shop Building - Blower Door Test and Air Leakage			
Building Area	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
Shop side of building	2040 CFM	-	-
Office side of building	1815 CFM	-	-
Total Shop Building	3855 CFM	64,000 cu ft	3.6 ACH

Building Envelope Recommendations: The largest improvement item for the Shop Bldg is to add additional R-38 fiberglass insulation to the existing ceiling insulation and R-19 fiberglass insulation to the existing wall insulation. A company in Colorado called Metal Building Outlet, is one that can provide custom, pre-cut fiberglass insulation in white poly-bags for easy installation. The project would be a large under taking but would result in significant energy savings. Increasing roof insulation will eliminate ice damming and water leakage from ice damming. It will also stop falling ice damage on the sides of the building.

Recommendations for Building Envelope				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
The weather-stripping on the existing south facing exterior door and north facing exterior door is old and in need of replacement. Replace weather-stripping on both doors to ensure a proper air seal when door is closed.	Shop Bldg 1.1.1	$200	$100	2 yrs
Add bottom bulb seals to south exterior overhead garage door to ensure tight seal with floor.	Shop Bldg 1.1.2	$150	$75	2 yrs
Add R-38 custom cut fiberglass insulation in white poly-bags to underside of existing R9 roof insulation. Also, add R-19 custom cut fiberglass insulation in white poly-bags to existing R9 wall insulation. Insulation comes pre-cut for the roof and wall cavities along with metal banding, screws and tape for installation. $7,700 for materials shipped to Seattle. (Based on preliminary price quote from Building Outlet) $2,000 estimated for shipping from Seattle to Sutton, AK. Labor estimated at: 3 man crew x 3 weeks x 40 hrs/week x $30/hr = $10,800	Shop Bldg 1.1.3	$20,500	$2,500	8.2 yrs
Replace existing 12'x12' and 14'x16' overhead garage doors with new 2" thick Thermo Core (R-17.5) doors, each with 3 double pane windows for solar gain and natural light. $7,900 = Quote from Pioneer Door Inc including materials and labor to remove existing doors and install new doors. Double pane windows cost $55 per window extra.	Shop Bldg 1.1.4	$8,230	$92	89 yrs


Install new custom cut R-38 and R-19 fiberglass insulation to the existing roof and wall insulation, respectively.
Replace existing 400W metal halide lamps with new LED highbay lighting.


Water damage caused by ice damming on the Shop Bldg roof.
Adding R-38 insulation to the roof and R-19 to the walls will decrease heatloss and stop ice damming issues.

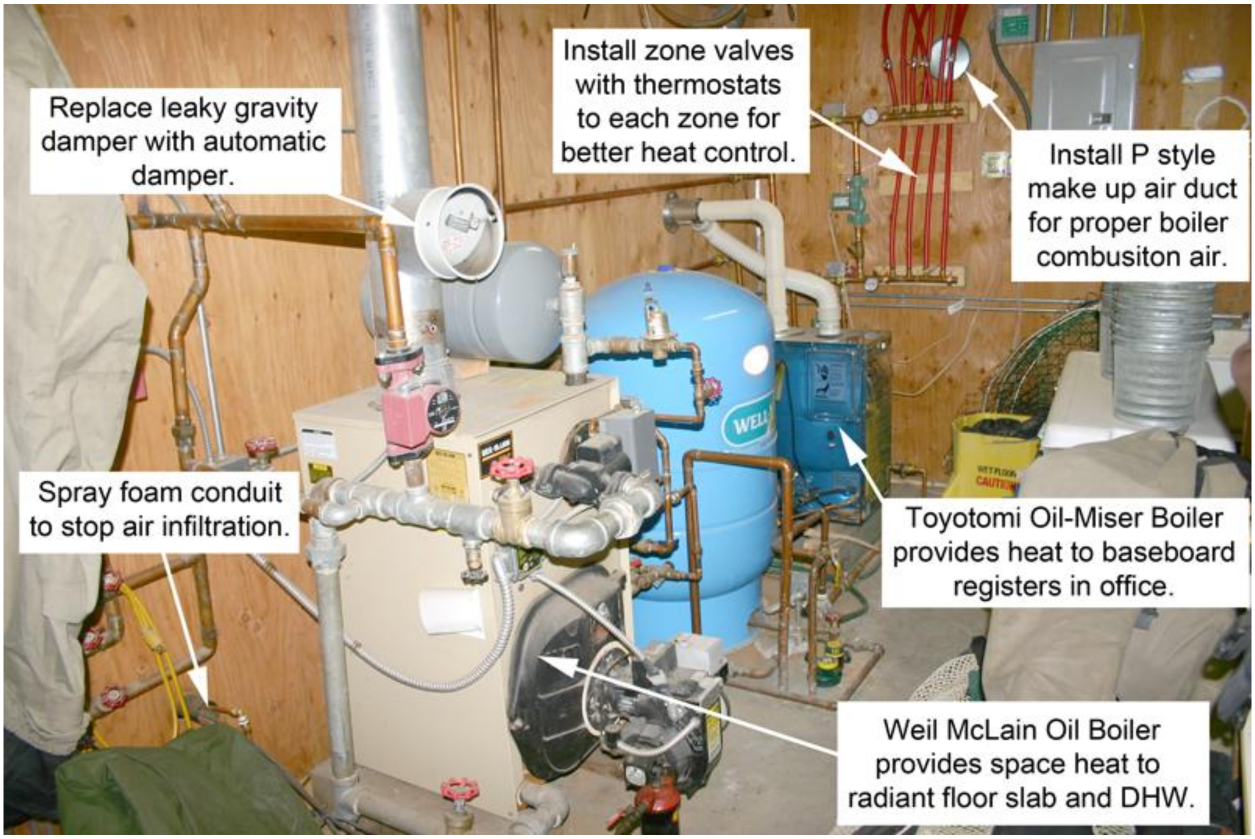
1.2. Recommendations for Mechanical Equipment

Mechanical Equipment: There are two oil boilers that provide heat to the shop building. The original Weil-McLain Oil Boiler heats the large concrete radiant floor slab and also provides heat for the DHW in the building. The Toyotomi Water Heater was installed when the office space was built and heats four zones with baseboard registers. Both oil boilers have over 80% efficiency and appear to be working well.

Shop Building - Mechanical Equipment				
Unit	**Input (BTU/hr)**	**Output (BTU/hr)**	**Efficiency**	**Heating Loads**
Weil-McLain Oil Boiler Model: WTGO-5	182,000	158,000	84.8% AFUE	Radiant Floor Slab & DHW
Toyotomi Water Heater Model: Oil Miser 180	148,000	Not disclosed on nameplate	83% AFUE	Baseboards in Office Space

Mechanical System Recommendations: It should be noted there are several practices relating the boiler room that do not comply with current codes. The International Mechanical Code, adopted by the State of Alaska, requires that the air tight fire door to the boiler room must remain shut. Secondly, the boiler room should not be used for storage of equipment and materials that clutter access in the room and pose a fire hazard. Finally, the existing make up air vent in the mechanical room is closed off in the winter time, requiring the Weil-McLain oil boiler to draw combustion air from inside the building. This is a safety issue because the oil boiler could back draft, pulling exhaust gases into the building and creating poor air quality for occupants. To solve this issue, a P trap style air intake duct is recommended, which uses a cold air trap to limit heat loss in the winter while still providing the boiler with make-up air.

Recommendations for Mechanical Equipment				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Existing conduit that carries the fuel lines from the fuel tank to the oil boilers is un-sealed and air is leaking through. Seal conduit with spray foam to stop air flow and heat loss.	Shop Bldg 1.2.1	$50	$25	2 yrs
Existing gravity damper on Weil McLain boiler exhaust stack is leaky and sticks open. Replace with inline automatic damper to reduce heat loss. $150 material cost for Honeywell 10" Round Automatic Damper. $25 shipping cost $100 labor cost	Shop Bldg 1.2.2	$275	$50	5.5 yrs
Existing make-up air vent is closed in the winter, reducing required combustion air for boiler. Install P trap style air intake duct, to efficiently bring in make-up air. $200 material cost 6 man hours x $30/hr = $180	Shop Bldg 1.2.3	$380	N/A	N/A
Put zone valves on each of the four hydronic zone loops with a thermostat for each zone. 4 zone valves x $100 each = $400 3 Thermostats x $100 each = $400 10 man hours x $30/hr = $300	Shop Bldg 1.2.4	$1,100	N/A	N/A



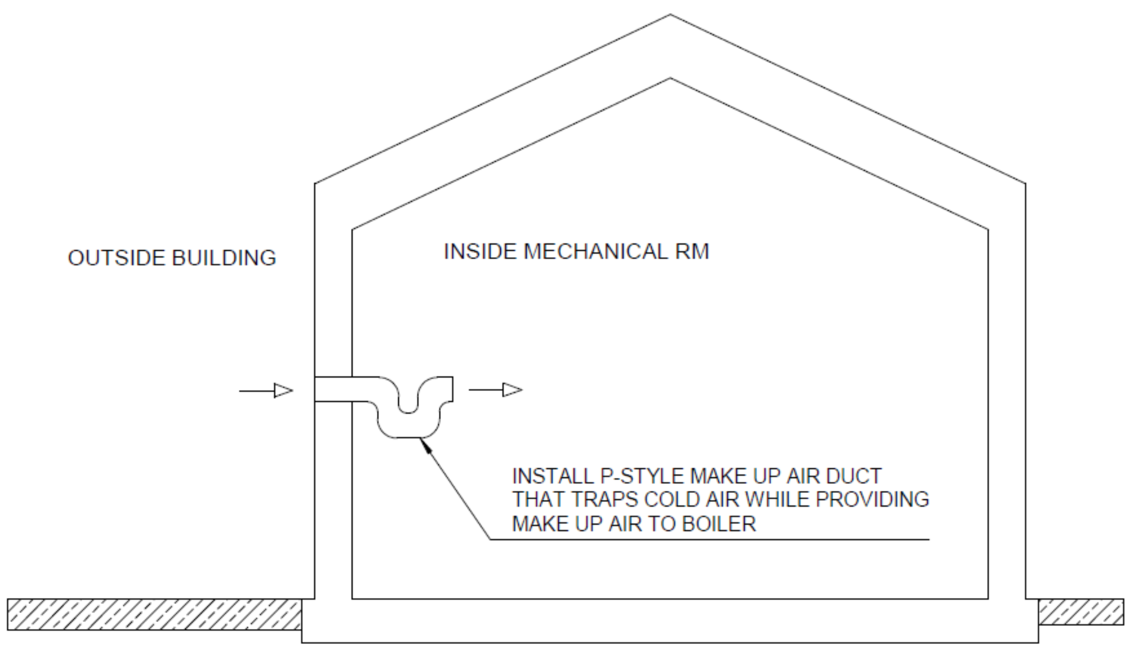


Diagram of a P-Style Make Up Air Duct

1.3. Recommendations for Lighting and Electrical appliances

There are significant energy savings available in upgrading the lighting in the Shop Bldg. Already, the CVTC has made smart energy upgrades by replacing incandescent lights with CFLs and installing T-8 lighting. IT is recommended that CVTC replace all incandescent lights with CFLs and replace all T-12 lighting with energy efficient T-8 lighting. As can be seen from the lighting upgrade table below, these improvements have paybacks of under 6 years. Replacing a 60W incandescent bulb with an equivalent lumen output 13W CFL has a payback of 4 months.

Another potential improvement is to replace the 400W Metal Halide lights in the shop side with energy efficient LED highbay lights. The payback for this item is around 12 years, based on 30 hours of use per week. Because this item has the longest payback it should be completed last, with the shorter payback items completed first. It should be noted that the payback is based on the hours the lights are on every week. If in the future the shop lights are used more than 30 hours per week, then the payback will become shorter and this option will have a higher priority.

Due to the fact that CVTC has staff in house that can install lighting, the labor costs for installing new light fixtures was not taken into account in the paybacks below. The only exception is the LED highbay lighting for the shop. This project may be more involved and a labor cost of $300 per fixture was used. If in-house staff can complete this project, than the associated payback not including labor costs will be 8.5 years.

Shop Building - Lighting Upgrades								
Improvement Number	**Existing Lights**	**Total Existing Fixtures**	**Replacement Lights**	**Total New Fixtures**	**Hours/ Week**	**Annual Savings in dollars***	**Total Installed Cost**	**Payback (yrs)**
Shop Bldg 1.3.1 (In Office Space)	2 bulb fixture with 60W incandescent bulbs	4	2x13W CFL with equivalent lumen output as existing lights	4	40	$116	$40	0.3
Shop Bldg 1.3.2 (In Office Space)	4 tube T12 (40W/tube), Magnetic Ballast	17	3 tube T8 (28W/tube), Electronic Ballast	17	40	$495	$2,193	4.4
Shop Bldg 1.3.3 (In Shop and Boiler Rm)	2 tube T12 (40w/tube), Magnetic Ballast	4	2 tube T8 (28W/tube), Electronic Ballast	4	40	$48	$288	6.0
Shop Bldg 1.3.4 (In Shop Space)	400W Metal Halide	6	Seesmart LED highbay, 6 tube (4')	8	30	$597	$7,085	11.9

* Annual savings is the amortized annual savings of the lighting upgrade based on the current electric rate of $0.15/kWh with 4% escalation annually.

2. ADMINISTRATION BUILDING

BUILDING DESCRIPTION

The Administration Building, or Admin Bldg, is located next to the Shop Bldg and the Greenhouse. The original brown building was built in 1990 off-site and was bought by CVTC and moved to its current location in 2004. The small purple addition was built on the east side to expand the office space.

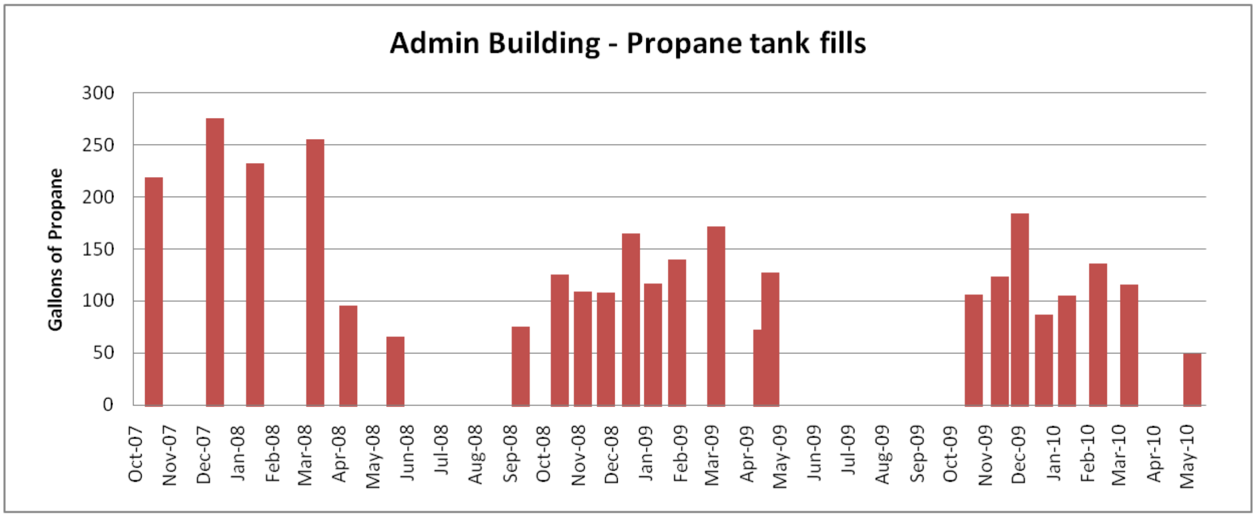
PROPANE CONSUMPTION AND CO_2 EMISSIONS

The Admin Bldg is the only building included in this energy audit that utilizes propane for space heat. Based on propane bills from 2007 to 2010, the bldg uses an average of 1,022 gallons of propane per heating year. This costs approximately $4,087 per year, based on the current propane price of $3.999/gal. On average the Admin Bldg generates 12,438 lbs of CO_2 emissions every year.

Admin Building - Propane Usage		
Heating Year	**Propane (Gal)**	**Propane Cost**
2007-2008	1,095 gal	$3,925
2008-2009	1,128 gal	$4,450
2009-2010	842 gal	$3,354
Average	1,022 gal Propane	$4,087 @ $3.999/gal
Average CO_2 Emissions	12,438 lbs CO_2*	

* Based on 12.17 lbs of CO_2 per gallon of propane.

Propane is stored in a large pressurized tank located behind the Admin Bldg, on the north side. Fuel is routed from the tank to two propane space heaters. The fuel tank is topped off throughout the year by a propane distributer. The fuel tank fills are charted below for the Admin Bldg.



Electrical Consumption

The Admin Bldg and Shop Bldg are powered from the same electric meter and therefore share one electric bill. This is discussed in the Shop Bldg section.

2.1. Recommendations for Building Envelope

Building Insulation: The new addition of the Admin Bldg is significantly under insulated in the floor and crawlspace. The addition is on blocks and sits above a raw gravel bed. Plywood siding was used to enclose the crawlspace area below the addition, however, no insulation exists on the plywood siding, rim joists, gravel bed, or floor frame. The existing insulation of the building is shown below.

Admin Building - Building Insulation		
Building Component	**R-Value and Description**	**BEES minimum standard**
Ceiling	The ceiling insulation of the original building and the addition could not be verified because no indoor ceiling hatches or outdoor attic hatches were found. According to the CVTC builder, the addition has R-44 blown cellulose in the ceiling.	R-38/49 [a]
Exterior Frame Wall	R-19 fiberglass batt insulation in 2X6 stud walls, with sheetrock interior and exterior wood siding. R-20 for entire wall system.	R-20
Floor	The floor of the original building could not be verified because no crawlspace hatches of outdoor hatches were found. The floor of the addition was accessed by crawlspace hatch. The building is resting on blocks with raw gravel bed below. No floor insulation or insulation on gravel bed is present. No rim joist insulation is present as well. A partial vapor barrier is present on floor.	R-30
Below Grade Wall	The building has no below grade walls since it is on blocks. However, the crawlspace is enclosed by plywood siding that extends down to grade. This siding is un-insulated and significant air gaps exist on the east side where the siding does not make contact with the gravel bed.	R-15/19 [b]
Windows	1) Double pane, vinyl frame, argon filled windows (R-3). 2) Wood frame, double pane window (R-2)	R-3

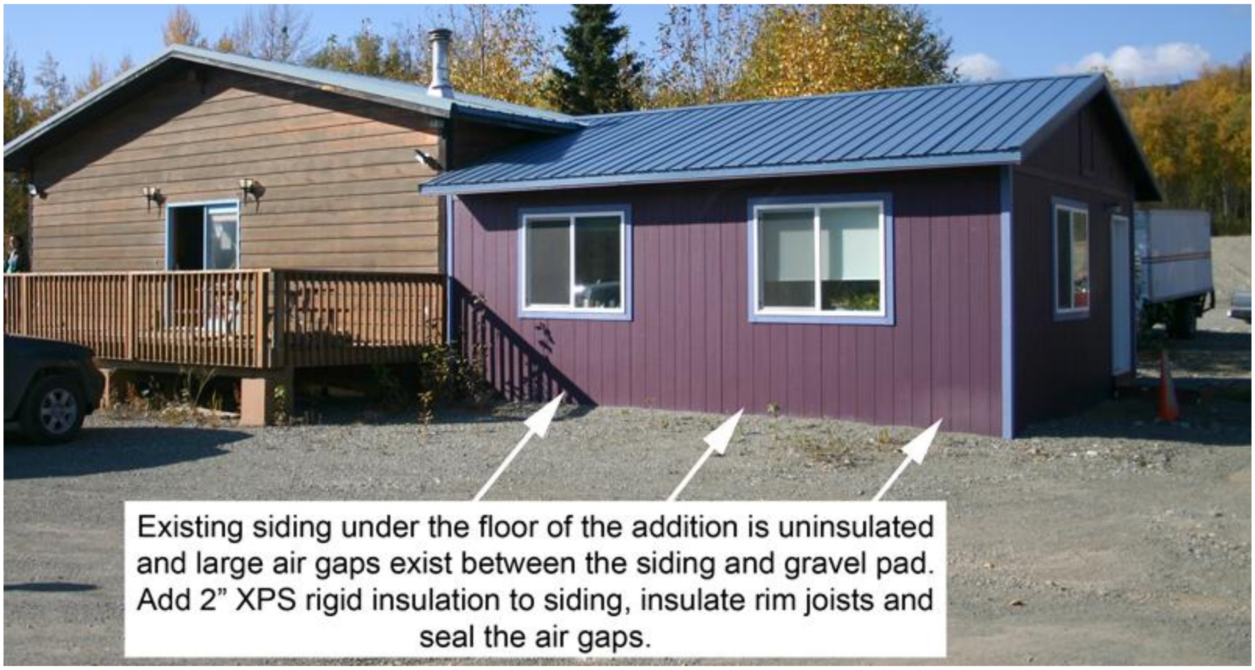
a, b. Refer to Building Insulation section in Energy Audit Methodology.

Air Leakage and Blower Door Test: The blower door test was completed on the exterior door of the addition of the Admin Bldg.

Admin Building - Blower Door Test and Air Leakage			
Building Area	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
Admin Bldg	845 CFM	10,944 cu ft	4.6 ACH

Building Envelope Recommendations: Major improvements can be made the building envelope of the Admin Bldg, including both air sealing, window and door replacement, and adding insulation. The crawlspace of the addition has no insulation on the crawlspace walls and large air gaps are present between the gravel bed and the crawlspace siding. Insulating the crawlspace siding with 2" of XPS rigid insulation, insulating the rim joists and sealing the air gaps will have a large impact on the building's heating bills.

Recommendations for Building Envelope				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) light sockets 2) wall hole penetration 3) leaky wood frame glass door Items were marked with blue tape during blower door test.	Admin Bldg 2.1.1	$200	$100	2 yrs
The weather-stripping on existing west facing exterior door has leaky and in need of replacement. Replace weather-stripping to ensure a proper air seal when door is closed.	Admin Bldg 2.1.2	$100	$50	2 yrs
Add 2" XPS rigid insulation to plywood crawlspace walls of addition (and original bldg if necessary) and insulate rim joists. Properly seal the crawlspace to stop air leakage. Costs and payback for addition only. It is recommended that the original building crawlspace be assessed. Payback will be similar for both. 50 man hours x $30/hr = $1,500 100 sq ft x $5/sq ft for materials = $500	Admin Bldg 2.1.3	$2,000	$800	2.5 yrs
Existing bathroom fan is leaking air. Install a gravity damper to stop heat loss.	Admin Bldg 2.1.4	$200	$50	4 yrs
Replace existing: 1) 70"x50" wood frame double pane window and 2) 72"x80" wood frame door with double pane glass with a new vinyl frame, double pane, argon filled, low-e window and door.	Admin Bldg 2.1.5	$2,250	$150	15 yrs



2.2. Recommendations for Mechanical Equipment

Mechanical Equipment: There are two propane heaters that provide space heat to the building; one heater located in the original building and the other located in the addition. An electric hot water heater provides DHW to the building's only bathroom. The nameplates of both propane heaters did not disclose the unit's input, output or efficiency.

Admin Building - Mechanical Equipment				
Unit	**Input (BTU/hr)**	**Output (BTU/hr)**	**Efficiency**	**Heating Loads**
Empire Comfort Systems Propane Heater	N/A	N/A	N/A	Original Bldg
Windor Plus Propane Heater	N/A	N/A	N/A	Addition
Electric Hot Water Heater	N/A	N/A	N/A	DHW

Mechanical System Recommendations: The Windor propane heater in the addition was not working at the time of the site visit. If mechanical problems with the Windor propane heater persist consider installing with a new high efficiency direct-vent propane heater, that utilizes outside combustion air.

Refer to the "Price of heating with heating oil, propane, and electricity" section of the report for a comparison of heating oil and propane heating.

2.3. Recommendations for Lighting and Electrical appliances

All of the lighting fixtures in the Admin Bldg are multi-bulb fixtures, with no T-12 or T-8 fixtures. The CVTC has been doing a great job of replacing the incandescent lights in the Admin Bldg with CFLs. At the time of the energy audit, the majority of the light fixtures had CFLs with just a few incandescent remaining. It is recommended that the replacement strategy is continued so that all lighting is CFL. Replacing a 60W bulb with an equivalent lumen output 13W CFL has a payback of 4 months.

3. GREENHOUSE BUILDING

BUILDING DESCRIPTION

The Greenhouse is located next to the Shop Bldg and the Admin Bldg. The building is divided into two spaces: a meeting space and a sun space. The meeting space is a large open room used as a gathering place or work place. The sun space is on the south side of the Greenhouse and is used to grow vegetables. The Greenhouse is built with various materials including log, adobe and unique insulation materials, including compressed plastic bags.

Currently, the Greenhouse is used seasonally. In the spring, summer and fall the greenhouse is used for growing produce and as meeting space. However, in the winter the building is not used because it is too expensive to heat, due to the fact that the building's primary heat source is an electric hot water heater. Heating with electricity is significantly more expensive than heating with heating oil. There is a wood stove in the meeting space that can be used to provide supplemental building heat if necessary.

RENEWABLE ENERGY SYSTEMS

The Greenhouse produces electricity from its array of three Shell 175W Solar PV panels and one Southwest Wind Power 1kW Whisper 200 wind turbine. Currently, the Whisper 200 wind turbine is not operational due to its tower collapsing in a January 2010 windstorm. CVTC plans to rebuild the tower with increased structural integrity and replace the broken blades of the wind turbine. The renewable energy system utilizes a battery bank of twelve Gould Batteries (1050 Amp Hour @ 8 Hour Rate) and an Outback Power Systems grid tied inverter. Unfortunately, the renewable energy systems are not data logged and it is unclear how much power is produced by the wind turbine and solar PV panels.

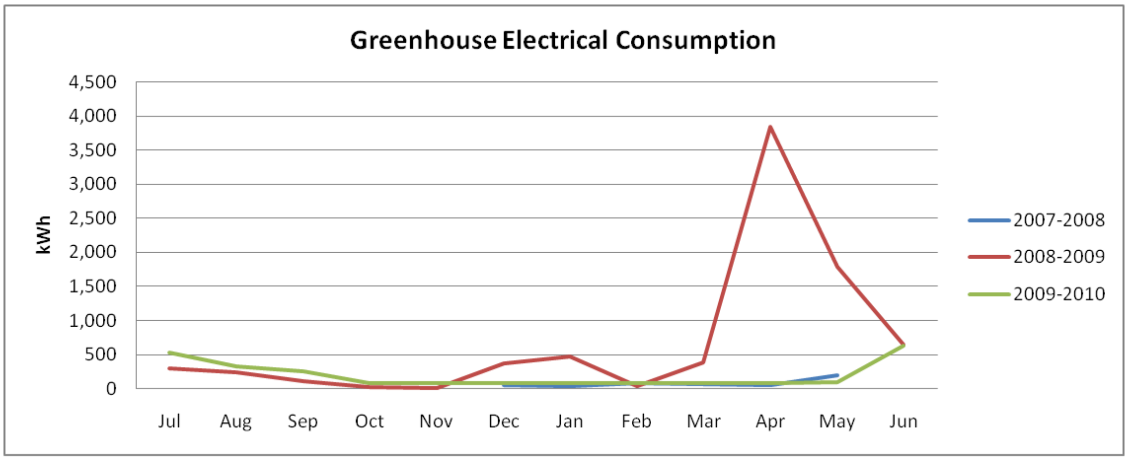
HEATING OIL CONSUMPTION AND CO_2 EMISSIONS

The Greenhouse does not use heating oil or propane to heat the building. It only uses an electric hot water heater for space heat. Due to this, the building produces no CO_2 emissions from heating oil or propane.

Electrical Consumption

The Greenhouse uses electricity for lighting, greenhouse exhaust fans and building space heat. Although the building has a solar PV array and a wind generator, there is no data available showing the systems energy production and therefore cannot be tabulated or graphed . Based on data from 2007 to 2010, the Greenhouse consumes an average of 5,308 kWh annually. At current electric costs of $0.15/kWh, this is $796 annually.

Greenhouse - Electricity Usage		
Heating Year	**Electricity**	**Electricity Cost**
2008-2009	8,210 kWh	N/A
2009-2010	2406 kWh	N/A
Average	5,308 kWh	$796 @ $0.15/kWh



3.1. Recommendations for Building Envelope

Building Insulation: The Greenhouse is significantly under-insulated compared to the BEES building standards. However, the building is only used seasonally and is not occupied on a continuous basis. Therefore, making energy efficiency improvements to the building envelope may not be necessary or justified at this time.

Greenhouse - Building Insulation		
Building Component	**R-Value and Description**	**BEES minimum standard**
Ceiling	The roof insulation in the Greenhouse could not be verified because it could not be accessed.	R-38/49 [a]
Exterior Frame Wall	The walls incorporate various bldg materials: 1) Standard log wall with an average log thickness of 9" (R-11) 2) 22" thick wall with plastic bags inside for insulation. Adobe exterior and interior face.	R-20
Floor	Concrete floor with radiant floor. It has not been confirmed if insulation exists under the radiant floor slab.	R-30
Below Grade Wall	N/A, slab-on-grade	R-15/19 [b]
Windows	1) Double pane wood frame windows in the meeting space. Large windows face into the sun space. (R-2) 2) Single pane wood frame windows in the sun space. (R-1)	R-3

a, b. Refer to Building Insulation section in Energy Audit Methodology.

Air Leakage and Blower Door Test: The blower door test was completed using the west door of the meeting space area in the Greenhouse. The test focused on testing the meeting space and not the sun space because the sun space did not appear to be well sealed. From the blower door test it was determined that the Greenhouse has the most air leakage out of all other buildings in the energy audit, at over 22 ACH at -50 Pa.

The large amount of air leakage is due to the large air gaps on the roof ridge between the meeting space and the sun space. Two exhaust fans exist in this area with no dampers and air is free to move into or out of the building.

Greenhouse Building - Blower Door Test and Air Leakage			
Building Area	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
Meeting Space	4,415 CFM	12,000 cu ft	22.1 ACH

3.2. Recommendations for Mechanical Equipment

Mechanical Equipment: There is one electric hot water heater that provides space heat to the Greenhouse via the building's concrete radiant floor slab. Due to the high cost of using electric heat for this radiant floor slab, the electric hot water heater is not being used in the winter. If CVTC intends to use the meeting room regularly during the heating season, then consideration should be made on replacing the water heater with a more efficient appliance, such as a Toyotomi Water Heater. Energy efficiency improvements to the building envelope is recommended if CVTC intends to use the building during the heating season, as well.

A wood stove is also present in the meeting space that can be used for supplemental building heat.

Greenhouse Building - Mechanical Equipment				
Unit	**Input (BTU/hr)**	**Output (BTU/hr)**	**Efficiency**	**Heating Loads**
Electric Hot Water Heater	N/A	N/A	N/A	Meeting space concrete radiant floor slab
Wood Stove	N/A	N/A	N/A	Meeting space

3.3. Recommendations for Lighting and Electrical appliances

The lighting in the Greenhouse is already energy efficient with CFL lights. There are no lighting improvements are necessary for this building.

4. HEALTH & SOCIAL SERVICES BUILDING

BUILDING DESCRIPTION

The Health & Social Services Building, or H&SS Bldg, is located in the town of Sutton, approximately one mile northeast along the Glenn Hwy from the Shop Bldg. The original building used to be a church and has since been converted into a large meeting room on the top floor and office space and exam rooms on the bottom floor. At the time of the energy audit, a new kitchen addition was being finished, located on the back of the building.

The front south face of the building has good solar exposure. A potential option for installing a solar thermal or grid tied solar PV system may be possible on the south facing awning. This will be discussed in the renewable energy section of the report.

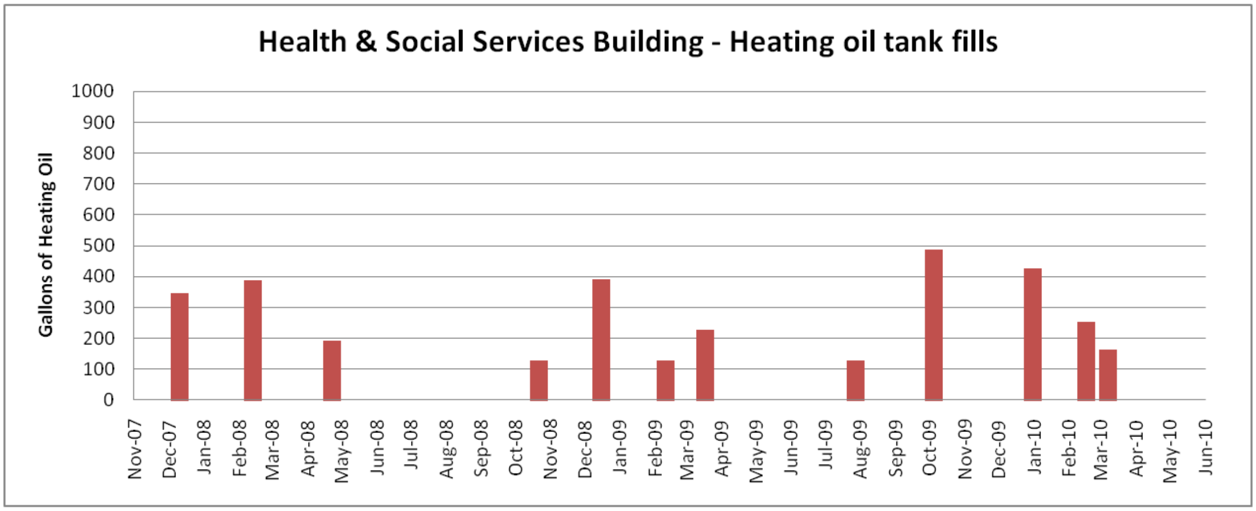
HEATING OIL CONSUMPTION AND CO_2 EMISSIONS

The H&SS Bldg uses an average of 1,043 gallons of heating oil per heating year, based on data from 2008 to 2010, making it the third largest consumer of heating oil after the Shop and the School. Based on the current heating oil price of $3.05/gal, it costs approximately $3,181 annually to heat the building. On average the H&SS Bldg generates 23,347 lbs of CO_2 annually.

H&SS Building - Heating Oil Usage		
Heating Year	**Heating Oil (gal)**	**Heating Oil Cost**
2008-2009	764 gal	$2,143
2009-2010	1,321 gal	$3,798
Average Heating Oil Consumption	1,043 gal	$3,181 @ $3.05/gal
Average CO_2 Emissions	23,347 lbs CO_2*	

* Based on 22.384 lb of CO_2 per gallon of heating oil.

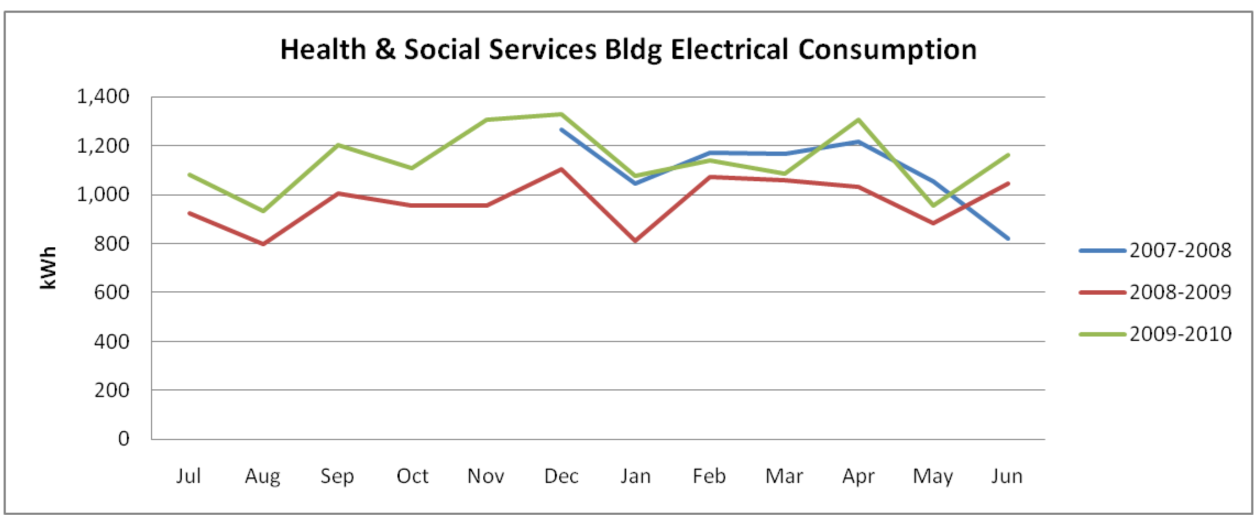
Heating oil is stored in a 500 gal fuel tank located behind the H&SS Bldg, on the north side. Fuel is routed from the tank to the oil furnace located on the bottom floor of the building. The fuel tank is topped off throughout the year by a heating oil distributer. The fuel tank fills are charted below for the H&SS Bldg.



Electrical Consumption

The H&SS Bldg is the fourth largest consumer of electricity, following the Shop Bldg, Admin Bldg, and Ya Ne Dah Ah School. The building uses an average of 12,666 kWh per heating year, based on data from 2007 to 2010. At the current price of $0.15/kWh, this amounts to $1,900 in electricity every year.

H&SS Building - Electrical Usage		
Heating Year	**Electricity (kWh)**	**Electricity Cost**
2008-2009	11,648 kWh	N/A
2009-2010	13,683 kWh	N/A
Average	12,666 kWh	$1,900 @ $0.15/kWh



4.1. Recommendations for Building Envelope

Building Insulation: Overall, the building envelope is well insulated, except for the original building's foundation walls. The ceiling of the original building was recently remodeled with a proper R-38 roof and vapor barrier. The kitchen addition is constructed with proper insulation in the roof, walls and foundation walls. The original building's foundation wall insulation is below the BEES standard and energy savings could be made by upgrading this insulation.

H&SS Building - Building Insulation		
Building Component	**R-Value and Description**	**BEES minimum standard**
Ceiling	1) The original hot roof and ceiling was recently remodeled with R-38 fiberglass batts and a new vapor barrier. 2) The kitchen addition has a cold roof with R-44 blown cellulose.	R-38/49 [a]
Exterior Frame Wall	R-19 fiberglass batt insulation in 2X6 stud walls, with sheetrock interior and exterior wood siding. R-20 for entire wall system.	R-20
Floor	1) The crawlspace of the original building could not be accessed because the existing electric hot water heater is built over the access hatch. 2) The crawlspace of the kitchen addition has a vapor barrier on the dirt floor with no insulation under it.	R-30
Below Grade Wall	1) 2" spray foam around original foundation wall (R-12). Except for west foundation wall which is exposed concrete block wall. 2) Insulated Concrete Form (ICF) on kitchen addition foundation wall (R-20).	R-15/19 [b]
Windows	1) Double pane, vinyl frame, argon filled windows (R-3) in downstairs of original bldg and in kitchen addition. 2) Double pane, wood frame, windows (R-2) in upstairs meeting room.	R-3

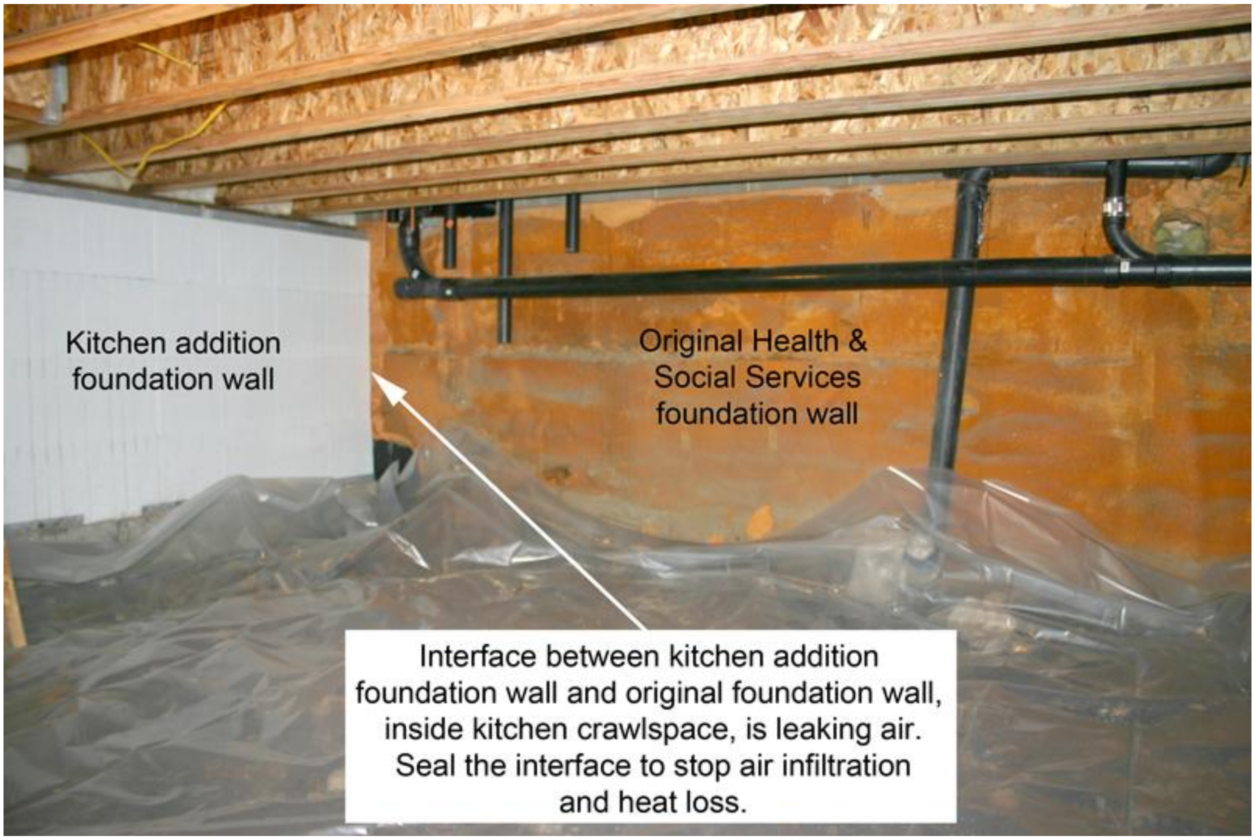
a, b. Refer to Building Insulation section in Energy Audit Methodology.

Air Leakage and Blower Door Test: The blower door test was completed using the east exterior door on the top floor of the H&SS Bldg. The entire building was tested at once. The building is leaky at 5.7 ACH50 and requires air sealing to improvements. A typical 5 Star building has 3 ACH50.

H&SS Building - Blower Door Test and Air Leakage			
Building Area	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
H&SS Bldg	2,032 CFM	21,504 cu ft	5.7 ACH

Building Envelope Recommendations: The recommended improvements for the H&SS Bldg are air sealing and adding additional insulation to the under-insulated basement/foundation wall.

Recommendations for Building Envelope				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) wall electrical outlets 2) interface between kitchen addition foundation wall and original foundation wall inside kitchen crawlspace Items were marked with blue tape during blower door test.	H&SS Bldg 4.1.1	$200	$100	2 yrs
The following wood frame, double pane windows were found to be leaking air at the edges of their frames: 1) seven 22"x76" windows located in the top floor meeting room, 2) one 84"x58" window located in the top floor meeting room, 3) one 27"x39" window located on the bottom floor, and 4) one 21"x47" window located on the bottom floor. Seal the air leaks of these window frames to reduce air infiltration and heat loss.	H&SS Bldg 4.1.2	$500	$250	2 yrs
The weather-stripping on the: 1) existing south facing exterior door, 2) west facing bottom floor exterior door, and 3) east facing exterior door is leaking air and in need of replacement. Replace weather-stripping on all three doors to ensure a proper air seal when door is closed.	H&SS Bldg 4.1.3	$300	$150	2 yrs
Add 4" XPS rigid insulation over existing un-insulated west concrete block wall. (Cost only includes cost of insulation and does not include exterior flashing or sheathing or siding)	H&SS Bldg 4.1.4	$1000	$230	4.4 yrs
Add additional spray foam or rigid to existing foundation walls that already have 2" spray foam. (Cost only includes cost of insulation and does not include exterior flashing or sheathing or siding)	H&SS Bldg 4.1.5	$1,400	$130	10.8 yrs
Replace all wood frame, double pane windows discussed in item 4.00 with new vinyl frame, double pane, argon filled, low-e windows.	H&SS Bldg 4.1.6	$3,900	$300	13 yrs



4.2. Recommendations for Mechanical Equipment

Mechanical Equipment: The CVTC is planning to replace the existing oil fired furnace and related ductwork with a new high efficiency oil fired boiler and baseboard registers. During the site visit, the baseboard registers were in the process of being installed. An electric hot water heater produces the DHW for the building. In the kitchen addition there is ductwork in place for a Heat Recovery Ventilator (HRV). The HRV has not been installed at the time of the site visit, but is anticipated to be installed in the future. The HRV will use exhaust air from the top floor bathroom to temper incoming fresh air for the top floor.

H&SS Building - Mechanical Equipment				
Unit	**Input (BTU/hr)**	**Output (BTU/hr)**	**Efficiency**	**Heating Loads**
Oil Fired Furnace	Note: To be replaced with new high efficiency oil boiler			Space heat for entire building
Reliance 606 Electric Hot Water Heater (53 gal)	N/A	N/A	N/A	DHW
Heat Recovery Ventilator (HRV)	Note: This unit was not installed during the site visit, but is anticipated to be installed in the future.			Tempers fresh air for top floor of building

4.3. Recommendations for Lighting and Electrical appliances

The top floor of the H&SS Bldg already utilizes energy efficient lighting with CFL lights in the meeting room and T-8 lighting in the kitchen addition. However, the bottom floor office space uses primarily T-12 lighting fixtures with magnetic ballasts. Swapping these old, inefficient T-12's with energy efficient T-8 fixtures with electronic ballasts is recommended.

The installed cost for the T-8 retrofit does not include labor, as this can be done in-house by CVTC.

H&SS Building - Lighting Upgrades								
Improvement Number	**Existing Lights**	**Total Existing Fixtures**	**Replacement Lights**	**Total New Fixtures**	**Hours/ Week**	**Annual Savings in dollars***	**Total Installed Cost**	**Payback (yrs)**
H&SS Bldg 4.3.1	2 tube T-12 light fixture (40W/tube)	14	2 tube T-8 light fixture (28W/tube)	14	40	$168	$1,008	6.0 yrs

* Annual savings is the amortized annual savings of the lighting upgrade based on the current electric rate of $0.15/kWh with 4% escalation annually.

5. YA NE DAH AH SCHOOL BUILDING

BUILDING DESCRIPTION

The Ya Ne Dah Ah School Building is located on the CVTC property near Moose Creek, next to the Ahtna Language Bldg, Transportation Dept. Bldg, and Indian Child Welfare Act Program Bldg (ICWAP Bldg). The School Bldg has one large classroom space that can be divided in two by a large wall divider. The bldg also has a kitchen and an office space.

HEATING OIL CONSUMPTION AND CO_2 EMISSIONS

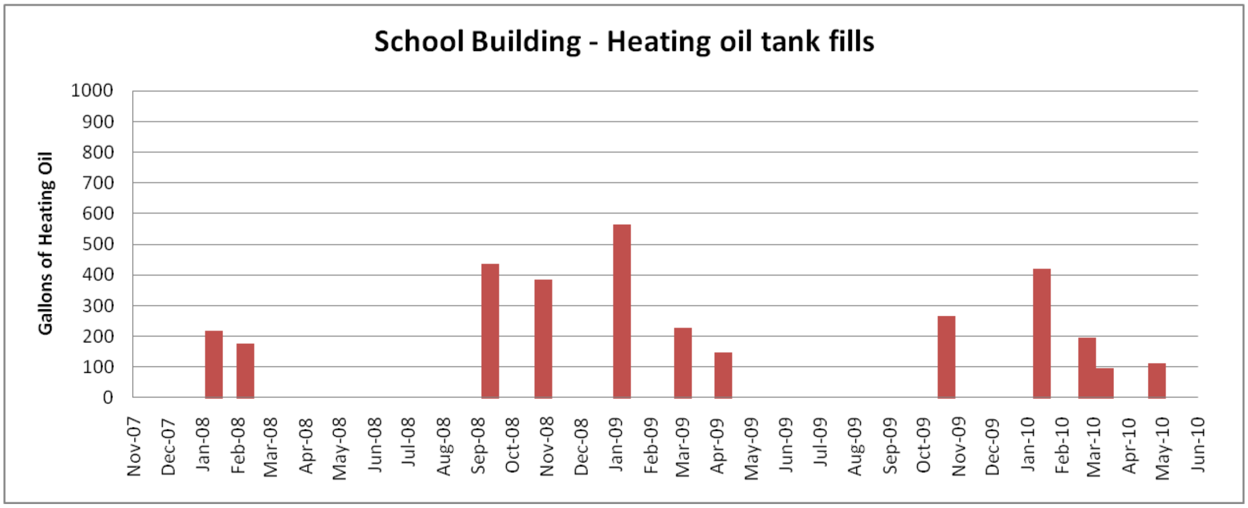
The School Bldg uses an average of 1,290 gallons of heating oil per heating year, based on data from 2008 to 2010, making it the second largest consumer of heating oil after the Shop Bldg. Based on the current heating oil price of $3.05/gal, it costs approximately $3,935 annually to heat the building. On average the School Bldg generates 28,875 lbs of CO_2 annually.

It is interesting that the School used 675 gal more of heating oil in 2008-09 heating season. The reason is that the School was occupied more during the 2008-2009 winter, as can be seen from the bldg's electrical consumption.

School Building - Heating Oil Usage		
Heating Year	**Heating Oil (gal)**	**Heating Oil Cost**
2008-2009	1,627 gal	$5,163
2009-2010	952 gal	$2,746
Average Heating Oil Consumption	1,290 gal	$3,935 @ $3.05/gal
Average CO_2 Emissions	28,875 lbs CO_2*	

* Based on 22.384 lb of CO_2 per gallon of heating oil.

Heating oil is stored in a 500 gal fuel tank located behind the School Bldg. Fuel is routed from the tank to two large Toyostoves located in the office and classroom. The fuel tank is topped off throughout the year by a heating oil distributer. The fuel tank fills are charted below for the School Bldg.

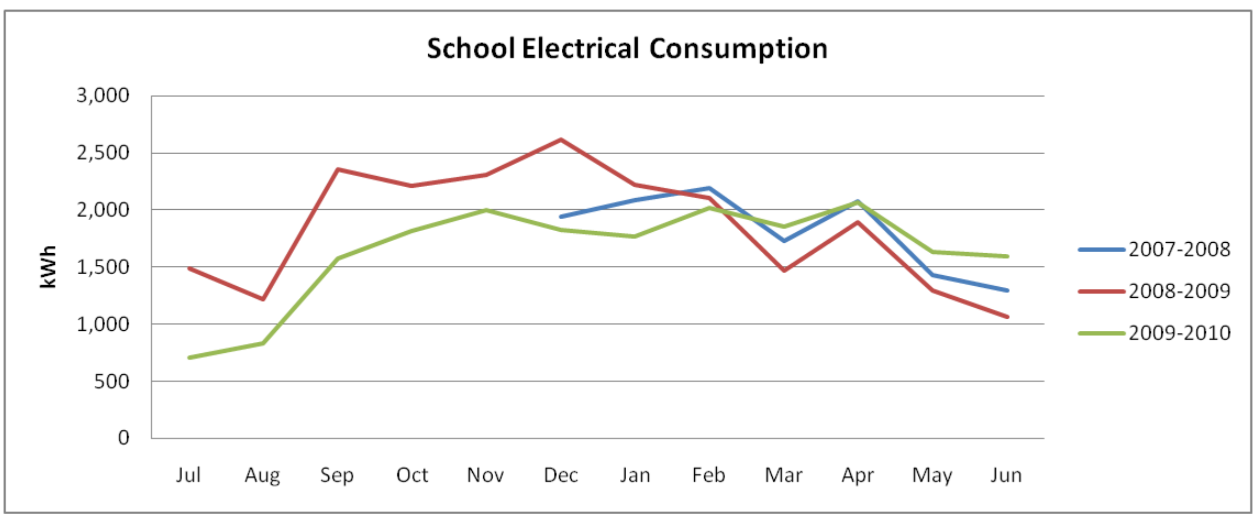


ELECTRICAL CONSUMPTION

The School Bldg is the largest consumer of electricity of the 14 buildings audited. The building uses an average of 20,974 kWh per heating year, based on data from 2007 to 2010. At the current price of $0.15/kWh, this amounts to $3,146 in electricity every year.

School Building - Electrical Usage		
Heating Year	**Electricity (kWh)**	**Electricity Cost**
2008-2009	22,241 kWh	N/A
2009-2010	19,706 kWh	N/A
Average	20,974 kWh	$3,146 @ $0.15/kWh

As can be seen from the graph of the School's electrical consumption, the School used significantly more electricity during the 2008-2009 heating season than in the 2009-2010 heating season. This shows that the school was more utilized during the 2008-2009 winter, which is also the reason that the School burned significantly more fuel during this heating season.



5.1. Recommendations for Building Envelope

Building Insulation: Overall, the building envelope is well insulated and well sealed, except for the crawlspace which has several large sources of air leakage.

School Building - Building Insulation		
Building Component	**R-Value and Description**	**BEES minimum standard**
Ceiling	The School has a cold roof with R-44 blown cellulose.	R-38/49 [a]
Exterior Frame Wall	R-19 fiberglass batt insulation in 2X6 stud walls, with sheetrock interior and exterior wood siding. R-20 for entire wall system.	R-20
Floor	The large crawlspace that extends under the entire bldg has a vapor barrier on the dirt floor with no insulation under it.	R-30
Below Grade Wall	The crawlspace walls consist of Insulated Concrete Forms (ICF) (R-20). However, there are 4 vents installed in the rim joists in the crawlspace, which allow significant heat loss and infiltration.	R-15/19 [b]
Windows	Double pane, vinyl frame, argon filled windows (R-3).	R-3

a, b. Refer to Building Insulation section in Energy Audit Methodology.

Air Leakage and Blower Door Test: The blower door test was completed using the southeast exterior door on the School Bldg to test the entire building at once. During the test it was discovered that there was a significant amount of air flow coming from the building's crawlspace. To quantify this leakage, two blower door tests were completed, one with the crawlspace door open and a second with the crawlspace door closed. The tests show that the crawlspace leaks 4 times as much air as the rest of the building envelope. It was determined that the excess air flow in the crawlspace was coming from 4 open vents in the rim joists and a vent fan that was continuously venting air from the crawlspace to the outdoors.

If the crawlspace hatch is closed, the School Bldg is a very tight structure at 0.9 ACH50. This is the tightest building in the audit. The building's three exterior doors were found to be very tight and there were no air leaks occurring around the buildings electrical outlets or windows.

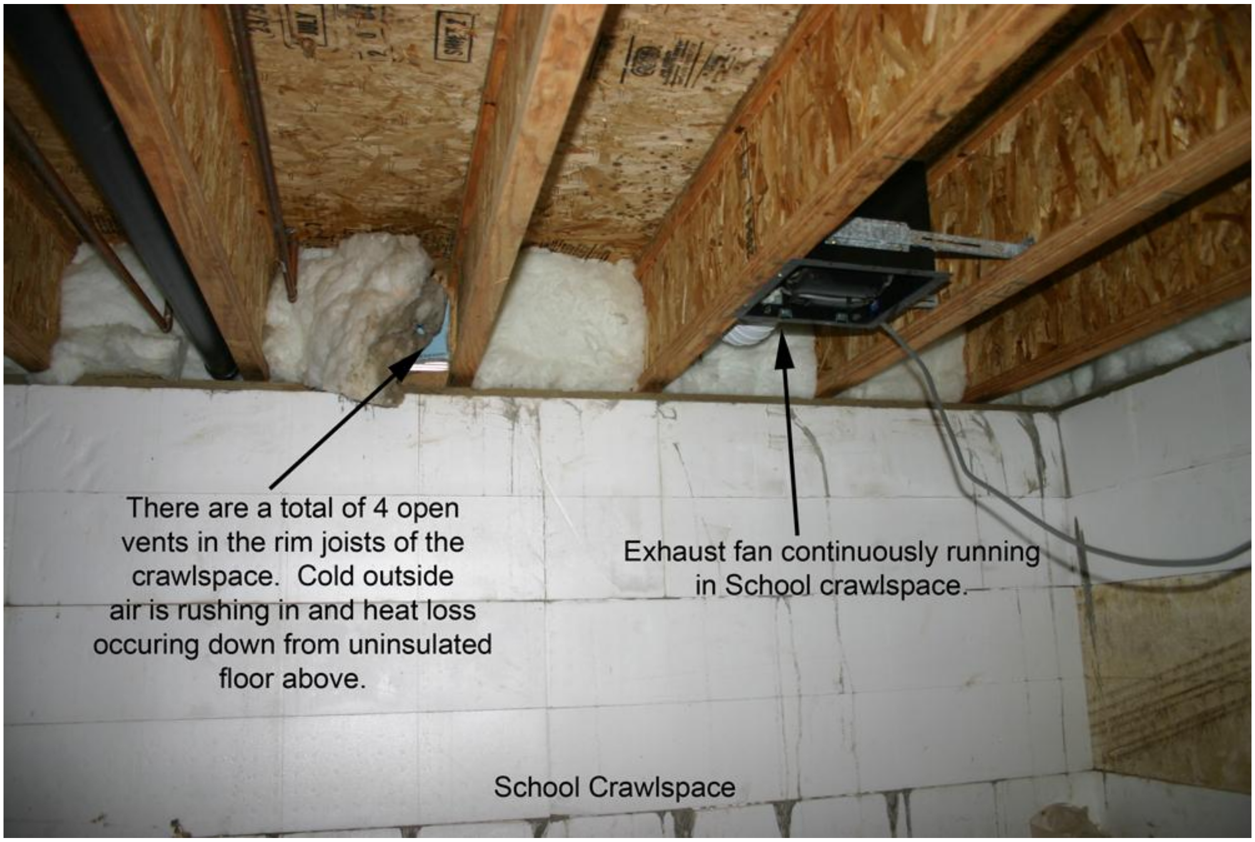
School Building - Blower Door Test and Air Leakage			
Building Area	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
With crawlspace hatch open	1,756 CFM	24,192 cu ft	4.4 ACH
With crawlspace hatch closed	371 CFM	24,192 cu ft	0.9 ACH

Building Envelope Recommendations: Overall, the School's building envelope is tight and has met most of the BEES insulation standards. The only poor building component is the leaky crawlspace. It appears that the 4 vents and continually running exhaust fan in the crawlspace were installed 2 years ago after an exterior water spigot burst and flooded the School's crawlspace. Also, according to School personnel, there still exists a water leak in the crawlspace that has not been located and is still leaking water. The vents and fan are used to vent the humidity associated with this water. It is recommended that the water leaks be located and repaired. After the crawlspace is completely dried, the 4 vents should be sealed and the rim joist insulation re-installed. The exhaust fan should be removed and the exhaust hole sealed and re-insulated.

If ventilation of humid air from the crawlspace remains necessary, the vent fan should be controlled by a humidistat. A self closing or motorized damper allowing warm air into the crawlspace from the heated space above should be installed at the opposite end of the crawlspace from the fan. This would allow heated air to absorb moisture from across the crawlspace floor before being vented outside by the fan.

Another source of heat loss from air leakage is the front entrance door due to its heavy usage and the fact that is remains propped open at times to allow students to enter or leave. The construction of an arctic entry should be considered to address this issue. An arctic entry would also create a much needed mud room space for students to remove and store shoes and jackets. Instead or heated air rushing immediately outside through the front door, heat would be trapped in the arctic entry where it will provide a warm room for removing or putting on shoes and jackets. While the payback from heat recovery alone for an arctic entry is rather long (@20 years), the benefits to the school of creating this value added and useful space must also be factored into the return on investment.

Recommendations for Building Envelope				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Stop existing water leak and completely dry the School crawlspace. Seal and insulate the penetrations associated with the 4 vents and one exhaust fan in the crawlspace. $100 material cost 30 man hours x $30/hr = $900	School Bldg 5.1.1	$1,000	$800	1.3 yrs
The existing attic hatch is leaking air and is un-insulated. Repair weather-stripping on attic hatch to stop air flow and insulate with R-38 insulation	School Bldg 5.1.2	$100	$50	2 yrs
Install an arctic entry in front of the main exterior door.	School Bldg 5.1.3	$10,000	$500	20 yrs



5.2. Recommendations for Mechanical Equipment

Mechanical Equipment: The School is heated with two direct vent Toyostoves and a Heat Recovery Ventilator (HRV). The HRV is a great addition to the school because it brings in fresh air and increased air quality to the very tight building envelope. The HRV is manually operated with a comfort control dial. It is recommended that the HRV be continued to be operated properly to ensure good air quality in the school. An electric hot water heater located in the crawlspace produces the DHW for the building. The direct vent Toyostoves have a high efficiency of 87% AFUE.

School Building - Mechanical Equipment				
Unit	**Input (BTU/hr)**	**Output (BTU/hr)**	**Efficiency**	**Heating Loads**
Laser 73 Toyostove	N/A	N/A	87% AFUE	Space Heat
Laser 73 Toyostove	N/A	N/A	87% AFUE	Space Heat
Heat Recovery Ventilator (HRV)	N/A	N/A	N/A	Tempers fresh air for building

5.3. Recommendations for Lighting and Electrical appliances

The existing lighting in the School is already energy efficient T-8 lighting, with 32W tubes. This is a great lighting system for the school at this time. It is recommended that as the 32W T-8 tubes burn out that they are replaced with the more energy efficient 28W or 25W T-8 tubes.

6. AHTNA LANGUAGE BUILDING

BUILDING DESCRIPTION

The Ahtna Language Building, or Language Bldg, is the oldest building in this audit, and is located on the Moose Creek property next to the ICWAP Bldg, Transportation Bldg, Transit Bldg and School. It was at one time a drive-in diner and has since been converted into office space. The building also has a small apartment in the back of the building that is used for housing a travelling language teacher. This building was constructed when energy prices were far less than today and has gone through a series of renovations and additions that are not energy efficient. Therefore, making significant investments for improvements is likely to produce marginal returns. Consideration should be given to constructing a new energy efficient office complex to house the functions of this building, the ICWAP bldg, Transportation Bldg and Transit Building.

RENEWABLE ENERGY SYSTEMS

There is a large grid-tied, tracking solar PV array located behind the Language Bldg. The solar PV array has eighteen 125W Kyocera PV panels giving it a total nameplate capacity of 2,250 W.

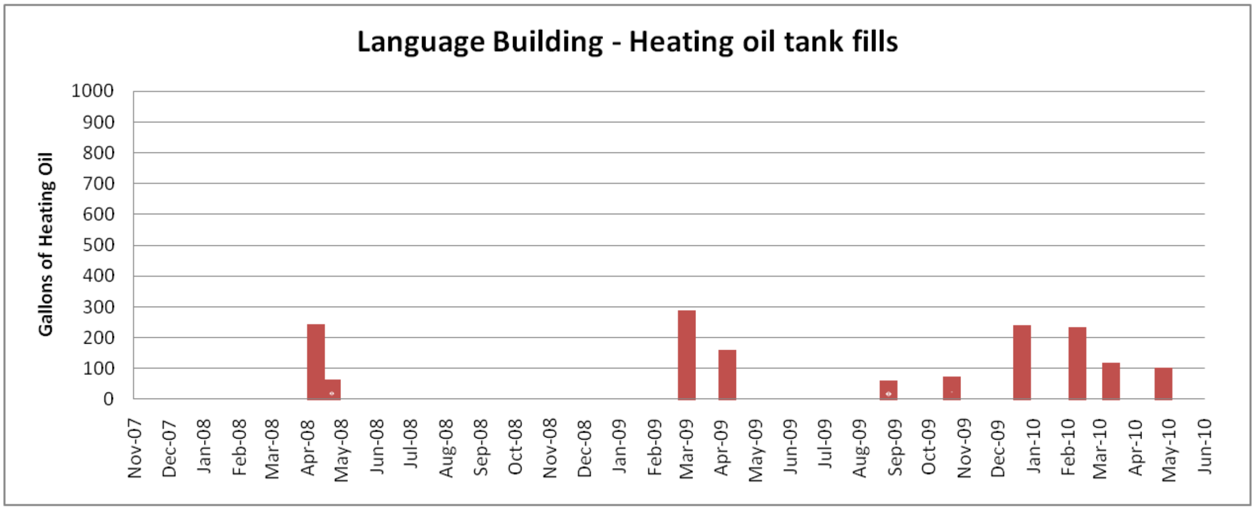
HEATING OIL CONSUMPTION AND CO_2 EMISSIONS

The Language Bldg uses an average of 658 gallons of heating oil per heating year, based on data from 2008 to 2010. Based on the current heating oil price of $3.05/gal, it costs approximately $2,007 annually to heat the building. On average the Language Bldg generates 14,729 lbs of CO_2 annually.

Language Building - Heating Oil Usage		
Heating Year	**Heating Oil (gal)**	**Heating Oil Cost**
2008-2009	647 gal	$1,980
2009-2010	669 gal	$1,946
Average Heating Oil Consumption	658 gal	$2,007 @ $3.05/gal
Average CO_2 Emissions	14,729 lbs CO_2*	

* Based on 22.384 lb of CO_2 per gallon of heating oil.

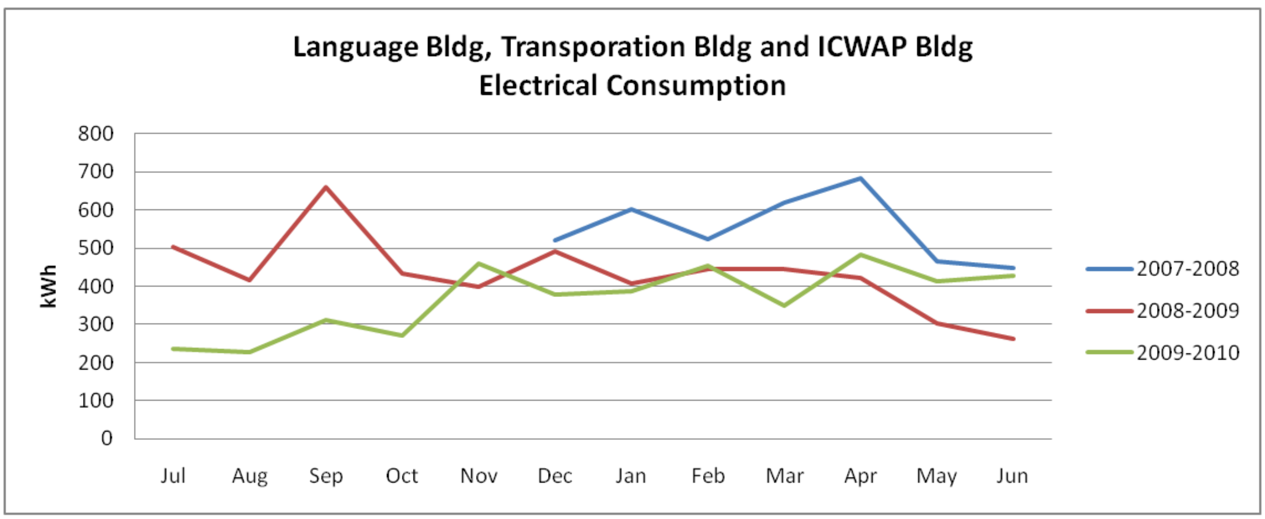
Heating oil is stored in a 500 gal fuel tank located behind the Language Bldg, on the south side. Fuel is routed from the tank to two Toyostoves in the building. The fuel tank is topped off throughout the year by a heating oil distributer. The fuel tank fills are charted below for the Language Bldg.



ELECTRICAL CONSUMPTION - LANGUAGE, TRANSPORTATION, ICWAP & TRANSIT BLDG

The Language Bldg, Transportation Bldg, ICWAP Bldg and Transit Bldg all share one electric meter. Combined, the buildings use an average of 4,793 kWh per heating year, based on data from 2007 to 2010. At the current price of $0.15/kWh, this amounts to $719 in electricity every year.

Language, Transportation and ICWP Building - Electrical Usage		
Heating Year	**Electricity (kWh)**	**Electricity Cost**
2008-2009	5,184 kWh	N/A
2009-2010	4,401 kWh	N/A
Average	4,793 kWh	$719 @ $0.15/kWh



6.1. Recommendations for Building Envelope

Building Insulation: The existing insulation of the Language Bldg is significantly under the BEES insulation standards.

Language Building - Building Insulation		
Building Component	**R-Value and Description**	**BEES minimum standard**
Ceiling	The roof insulation of the bldg could not be accessed because no interior ceiling or exterior attic hatches could be found.	R-38/49 [a]
Exterior Frame Wall	2 x 4 exterior stud wall with old fiberglass batt insulation. (R-11)	R-20
Floor	The floor insulation could not be accessed because no floor hatches could be found.	R-30
Below Grade Wall	None found.	R-15/19 [b]
Windows	1) Wood frame, single pane windows (R-1). 2) Wood frame, double pane windows (R-2).	R-3

a, b. Refer to Building Insulation section in Energy Audit Methodology.

Air Leakage and Blower Door Test: The blower door test was completed using the west facing exterior door. The entire building was tested at once. The Language Bldg is the second worst building for air infiltration, after the Greenhouse, at 13.7 ACH50. Significant air sealing improvements are required. A typical 5 Star building has 3.0 ACH50.

Language Building - Blower Door Test and Air Leakage			
Building Area	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
Language Bldg	2,017 CFM	8,813 cu ft	13.7 ACH

Building Envelope Recommendations: Retrofitting the building with increased insulation will be capital intensive with marginal returns and is not recommended. It is recommended that a new office complex is installed to house the functions of this building and the other out buildings on the site.

In the interim, air sealing is recommended for the Language Bldg due to its major air infiltration issues.

Recommendations for Building Envelope				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) ceiling light fixtures 2) electrical breaker box 3) penetrations in ceiling Items were marked with blue tape during blower door test.	Language Bldg 6.1.1	$200	$100	2 yrs
Air seal window frames and add plastic membrane to interior side of window to reduce air leakage and heat loss.	Language Bldg 6.1.2	$500	$250	2 yrs
The weather-stripping on the following doors is leaking air: 1) rear exterior door, 2) front entry door, and 3) east facing exterior door. Replace weather-stripping on all three doors to ensure a proper air seal when door is closed.	Language Bldg 6.1.3	$300	$150	2 yrs
The following interfaces between the wall top and ceiling is leaking air: 1) interface between exterior walls and ceiling, and 2) interface between partition wall that separates the office space and storage space and the ceiling. Caulk and seal these seams to stop air leakage and heat loss.	Language Bldg 6.1.4	$400	$200	2 yrs
Remove decommissioned oil furnace along with unneeded fuel line and cap leaky exhaust stack to stop unnecessary air leakage and heat loss.	Language Bldg 6.1.5	$200	$50	4 yrs
Bathroom fan is leaking air because it most likely does not have a damper. Install a new damper on the existing bathroom fan.	Language Bldg 6.1.6	$200	$50	4 yrs

6.2. Recommendations for Mechanical Equipment

Mechanical Equipment: The Language Bldg uses two direct vent, oil fired Toyostoves for space heat and an electric hot water heater for DHW. An old oil furnace used to heat the building, but is now decommissioned. However, the oil furnace with associated fuel line and exhaust stack still remain in the building. The exhaust stack is a significant source of air leakage. It is recommended that the oil furnace be removed along with the unneeded fuel line and that the exhaust stack be capped to stop unnecessary air leakage and heat loss.

Language Building - Mechanical Equipment				
Unit	**Input (BTU/hr)**	**Output (BTU/hr)**	**Efficiency**	**Heating Loads**
Laser 73 Toyostove	N/A	N/A	87% AFUE	Space Heat for Office
Laser 56 Toyostove	N/A	N/A	87% AFUE	Space Heat for Bedroom
Electric Hot Water Heater	N/A	N/A	N/A	DHW
Decommissioned Oil Fired Furnace	N/A	N/A	N/A	Unit is not used

6.3. Recommendations for Lighting and Electrical Appliances

The Language Bldg already utilizes CFL lighting and T-8 light fixtures. No energy efficient lighting improvements are recommended at this time. The building also utilizes an electric stove in the kitchen.

7. TRANSPORTATION BUILDING

BUILDING DESCRIPTION

The Transportation Dept. Building, or Transportation Bldg, is located on the Moose Creek property next to the Language Bldg, ICWAP Bldg and School. The building is 608 sq. ft. and is much smaller than many of the other CVTC buildings. Over the years the building has had a couple additions. The first addition added new office space in the rear of the building. The second addition added a bathroom to the west side of the building.

HEATING OIL CONSUMPTION AND CO_2 EMISSIONS - TRANSPORTATION BLDG AND ICWAP BLDG

The Transportation Bldg and the ICWAP Bldg share a 500 gallon fuel tank, located behind the buildings. The Transit Bldg, which is not included in this audit, is located next the Transportation Bldg with its own 500 gallon fuel tank. It appears that the heating oil distributer does not properly differentiate between these two fuel tanks on the heating oil bills. Therefore, making it impossible to determine which tank the bill is for. This most likely happens because the tanks and buildings are not well marked, making it difficult for the heating oil distributer to accurately describe the tank they're filling. It is recommended that these two tanks be properly named and marked so that the fuel usage of the buildings can be accurately known.

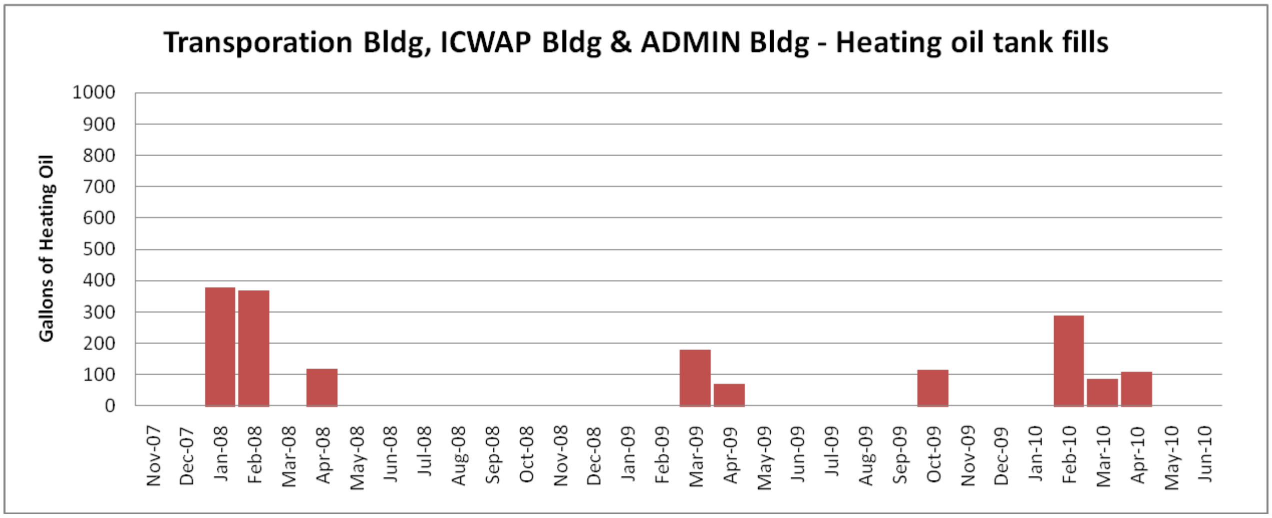
Due to this issue, the heating oil consumption of the Transportation Bldg, ICWAP Bldg, and Transit Bldg must be combined and looked at together.

Using the data available, it appears as if the three buildings use a combined average of 490 gallons of heating oil per heating year, based on data from 2008 to 2010. Based on the current heating oil price of $3.05/gal, it costs approximately $1,495 annually to heat the building. On average the three buildings generate 10,968 lbs of CO_2 combined each year.

Transportation, ICWAP & Transit Bldg - Heating Oil Usage		
Heating Year	**Heating Oil (gal)**	**Heating Oil Cost**
2007-2008	785 gal	$2,537
2008-2009	196 gal	$525
2009-2010	489 gal	$1,427
Average Heating Oil Consumption	490 gal	$1,495 @ $3.05/gal
Average CO_2 Emissions	10,968 lbs CO_2*	

* Based on 22.384 lb of CO_2 per gallon of heating oil.

The two 500 gallon fuel tanks are topped off throughout the year by a heating oil distributer. The fills of both fuel tanks charted below.



Electrical Consumption

The Transporatation Bldg shares an electric meter with the Language Bldg, and the combined electrical consumption is shown in the Language Bldg section.

7.1. Recommendations for Building Envelope

Building Insulation: The roof and crawlspace insulation of the original transportation bldg could not be determined because they could not be accessed during the site visit. It is believed that the building is under insulated in these areas.

Transportation Building - Building Insulation		
Building Component	**R-Value and Description**	**BEES minimum standard**
Ceiling	The roof insulation of the bldg could not be accessed because no interior ceiling or exterior attic hatches could be found.	R-38/49 [a]
Exterior Frame Wall	1) The original bldg and rear office addition have 2 x 4 exterior stud walls with fiberglass batt insulation. (R-11) 2) The bathroom addition has 2 x 6 exterior stud wall with fiberglass batt insulation. (R-19)	R-20
Floor	The floor insulation could not be accessed because no interior floor hatches or exterior access hatches could be found.	R-30
Below Grade Wall	None found. Building is on blocks.	R-15/19 [b]
Windows	Double pane, vinyl frame, argon filled windows (R-3).	R-3

a, b. Refer to Building Insulation section in Energy Audit Methodology.

Air Leakage and Blower Door Test: The blower door test was completed using the only exterior door of the building. The entire building was tested at once. The building is leaky at 4.9 ACH50 and requires air sealing to improvements. A typical 5 Star building has 3 ACH50.

Transportation Building - Blower Door Test and Air Leakage			
Building Area	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
Transportation Bldg	396 CFM	4,864 cu ft	4.9 ACH

Building Envelope Recommendations: It is recommended that a new office complex be built to house the functions of the Transportation Bldg and the other out buildings on the site. In the interim, it is recommended that the Transportation Bldg be properly air sealed.

Recommendations for Building Envelope				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) electrical outlets and Ethernet outlet, 2) electrical panel, and 3) old inlet and outlet to removed toyostove in the rear office addition. Items were marked with blue tape during blower door test.	Transportation Bldg 7.1.1	$200	$100	2 yrs
The weather-stripping on the existing exterior door is leaking air and in need of replacement. Replace weather-stripping on the door to ensure a proper air seal when door is closed.	Transportation Bldg 7.1.2	$100	$50	2 yrs

7.2. Recommendations for Mechanical Equipment

Mechanical Equipment: Only one direct vent, Laser 30 Toyostove is used to provide space heat to the building. And electric hot water heater provides DHW to the building. No improvements to mechanical equipment is recommended at this time.

Transportation Building - Mechanical Equipment				
Unit	**Input (BTU/hr)**	**Output (BTU/hr)**	**Efficiency**	**Heating Loads**
Laser 30 Toyostove	N/A	N/A	87% AFUE	Space Heat
Electric Hot Water Heater (53 gal)	N/A	N/A	N/A	DHW

7.3. Recommendations for Lighting and Electrical appliances

The Transportation Bldg primarily uses T-12 lighting fixtures with magnetic ballasts. Swapping these old, inefficient T-12's with energy efficient T-8 fixtures with electronic ballasts is recommended.

Transportation Building - Lighting Upgrades								
Improvement Number	**Existing Lights**	**Total Existing Fixtures**	**Replacement Lights**	**Total New Fixtures**	**Hours/ Week**	**Annual Savings in dollars***	**Total Installed Cost**	**Payback (yrs)**
Transportation Bldg 7.3.1	2 Tube T12 (40W/tube)	8	2 Tube T8 (28W/tube)	8	40	$96	$576	6.0 yrs

* Annual savings is the amortized annual savings of the lighting upgrade based on the current electric rate of $0.15/kWh with 4% escalation annually.

8. INDIAN CHILD WELFARE ACT PROGRAM BUILDING

BUILDING DESCRIPTION

The Indian Child Welfare Act Program Building, or ICWAP Bldg, is located at the Moose Creek property next to the Transportation Bldg and the Language Bldg. The ICWAP Bldg is the smallest building in the audit at 280 sq ft. It is a single room structure with no bathroom.

HEATING OIL CONSUMPTION AND CO_2 EMISSIONS

The ICWAP Bldg shares a 500 gallon fuel tank with the Transportation Bldg. Refer to the Transportation Bldg section for the discussion of heating oil consumption and CO_2 emissions.

ELECTRICAL CONSUMPTION

The ICWAP Bldg is on the same meter as the Transportation Bldg and Language Bldg. Refer to the Language Building section for the discussion of electrical consumption.

8.1. RECOMMENDATIONS FOR BUILDING ENVELOPE

Building Insulation: The crawlspace and roof insulation for the ICWAP Bldg could not to be determined because they could not be accessed during the site visit. It is believed that these areas are under insulated.

ICWAP Building - Building Insulation		
Building Component	**R-Value and Description**	**BEES minimum standard**
Ceiling	The roof insulation of the bldg could not be accessed because no interior ceiling or exterior attic hatches could be found.	R-38/49 [a]
Exterior Frame Wall	2 x 4 exterior stud walls with fiberglass batt insulation (R-11).	R-20
Floor	The floor insulation could not be accessed because no interior floor hatches or exterior access hatches could be found.	R-30
Below Grade Wall	None found. Building is on blocks.	R-15/19 [b]
Windows	1) Double pane, vinyl frame, argon filled windows (R-3). 2) Double pane, wood frame, windows (R-2).	R-3

a, b. Refer to Building Insulation section in Energy Audit Methodology.

Air Leakage and Blower Door Test: The blower door test of the ICWAP Bldg shows that the bldg is quite leaky, which was unexpected based on the small size of the bldg. The test results show that the ICWAP bldg has more air leaks than the Transportation Bldg, even though the ICWAP Bldg is half the size. The blower door test was completed using the only exterior door of the building and the entire building was tested at once.

ICWAP Building - Blower Door Test and Air Leakage			
Building Area	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
H&SS Bldg	423 CFM	2,240 cu ft	11.3 ACH

Building Envelope Recommendations: It is recommended that a new office complex be built to house the functions of the ICWAP Bldg and the other out buildings on the site. In the interim, it is recommended that the ICWAP Bldg be properly air sealed.

Recommendations for Building Envelope				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
Air seal the following: 1) light fixtures in ceiling 2) window frame gaskets 3) electrical outlets and electrical breaker box, and 4) fuel line penetration Items were marked with blue tape during blower door test.	ICWAP Bldg 8.1.1	$100	$50	2 yrs
Air is leaking along the interface between the floor and the exterior walls, marked with blue tape during site visit. Seal this interface to stop air infiltration.	ICWAP Bldg 8.1.2	$200	$100	2 yrs
The weather-stripping on the existing exterior door is leaking air and in need of replacement. Replace weather-stripping on the door to ensure a proper air seal when door is closed.	ICWAP Bldg 8.1.3	$100	$50	2 yrs
Air seal window frames and add plastic membrane to interior side of window to reduce air leakage and heat loss.	ICWAP Bldg 8.1.4	$100	$50	2 yrs

8.2. Recommendations for Mechanical Equipment

Mechanical Equipment: The building uses one oil-fired, direct vent, Toyostove to heat its single room. Since there is no bathroom or kitchen in the building, no DHW units are needed. No improvements to mechanical equipment is recommended at this time.

ICWAP Building - Mechanical Equipment				
Unit	**Input (BTU/hr)**	**Output (BTU/hr)**	**Efficiency**	**Heating Loads**
Laser 30 Toyostove	N/A	N/A	87% AFUE	Space Heat

8.3. Recommendations for Lighting and Electrical appliances

The ICWAP Bldg uses four 100W incandescent light bulbs to light the building. It is recommended that each bulb be swapped with an equivalent light output CFL, such as a 24W CFL. The payback for this replacement is based on the lights in the building being used 30 hours per week.

ICWAP Building - Lighting Upgrades								
Improvement Number	**Existing Lights**	**Total Existing Fixtures**	**Replacement Lights**	**Total New Fixtures**	**Hours/ Week**	**Annual Savings in dollars***	**Total Installed Cost**	**Payback (yrs)**
ICWAP Bldg 8.3.1	100W Incandescent Lights	4	24W CFL with equivalent light output as existing	4	30	$71	$46	0.6 yrs

* Annual savings is the amortized annual savings of the lighting upgrade based on the current electric rate of $0.15/kWh with 4% escalation annually.

9. RESIDENTIAL RENTAL UNITS A, B, C, D, E & F

BUILDING DESCRIPTION

The CVTC owns six residential units that are rented to tenants. Unit A, Unit B and Unit C are single family buildings. Unit D, Unit E and Unit F are duplexes. The oldest of the buildings is Unit A (construction date is unknown) and was an existing building purchased by CVTC. The rest of the units were built by CVTC's in-house carpenters, with one building being built each year from 2000 to 2004.

Overall, the residential units built by CVTC (Units B, C, D, E & F) are well built with tight building envelopes and proper building insulation. However, Unit A is poorly insulated with a leaky building envelope making it a significant consumer of energy and a top priority for energy efficiency improvements.

HEATING OIL CONSUMPTION AND CO_2 EMISSIONS

Each tenant pays for their own heating oil. Each single family units has one 500 gal heating oil tank and each duplex has two 500 gal heating oil tanks, one for each unit within the duplex. Due to the fact that CVTC does not pay the heating oil bills for these buildings, the records are not easily obtainable and have not been available for review. Thus, the heating oil consumption and associated CO_2 emissions have not been tabulated for the residential units.

ELECTRICAL CONSUMPTION

Each tenant also pays for their own electrical power. Like the heating oil records, CVTC does not have access to the power bills of each unit because the records are not easily obtainable. Due to the fact that the records have not been available, the electricity consumption of each residential building has not been tabulated.

9.1. Recommendations for Building Envelope

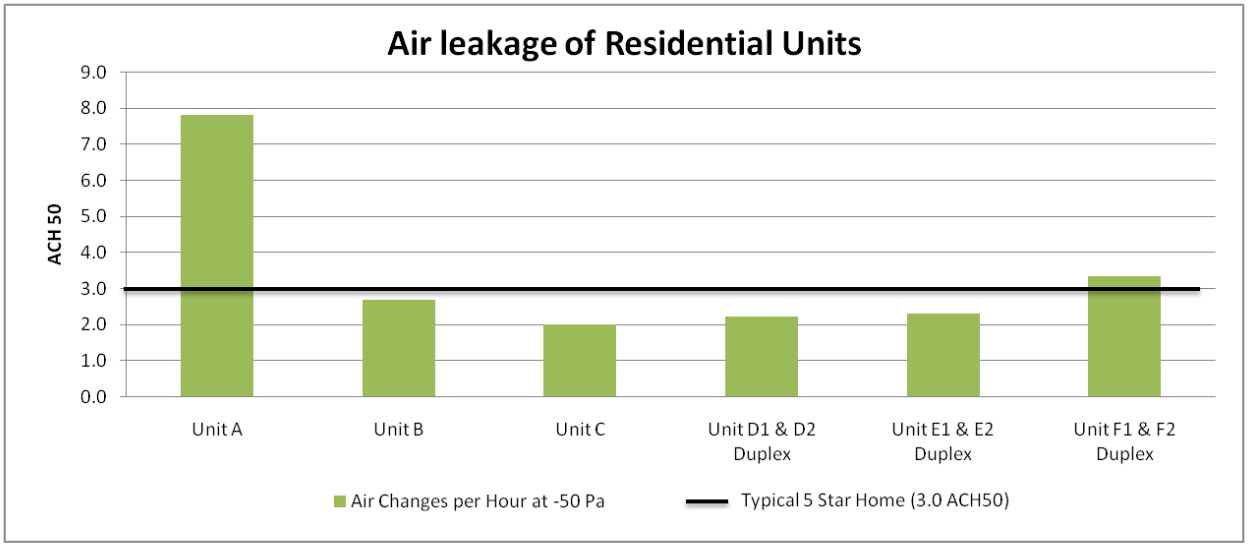
Building Insulation: The insulation of all of the residential units, except for Unit A, are generally the same because they were all built with the same type of construction by the same construction crew. These units meet most of the BEES minimum insulation standards and are well constructed. However, Unit A is significantly under insulated in the roof and crawlspace walls and requires energy efficiency improvements.

Building Component	Ceiling	Exterior Frame Wall	Floor	Below Grade Wall	Windows
Unit A	2" XPS rigid insulation in roof with limited amount of fiberglass batt insulation. (R-10)	2x4 construction, most likely 3.5" fiberglass batt insulation. (R-11)	Crawlspace floor has a well sealed vapor barrier with no insulation.	Crawlspace walls are exposed concrete with no insulation. Rim joists insulated with fiberglass batts.	1) Double pane wood frame windows. 2) Double pane vinyl frame windows.
Unit B	Blown in cellulose type insulation. (R-44)	2x6 construction with R-19 fiberglass batt insulation + siding + sheetrock. (R-20)	Crawlspace floor has a well sealed vapor barrier with no insulation.	Crawlspace walls are ICF[c]. Rim joists insulated with fiberglass batts. (R-20)	Double pane vinyl frame windows.
Unit C	Same as Unit B (R-44)	Same as Unit B (R-20)	Same as Unit B	Same as Unit B (R-20)	Same as Unit B
Unit D1 & D2 Duplex	Same as Unit B (R-44)	Same as Unit B (R-20)	Same as Unit B	Same as Unit B (R-20)	Same as Unit B
Unit E1 & E2 Duplex	Same as Unit B (R-44)	Same as Unit B (R-20)	Same as Unit B	Same as Unit B (R-20)	Same as Unit B
Unit F1 & F2 Duplex	Same as Unit B (R-44)	Same as Unit B (R-20)	Same as Unit B	Same as Unit B (R-20)	Same as Unit B
BEES minimum standard	R-38/49 [a]	R-20	R-30	R-15/19 [b]	R-3

a, b. Refer to Building Insulation section in Energy Audit Methodology.
c. ICF = Insulated Concrete Form with 2" of XPS on each face with 6" concrete in the middle (R-20).

Air Leakage and Blower Door Test: Overall, the residential units built by CVTC (Units B, C, D, E & F) are very well sealed, as can be seen from the air leakage graph and table below. A typical 5 Star home has 3 ACH50, which all of the units are better than, except for Unit A and Unit F. Unit B and Unit C are the only two buildings that utilize a Heat Recovery Ventilator (HRV). Because Unit D, E and F have tight building envelopes, installing HRVs may be needed if tenants experience poor air quality or moisture problems.

As is expected, the air leakage in Unit A is significant and many air sealing improvements are necessary.



The blower door test for the single family buildings was completed on the front door of the unit. The blower door test for the duplexes required two blower door tests, with each side of the duplex being tested separately. In the table below, the test results for each side of the duplex are shown and are added together to obtain the total CFM50 for the entire duplex.

Residential Units - Blower Door Test and Air Leakage			
Residential Unit	**Air Leakage @ - 50 Pa**	**Estimated Bldg Volume**	**Air Changes per Hour @ - 50 PA**
Unit A	900 CFM	6,912 cu ft	7.8 ACH
Unit B	402 CFM	8,960 cu ft	2.7 ACH
Unit C	300 CFM	8,960 cu ft	2.0 ACH
Unit D1 & D2 Duplex	173 + 257 = 430 CFM	11,648 cu ft	2.2 ACH
Unit E1 & E2 Duplex	263 + 267 = 530 CFM	13,824 cu ft	2.3 ACH
Unit F1 & F2 Duplex	444 + 362 = 806 CFM	14,432 cu ft	3.4 ACH

Building Envelope Recommendations: Out of all the residential units, Unit A was determined to have the most need for building envelope improvements. The rest of the residential buildings do not require significant building envelope improvements at this time. The major improvements for Unit A involve adding additional insulation to the roof and crawlspace walls, along with air sealing.

Recommendations for Building Envelope				
Description of Capital Investment	**Improvement Number**	**Installed Cost**	**Annual Savings**	**Payback**
The following sources of air leakage were found in Unit A: 1) No outside air damper on bathroom fan, 2) Attic hatch seal, 3) Hole associated with clothes washer plumbing, 4) Window frame in back room, 5) Penetrations under the kitchen sink leading to the crawlspace. All items were marked with blue tape during the blower door test. Install a new damper to the bathroom fan and air seal the items above.	Unit A 9.1.1	$400	$200	2 yrs
Install blown in cellulose insulation in the roof of Unit A to obtain R-38 minimum.	Unit A 9.1.2	$2,160	$472	4.6 yrs
Install 4" of XPS rigid insulation (R-20) to interior side of crawlspace wall of Unit A.	Unit A 9.1.3	$2,400	$366	6.6 yrs

9.2. Recommendations for Mechanical Equipment

Mechanical Equipment: All of the residential units use an oil fired toyostove for space heat and an electric boiler to provide DHW. Currently, Unit B and Unit C are the only units with HRVs, made by Venmar AVS (Solo model).

Mechanical Equipment	Space Heater	Heat Recovery Ventilator (HRV)	Domestic Hot Water	Stove	Refrigerator
Unit A	Laser 73 Oil-fired Toyostove	None	Electric	Electric	Electric
Unit B	Laser 73 Oil-fired Toyostove	HRV in crawlspace	Electric	Electric	Electric
Unit C	Laser 73 Oil-fired Toyostove	HRV in crawlspace	Electric	Electric	Electric
Unit D1 & D2 Duplex	Laser 56 Oil-fired Toyostove in each unit	None	Electric	Electric	Electric
Unit E1 & E2 Duplex	Laser 56 Oil-fired Toyostove in each unit	None	Electric	Electric	Electric
Unit F1 & F2 Duplex	Laser 56 Oil-fired Toyostove in each unit	None	Electric	Electric	Electric

Mechanical System Recommendations: Due to the fact that Unit D, E and F are fairly tight buildings without any HRV systems, the tenants in these units may or may not have poor air quality issues. If tenants do experience moisture or poor air quality problems, it is recommended that an HRV be installed for the unit. The HRV will allow heat from exhaust air to be recovered in the fresh air intake. The HRV will provide adequate fresh outside air and dehumidify the living space. All though this is not a significant energy saving measure, it is a proper air quality and health measure, if needed.

9.3. Recommendations for Lighting and Electrical Appliances

Overall, most of the residential units use some incandescent lights and some new energy efficient CFLs. It is recommended that the old incandescent lights be replaced with new CFLs. Unit A, B and C each have one 4 tube T12 fixture in their kitchen. It is recommended that the T12 fixtures be replaced with new energy efficient T8 fixtures with electronic ballasts.

Unit A, B & C - Lighting Upgrades								
Improvement Number	**Existing Lights**	**Total Existing Fixtures**	**Replacement Lights**	**Total New Fixtures**	**Hours/ Week**	**Annual Savings in dollars***	**Total Installed Cost**	**Payback (yrs)**
One fixture in Unit A, B & C 9.3.1	4 tube T12 (40W/tube)	3	3 tube T8 (28W/tube)	3	40	$87	$387	4.4 yrs

* Annual savings is the amortized annual savings of the lighting upgrade based on the current electric rate of $0.15/kWh with 4% escalation annually.

RENEWABLE ENERGY ASSESSMENT

In recent years, CVTC has been committed to using renewable energy systems. CVTC already has a large 2,250 W, grid-tied, tracking solar PV array installed next to the Language Bldg. Additionally, CVTC utilizes three 175W Solar PV panels and one Southwest Wind Power 1kW Whisper 200 wind turbine at their Greenhouse. During the site visit additional possibilities of utilizing renewable energy systems were identified and evaluated.

For the renewable energy assessment, five different possibilities were evaluated. The following report contains the details to the five possibilities.

1. Wood Heating System for the Shop Building (Option 1)
2. Combined Wood Heating and Solar Thermal System for the Shop Building (Option 2)
3. Solar PV for the Shop Building
4. Solar PV for the H&SS Building
5. Wind Resource Data Monitoring through the AEA Anemometer Loan Program

Overall, it was determined that either a Wood Heating System (Option 1) or a combined Wood Heating and Solar Thermal System (Option 2) would be a cost effective renewable energy project for the Shop Building. A conceptual design for Option 2 was created and two drawing sheets are attached it the end of the report.

The Solar PV systems for the Shop Bldg and H&SS building were not found to be cost effective at this time due to the high cost of solar PV and relatively low electricity prices.

Currently, the CVTC does not have adequate wind data for an economic analysis of a larger wind turbine system. The next step should be installing a meteorological tower, or MET Tower, to measure wind speeds at 30m. There is an Alaska Energy Authority (AEA) program that loans these MET towers to qualifying communities. Refer to this section in the report to sign up for the program.

DATA MONITORING EXISTING RENEWABLE ENERGY SYSTEMS

During the site visit it was determined that none of the CVTC's existing renewable energy systems are being data monitored. This is unfortunate because it makes it nearly impossible to determine how well the solar PV and wind systems are performing and how much energy they are producing.

It is recommended that all of CVTC's solar PV systems and wind turbine be data logged so that their performance can be recorded and visualized. The village can use this data to show how much energy their systems are producing. It would also be a great way to show potential granting agencies how the village is actually performing when it comes to renewable energy.

Many of the current data logging units on the market allow data to be wirelessly uploaded to the internet for easy access.

WOOD & SOLAR THERMAL SYSTEM - SHOP BLDG

OVERVIEW

Of all the CVTC buildings, the Shop Bldg has by far the best solar exposure, and the greatest annual heating load. The long southern face of the Shop faces due south with an un-interrupted view of the low mountains ahead. The Shop also has a radiant concrete floor on the ground floor, which is a great asset for either solar thermal or wood heating due to the fact that radiant floors require lower supply temps (100F) as opposed to baseboard registers (140F). Finally, the Shop Bldg is used consistently by CVTC for office space for the Environmental Department and storage/shop space for bldg maintenance. Annually the Shop consumes an average of 1,818 gallons of heating oil annually ($5,545 @ $3.05/gal).

Due to these facts, the Shop would be a suitable place for successful wood heating and solar thermal heating systems, that would provide space heat to the building. Two options were evaluated in this report, each of which could displace all heating oil used at the building:

- **Option 1 - Wood Boiler System**
- **Option 2 - Combined Wood Boiler + Solar Thermal System**

Option 1- Wood Boiler System: This option includes the installation of one Garn WHS 2000, wood heating system. The Garn WHS (Wood Heating System) was selected because Garn is a reputable manufacturer of high efficiency cord wood boilers and many Garn boilers are currently in operation in Alaska with successful track records. Additionally, cord wood is readily available in the local Sutton area and can be either purchased from local providers or harvested by CVTC. The Garn WHS 2000 utilizes a built-in 1,825 gal water storage tank, so that wood can be burned in batches at high temperatures and a large quantity of heat can be stored in the storage tank for use throughout the day. This allows the Garn units to burn cord wood at an efficiency of 80% or better. This option could displace all of the heating oil used by the building if cord wood were burned to meet all heating loads. It is estimated that this option would require 14.3 cords of birch annually. At the current delivered cord wood price of $250/cord in Sutton, this wood fuel would have an annual cost of $3,575.

Option 2- Combined Wood Boiler + Solar Thermal System: Option 2 is an extension of Option 1, with the addition of an 8 panel array of solar thermal panels. The solar thermal panels would collect solar energy and transfer the heat into a closed glycol loop (50% propylene glycol). The glycol loop would transfer solar heat to the Garn WHS 2000's 1,825 gal water tank with a flat plate heat exchanger. This process allows solar energy to be collected by the solar thermal panels and stored in the Garn's water tank to be used for building heat. This option uses solar energy to offset a portion of the wood burn in the summer and shoulder seasons, reducing the annual wood demand. In recent years, combined wood and solar thermal systems have proven successful in Alaska. The Ionia Community in Kasilof, AK has been using a combined system since 2009 for heating their community buildings. It is estimated that Option 2 would require 11.9 cords of birch annually ($2,971 annual cost at $250/cord).

ECONOMIC EVALUATION OF OPTION 1 & OPTION 2

At 30 year Net Present Worth economic analysis for both options was completed using the current price of heating oil at $3.05/gal, escalating at 8% annually, and the current price of electricity at $0.15/kWh, escalating at 4% annually. A 2% discount rate was used for the time value of money. The evaluation assumes that the $250/cord wood price includes delivery to a storage area inside the shop building. CVTC staff would then move this wood into the wood boiler room and load and fire 90 lb batches of birch and/or spruce cord wood in the boiler. The recommended wood length for the Garn WHS 2000 is 24" to 32".

The evaluation also assumes that CVTC can internalize and use the available 30% Federal tax credit for the solar thermal system and a $1,500 Federal tax credit for the wood boiler system. The 30% tax credit can be applied only to the total installed cost of the solar thermal system.

Economic Analysis	Option 1	Option 2
Shop Building Project	**Wood Boiler System**	**Combined Wood Boiler & Solar Thermal System**
Estimated Project Cost	$36,673	$67,111
Federal Tax Credit for Wood and Solar	$1,500	$10,631
Net Project Cost with Tax Credit	$35,173	$56,480
Annual Heating Oil Savings from Wood Boiler	1,818 gal	1,511 gal
Annual Heating Oil Savings from Solar Thermal	0 gal	307 gal
Annual Heating Oil Savings	1,818 gal	1,818 gal
Annual Heating Oil Savings @ $3.05/gal	$5,545	$5,545
Annual Cord Wood Consumption (Birch)	14.3 cords	11.9 cords
Annual Cord Wood Delivered Cost @ $250/cord	$3,575	$2,971
Annual O&M Costs	$188	$332
30 yr Net Present Worth	$237,930	$235,709
Payback	10.8 yrs	13.2 yrs

The economic analysis shows that both options will payback in less than 14 years; Option 1 in 10.8 years and Option 2 in 13.2 years. The 30 yr Net Present Worth of both options is very close, with Option 1 having the higher value. Due to the fact that the payback is low on both options, either option would be cost effective.

Although the combined wood and solar thermal system (Option 2) has a slightly longer payback than the wood heating system only (Option 2), it may be the more attractive option if carbon emissions and labor to fire the wood boiler are considered. By harnessing additional solar energy with the solar thermal system and using it for space heating, the Shop Bldg would require less cord wood throughout the year, approximately 2.4 cords of birch saved annually. This means that CVTC would burn less wood and thus reduce carbon emissions. Additionally, burning less wood means that less labor by CVTC staff would be needed to load and fire the wood boiler, especially in summer months when the solar resource is greatest. Finally, because the escalation rate of cord wood prices is unknown in the future, using less wood will result in a smaller economic impact if cord wood prices escalate rapidly.

It is estimated that the solar thermal system in Option 2 will produce 17% of the Shop's heating requirement throughout the year. The rest would be supplied by the wood boiler.

Option 2 - Combined Wood And Solar Thermal System	Million BTUs	Heat Fraction
Annual Heat Produced by Solar	33	17%
Annual Heat Produced by Wood	162	83%
Annual Heating Load of Shop Bldg	195	100%

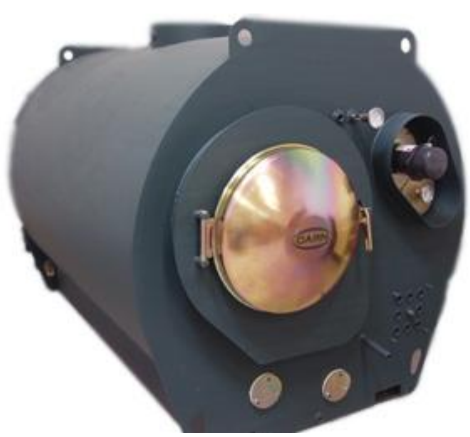
COST OF OPTION 1 & OPTION 2

The cost estimates for both options was based on price quotes from Alaska Heat Technologies (the GARN rep in Alaska) and from Heliodyne (solar thermal equipment supplier). The labor cost for installing the options was estimated to be 20% of total material costs. A 10% contingency on installation and material costs was also included.

The costs for the Wood Heating System only is shown below.

Wood Heating System Costs for Option 1 and Option 2 Item Description	Quantity	Unit	Material Unit Cost	Material Total Cost
WHS 2000V Garn Wood Boiler	1	each	$15,695	$15,695.00
WHS-IVF18 (6"x18 Internal Vertical Flue)	1	each	$650	$650.00
Chemical Water Treatment Kit	1	each	$295	$295.00
Enclosed Building Space	1	LS	$2,000	$2,000.00
1" copper pipe from Garn to Heating Loads	210	Lin Ft	$3.00	$630.00
1" pipe insulation	211	Lin Ft	$2.50	$527.50
Valve And Fitting Allowance	1	LS	$1,000	$1,000.00
Heat Exchanger	1	each	$4,000	$4,000
Shipping to Sutton, AK	1	LS	$2,985	$2,985.00
Total For Materials				$27,782.50
Installation at 20% of material cost				$5,557
10% Contingency				$3,334
Total investment of project				$36,673
Federal Tax Credit (Capped at $1,500 Maximum)				$1,500
Net Investment for wood				$35,173

A typical Garn WHS wood boiler is shown below.



The additional cost of the solar thermal system included in Option 2 is shown below. For the system components supplied by Heliodyne (excluding solar collectors) a 3% mark up on materials was added for 2011 prices. Heliodyne's prices for all components, except their solar collectors, will be marked up 3% next year, according to Heliodyne's marketing personnel.

Additional Solar Thermal System Costs for Option 2 Item Description	Quantity	Unit	2011 Mark up	2010 Material Unit Cost	Material Total Cost
Gobi 410-001	8	Each	0%	$1,359.00	$10,872.00
DYN-O-SEAL Unions	16	Each	3%	$25.00	$412.00
DYN-O-SEAL Combo Fitting (includes temp well and sensor)	1	Each	3%	$61.00	$62.83
Air Vent Kit	1	Each	3%	$28.00	$28.84
1" type L Copper	74	lin ft	0%	$3.00	$222.00
1" inside insulation	70	lin ft	0%	$2.50	$175.00
2" outside insulation + aluminum jacketing	4	lin ft	0%	$15.00	$60.00
Insulated Union between collectors with Aluminum Jacketing	14	Each	0%	$20.00	$280.00
Rail 002 000B	4	Each	3%	$204.00	$840.48
Rail 000 001	3	Each	3%	$42.00	$129.78
FLSH 000 000	9	Each	3%	$40.00	$370.80
Rack System To Wall Mount Collectors	1	LS	0%	$2,000.00	$2,000.00
Controller, Pumps, Pressure Gauge, and Valve Allowance	1	Each	3%	$2,300.00	$2,369.00
Single Wall Flat Plate HX	1	Each	3%	$3,000.00	$3,090.00
EXPT 005 000 (5 gal tank)	1	Each	3%	$123.00	$126.69
Wall Mount Bracket for Tank	1	Each	3%	$25.00	$25.75
Dyn-o-flow high temp Glycol (1 gallon)	9	Each	3%	$49.00	$454.23
Sensor wire (100ft)	1	Each	3%	$41.00	$42.23
FLOS 053 000 (Flow Sensor	1	Each	3%	$284.00	$292.52
Mixing Valve	1	Each	3%	$199.00	$204.97
Shipping	1	LS	0%	$1,000.00	$1,000.00
Total For Materials					$23,059.12
Installation at 20% of material cost					$4,611.82
10% Contingency					$2,767.09
Total investment of project					$30,438.04
Net Investment After 30% Federal Tax Credit					$21,306.63

CONCEPTUAL DESIGN

A conceptual design was created for the combined wood heating and solar thermal system (Option 2). The system costs and economics are based off of this design. A Conceptual Piping Schematic (G1.0) and a Conceptual Architectural Integration Plan (G2.0) were created and are attached in 11x17 format to the end of this report.

The design calls for the Garn WHS 2000 to be located in a wood boiler room inside the Shop Bldg. The wood boiler room would be made of metal studs and 5/8" drywall fire barrier, for fire protection, and located near the south side of the Shop's floor so piping can easily connect to the solar thermal system. The room would also have fire rated double doors, which can be opened for easy wood loading. Inside the wood boiler room would also be the solar thermal and wood controls, loop pumps and heat exchangers. Additionally, a minimum of 12" thick fiberglass batt insulation (R-38) would surround the wood boiler water tank to limit unwanted heat loss. The wood boiler would be placed on top of a insulated floor which includes a minimum of 4" thick rigid extruded polystyrene (blue board) insulation (R-20). Across from the double doors of the wood boiler room is the cord wood storage area. Cord wood can be conveniently stored in this location and be easily carried by CVTC staff through the double doors to load the nearby wood boiler.

An array of eight Heliodyne GOBI 410 solar thermal panels would be mounted to a structural aluminum rack on the south face of the Shop Building. The rack would have a snow visor (overhead roof) above the panels to keep snow and frost off the upper face of the panels. The underside of the visor has a 18" wide reflective surface used to increase solar gain of the collectors in the winter and shoulder seasons. The structural rack would hold the solar thermal panels so that the bottom of the panel would be approximately 6' above grade. Parking timber stops will ensure that vehicles will not back into the array. A collector loop, filled with 50% propylene glycol and 50% water for freeze protection, would transfer heat from the solar thermal array to a small flat plate heat exchanger located in the wood boiler room that would deliver solar heat to the Garn wood boiler's water tank.

The Garn wood boiler would also be connected to a separate large flat plate heat exchanger that would transfer heat into a pressurized water filled pipe loop that would deliver heat to the existing baseboard, radiant floor, and DHW heating loads. In this design the existing Weil McClain oil boiler is connected in parallel to the new wood/solar system as a backup and alternate heating source as needed.

Refer to the two conceptual design drawings at the end of the report for more information:

- Conceptual Piping Schematic (G1.0)
- Conceptual Architectural Integration Plan (G2.0)

[INSERT CONCEPTUAL PIPING SCHEMATIC (G1.0) HERE.]

[INSERT CONCEPTUAL ARCHITECTURAL INTEGRATION PLAN (G2.0) HERE.]

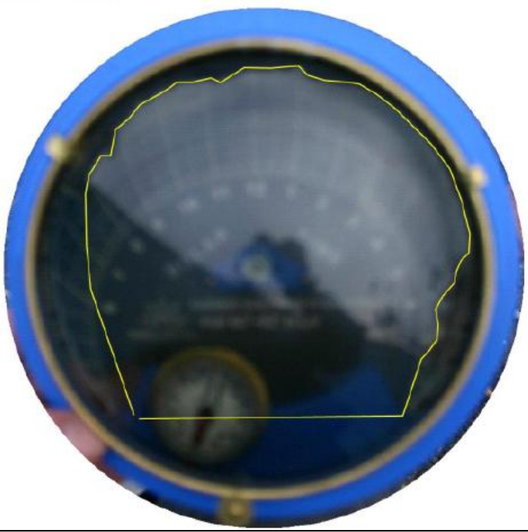
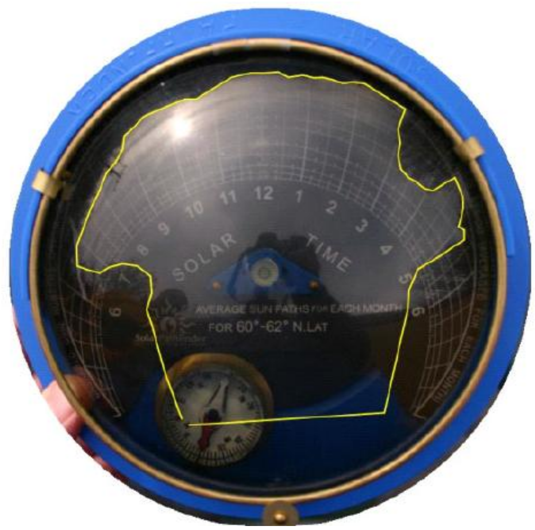
SOLAR PV - SHOP AND H&SS BUILDINGS

A solar PV or solar photovoltaic system was evaluated for both the Shop Bldg and H&SS Bldg, which would produce electricity from the sun's energy. Each grid-tied, PV system was based on an array of eight Sharp 230W PV panels with a total installed system cost estimated at $8 per Watt.

Unfortunately, the economics for grid tied PV systems in south-central Alaska are less than attractive at the moment. Due to relatively low electricity costs of $0.15/kWh and high installation costs of $8/Watt, both PV systems have paybacks of over 40 years. Additionally, the standard warranty for PV panels is limited to 25 years. Due to these facts, solar PV is not recommended at this time.

However, due to the consistent trend of increasing electricity prices and decreasing solar PV prices, there will be a time in the future when Solar PV for the Shop Bldg and H&SS Bldg will be cost effective. For example, when electricity prices reach $0.20/kWh, a grid-tied Solar PV system will have a 20 yr payback with a total installed price of $4 per Watt.

The 30 yr Net Present Worth economic analysis for Solar PV, along with the Solar Pathfinder images for the Shop Bldg and H&SS Bldg are shown below.

Solar Pathfinder - Shop Bldg	Solar Pathfinder - H&SS Bldg
	

Solar PV System	Shop Bldg	H&SS Bldg
Estimated Project Cost	$14,720	$14,720
30% Federal Tax Credit for Solar PV	$4,416	$4,416
Net Project Cost with Tax Credit	$10,304	$10,304
PV Panel	Sharp NU-U230F3	Sharp NU-U230F3
Number of Panels	8	8
Total Power Output @ 230W/panel (Watts)	1,840	1,840
Annual Electricity Savings (kWh)	1,358	1,253
Annual Electricity Savings @ $0.15/kWh	$204	$188
Annual O&M Costs	$50	$50
30 yr Net Present Worth	-$3,752	-$4,374
Payback (yrs)	41	44

ALASKA ENERGY AUTHORITY ANEMOMETER LOAN PROGRAM

Due to the fact that adequate wind speed and direction data is currently not available for Sutton, it is difficult to complete an accurate economic evaluation for new wind power systems. In order to collect the proper data, a 30m meteorological tower (MET) is needed that has two anemometers at 30m, one anemometer at 20m and one wind vane for measuring wind speeds and directions. CVTC may be eligible to obtain by loan such a MET Tower from the Alaska Energy Authority (AEA).

AEA administers the Anemometer Loan Program, which allows approved communities to monitor their wind resource with a 30 meter MET tower for up to 18 months. The program is currently not funded, according to the program manager James Jensen (771-3043). However, Jensen anticipates that funding for the program will begin next summer, allowing the program to start again in the summer of 2011. All documents required for the Anemometer Loan Program can be accessed on AEA's website: www.akenergyauthority.org/programwindanemometerloan.html.

In order to apply for the program, CVTC must:

1. Call or email James Jensen, Program Manager, to express interest. (jjensen@aidea.org) (907- 771-3043)

2. Complete the "Wind Energy Resource Assessment Program Statement of Interest" and either fax (907-771-3044) or email to James Jensen. The form can be accessed through AEA's website above.

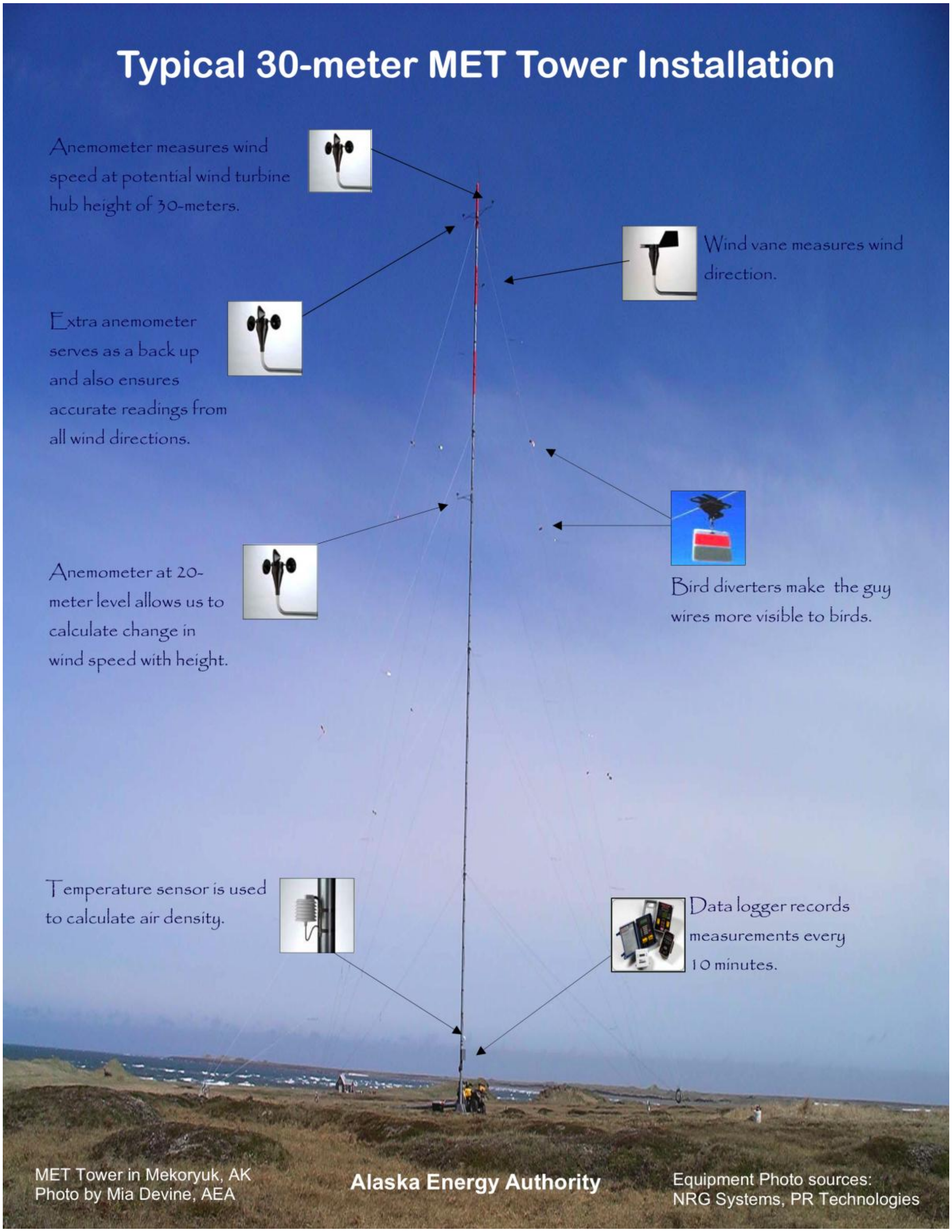
In order for AEA to approve CVTC in the program, this statement of interest should have the project clearly explained and have the support from the FAA and USFWS, to make it as easy as possible for AEA to review. CVTC will be competing against other potential applicants to obtain a limited number of MET towers. The FAA requires the submittal of FAA Form 7460-1, also attached to the report, and a map showing the exact location of the tower. The USFWS requires a map showing the tower location, a brief explanation of the project and site, and potential benefits to the community. James Jenson will guide the CVTC through the correct forms to submit to the FAA and USFWS.

If AEA approves CVTC for the program, then a Memorandum of Agreement will be signed.

It is recommended that the CVTC contact James Jenson and submit the Wind Energy Resource Assessment Statement of Interest to AEA before the end of 2010. With 12 to 18 months of wind data, a proper wind power economic analysis can be completed for the site. The CVTC can use this economic analysis to properly plan for a wind turbine or turbines for their site. It is anticipated that the MET Tower would be placed on the CVTC property near the Greenhouse, Admin Bldg and Shop Bldg. The MET Tower would have adequate clearances so that, if damaged, the tower would not fall on any buildings or power lines.

The MET tower that would most likely be used by CVTC is the tower currently in use at the Ionia Community in Kasilof. This is the only MET tower in use on the rail belt, according to Jensen. Once funding for the AEA program resumes, the program would pay for the dismantling, shipment and set up of the MET tower on CVTC property.

It is AEA policy that all wind data from the MET tower is public. In the unanticipated circumstance that the MET tower is not properly cared for or data logged, the AEA does have the authority to remove the tower. The typical AEA 30 meter MET tower is shown below.


Typical 30-meter MET Tower Installation
Anemometer measures wind speed at potential wind turbine hub height of 30-meters.
Wind vane measures wind direction.
Extra anemometer serves as a back up and also ensures accurate readings from all wind directions.
Anemometer at 20-meter level allows us to calculate change in wind speed with height.
Bird diverters make the guy wires more visible to birds.
Temperature sensor is used to calculate air density.
Data logger records measurements every 10 minutes.
MET Tower in Mekoryuk, AK
Photo by Mia Devine, AEA
Alaska Energy Authority
Equipment Photo sources:
NRG Systems, PR Technologies

Appendix B

Energy Efficiency Upgrade Cost Assessment

CVTC Tribal Buildings Energy Efficiency Cost Analysis

Building	Air Leak Test Rating	Building Envelope Estimated Cost	Estimated Annual Savings	Payback	Mechanical Estimated Cost	Estimated Annual Savings	Payback	Electrical Estimated Cost	Estimated Annual Savings	Payback	Total Estimated Cost	Total Estimated Annual Savings	Payback
Shop & ESD Offices	3.6	$ 29,080.00	$ 2,767.00	10.5	$ 1,805.00	$ 75.00	24.1	$ 7,085.00	$1,256.00	5.6	$ 37,970.00	$ 4,098.00	9.3
Administrative/Accounting	4.6	$ 4,750.00	$ 1,150.00	4.1	$ -	$ -		$ -	$ -		$ 4,750.00	$ 1,150.00	4.1
Greenhouse	22.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -	
Health & Social Services	5.7	$ 7,300.00	$ 1,160.00	6.3	$ -	$ -		$ 1,008.00	$ 168.00	6.0	$ 8,308.00	$ 1,328.00	6.3
Ya Ne Dah Ah School	4.4/0.9	$ 11,100.00	$ 1,350.00	8.2	$ -	$ -		$ -	$ -		$ 11,100.00	$ 1,350.00	8.2
Ahtna Language Building	13.7	$ 1,800.00	$ 800.00	2.3	$ -	$ -		$ -	$ -		$ 1,800.00	$ 800.00	2.3
Transportation	4.9	$ 300.00	$ 150.00	2.0	$ -	$ -		$ 576.00	$ 96.00	6.0	$ 876.00	$ 246.00	3.6
ICWA	11.3	$ 500.00	$ 250.00	2.0	$ -	$ -		$ 46.00	$ 71.00	0.6	$ 546.00	$ 321.00	1.7
Rental Housing	Varies	$ 4,960.00	$ 1,083.00	4.6	$ -	$ -		$ 387.00	$ 87.00	4.4	$ 5,347.00	$ 1,170.00	4.6
Totals		**$ 59,790.00**	**$ 8,710.00**	**6.9**	**$ 1,805.00**	**$ 75.00**	**24.1**	**$ 9,102.00**	**$1,678.00**	**5.4**	**$ 70,697.00**	**$ 10,463.00**	**6.8**

2012 Adjusted

Shop & ESD Offices	3.6	$ 8,580.00	$ 1,183.29	7.3	$ 705.00	$ 75.00	9.4	$ 7,085.00	$1,256.00	5.6	$ 16,370.00	$ 2,514.29	6.5
Administrative/Accounting	4.6	$ 4,750.00	$ 1,530.82	3.1	$ -	$ -		$ -	$ -		$ 4,750.00	$ 1,530.82	3.1
Greenhouse	22.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -	
Health & Social Services	5.7	$ 7,300.00	$ 1,544.13	4.7	$ -	$ -		$ 1,008.00	$ 168.00	6.0	$ 8,308.00	$ 1,712.13	4.9
Ya Ne Dah Ah School	4.4/0.9	$ 11,100.00	$ 1,797.05	6.2	$ -	$ -		$ -	$ -		$ 11,100.00	$ 1,797.05	6.2
Ahtna Language Building	13.7	$ 1,800.00	$ 1,064.92	1.7	$ -	$ -		$ -	$ -		$ 1,800.00	$ 1,064.92	1.7
Transportation	4.9	$ 300.00	$ 199.67	1.5	$ -	$ -		$ 576.00	$ 96.00	6.0	$ 876.00	$ 295.67	3.0
ICWA	11.3	$ 500.00	$ 332.79	1.5	$ -	$ -		$ 46.00	$ 71.00	0.6	$ 546.00	$ 403.79	1.4
Totals		**$ 34,330.00**	**$ 7,652.66**	**4.5**	**$ 705.00**	**$ 75.00**	**9.4**	**$ 8,715.00**	**$1,591.00**	**5.5**	**$ 43,750.00**	**$ 9,318.66**	**4.7**

Shop & ESD Offices	3.6	$ 8,580.00	$ 1,183.29	7.3	$ 705.00	$ 75.00	9.4	$ 7,085.00	$1,256.00	5.6	$ 16,370.00	$ 2,514.29	6.5
Health & Social Services	5.7	$ 7,300.00	$ 1,544.13	4.7	$ -	$ -		$ 1,008.00	$ 168.00	6.0	$ 8,308.00	$ 1,712.13	4.9
Ya Ne Dah Ah School	4.4/0.9	$ 11,100.00	$ 1,797.05	6.2	$ -	$ -		$ -	$ -		$ 11,100.00	$ 1,797.05	6.2
Totals		**$ 26,980.00**	**$ 4,524.47**	**6.0**	**$ 705.00**	**$ 75.00**	**9.4**	**$ 8,093.00**	**$1,424.00**	**5.7**	**$ 35,778.00**	**$ 6,023.47**	**5.9**

Administrative/Accounting	4.6	$ 4,750.00	$ 1,064.92	4.5	$ -	$ -		$ -	$ -		$ 4,750.00	$ 1,064.92	4.5
Ahtna Language Building	13.7	$ 1,800.00	$ 800.00	2.3	$ -	$ -		$ -	$ -		$ 1,800.00	$ 800.00	2.3
Transportation	4.9	$ 300.00	$ 199.67	1.5	$ -	$ -		$ 576.00	$ 96.00	6.0	$ 876.00	$ 295.67	3.0
ICWA	11.3	$ 500.00	$ 332.79	1.5	$ -	$ -		$ 46.00	$ 71.00	0.6	$ 546.00	$ 403.79	1.4
Totals		**$ 7,350.00**	**$ 1,332.46**	**5.5**	**$ -**	**$ -**	**0.0**	**$ 622.00**	**$ 167.00**	**3.7**	**$ 7,972.00**	**$ 1,499.46**	**5.3**

CVTC Energy Efficiency Cost Analysis of Tribal Buildings

Building	Air Leak Test Rating	Building Envelope Estimated Cost	Estimated Annual Savings	Payback	Mechanical Estimated Cost	Estimated Annual Savings	Payback	Electrical Estimated Cost	Estimated Annual Savings	Payback	Total Estimated Cost	Total Estimated Annual Savings	Payback
Shop & ESD Offices	3.6	$ 29,080.00	$ 2,767.00	10.5	$ 1,805.00	$ 75.00	24.1	$ 7,085.00	$1,256.00	5.6	$ 37,970.00	$ 4,098.00	9.3
Administrative/Accounting	4.6	$ 4,750.00	$ 1,150.00	4.1	$ -	$ -		$ -	$ -		$ 4,750.00	$ 1,150.00	4.1
Greenhouse	22.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -	
Health & Social Services	5.7	$ 7,300.00	$ 1,160.00	6.3	$ -	$ -		$ 1,008.00	$ 168.00	6.0	$ 8,308.00	$ 1,328.00	6.3
Ya Ne Dah Ah School	4.4/0.9	$ 11,100.00	$ 1,350.00	8.2	$ -	$ -		$ -	$ -		$ 11,100.00	$ 1,350.00	8.2
Ahtna Language Building	13.7	$ 1,800.00	$ 800.00	2.3	$ -	$ -		$ -	$ -		$ 1,800.00	$ 800.00	2.3
Transportation	4.9	$ 300.00	$ 150.00	2.0	$ -	$ -		$ 576.00	$ 96.00	6.0	$ 876.00	$ 246.00	3.6
ICWA	11.3	$ 500.00	$ 250.00	2.0	$ -	$ -		$ 46.00	$ 71.00	0.6	$ 546.00	$ 321.00	1.7
Rental Housing	Varies	$ 4,960.00	$ 1,083.00	4.6	$ -	$ -		$ 387.00	$ 87.00	4.4	$ 5,347.00	$ 1,170.00	4.6
Totals		**$ 59,790.00**	**$ 8,710.00**	**6.9**	**$ 1,805.00**	**$ 75.00**	**24.1**	**$ 9,102.00**	**$1,678.00**	**5.4**	**$ 70,697.00**	**$ 10,463.00**	**6.8**

2012 Adjusted

Shop & ESD Offices	3.6	$ 8,580.00	$ 1,183.29	7.3	$ 705.00	$ 75.00	9.4	$ 7,085.00	$1,256.00	5.6	$ 16,370.00	$ 2,514.29	6.5
Administrative/Accounting	4.6	$ 4,750.00	$ 1,530.82	3.1	$ -	$ -		$ -	$ -		$ 4,750.00	$ 1,530.82	3.1
Greenhouse	22.1	$ -	$ -		$ -	$ -		$ -	$ -		$ -	$ -	
Health & Social Services	5.7	$ 7,300.00	$ 1,544.13	4.7	$ -	$ -		$ 1,008.00	$ 168.00	6.0	$ 8,308.00	$ 1,712.13	4.9
Ya Ne Dah Ah School	4.4/0.9	$ 11,100.00	$ 1,797.05	6.2	$ -	$ -		$ -	$ -		$ 11,100.00	$ 1,797.05	6.2
Ahtna Language Building	13.7	$ 1,800.00	$ 1,064.92	1.7	$ -	$ -		$ -	$ -		$ 1,800.00	$ 1,064.92	1.7
Transportation	4.9	$ 300.00	$ 199.67	1.5	$ -	$ -		$ 576.00	$ 96.00	6.0	$ 876.00	$ 295.67	3.0
ICWA	11.3	$ 500.00	$ 332.79	1.5	$ -	$ -		$ 46.00	$ 71.00	0.6	$ 546.00	$ 403.79	1.4
Totals		**$ 34,330.00**	**$ 7,652.66**	**4.5**	**$ 705.00**	**$ 75.00**	**9.4**	**$ 8,715.00**	**$1,591.00**	**5.5**	**$ 43,750.00**	**$ 9,318.66**	**4.7**

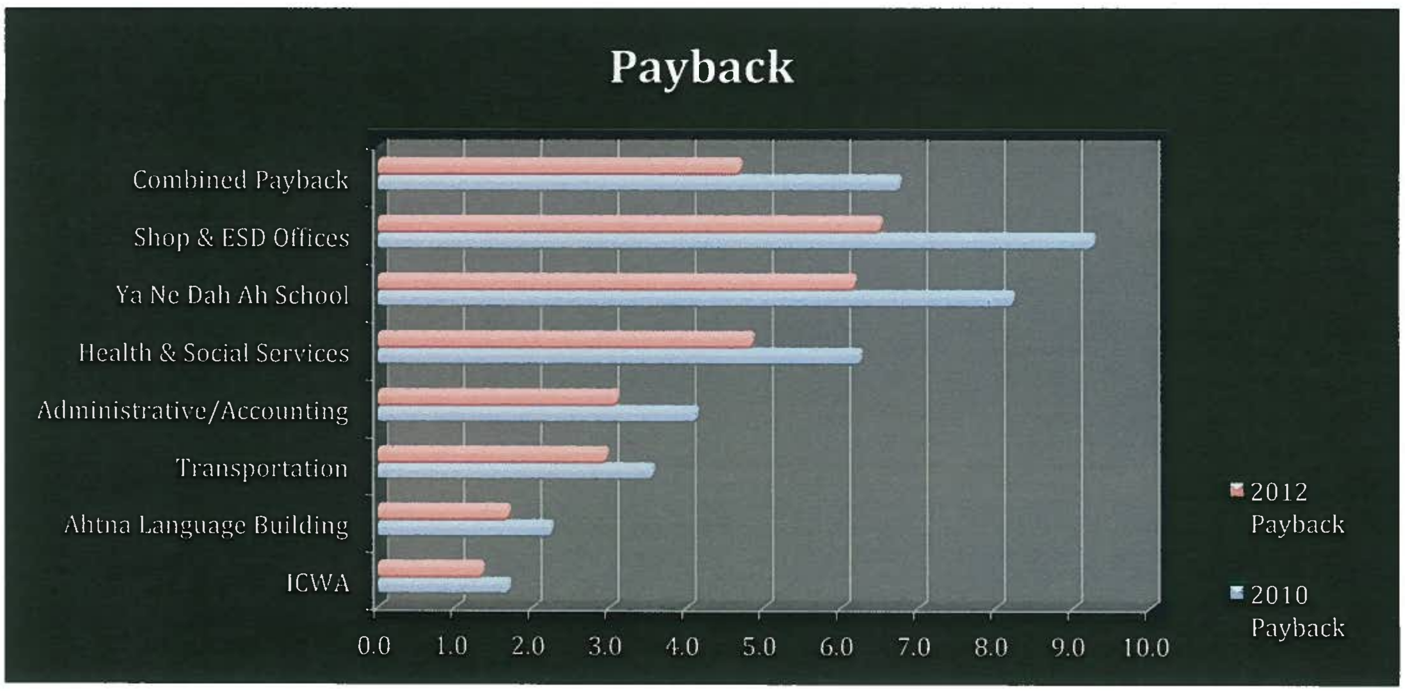
Shop & ESD Offices	3.6	$ 8,580.00	$ 1,183.29	7.3	$ 705.00	$ 75.00	9.4	$ 7,085.00	$1,256.00	5.6	$ 16,370.00	$ 2,514.29	6.5
Health & Social Services	5.7	$ 7,300.00	$ 1,544.13	4.7	$ -	$ -		$ 1,008.00	$ 168.00	6.0	$ 8,308.00	$ 1,712.13	4.9
Ya Ne Dah Ah School	4.4/0.9	$ 11,100.00	$ 1,797.05	6.2	$ -	$ -		$ -	$ -		$ 11,100.00	$ 1,797.05	6.2
Totals		**$ 26,980.00**	**$ 4,524.47**	**6.0**	**$ 705.00**	**$ 75.00**	**9.4**	**$ 8,093.00**	**$1,424.00**	**5.7**	**$ 35,778.00**	**$ 6,023.47**	**5.9**

Administrative/Accounting	4.6	$ 4,750.00	$ 1,064.92	4.5	$ -	$ -		$ -	$ -		$ 4,750.00	$ 1,064.92	4.5
Ahtna Language Building	13.7	$ 1,800.00	$ 800.00	2.3	$ -	$ -		$ -	$ -		$ 1,800.00	$ 800.00	2.3
Transportation	4.9	$ 300.00	$ 199.67	1.5	$ -	$ -		$ 576.00	$ 96.00	6.0	$ 876.00	$ 295.67	3.0
ICWA	11.3	$ 500.00	$ 332.79	1.5	$ -	$ -		$ 46.00	$ 71.00	0.6	$ 546.00	$ 403.79	1.4
Totals		**$ 7,350.00**	**$ 1,332.46**	**5.5**	**$ -**	**$ -**	**0.0**	**$ 622.00**	**$ 167.00**	**3.7**	**$ 7,972.00**	**$ 1,499.46**	**5.3**

Building	2010 Estimated Annual Savings	2012 Estimated Annual Savings
Transportation	$ 246.00	$ 295.67
ICWA	$ 321.00	$ 403.79
Ahtna Language Building	$ 800.00	$ 1,064.92
Administrative/Accounting	$ 1,150.00	$ 1,530.82
Health & Social Services	$ 1,328.00	$ 1,712.13
Ya Ne Dah Ah School	$ 1,350.00	$ 1,797.05
Shop & ESD Offices	$ 4,098.00	$ 2,514.29

Building	2010 Payback	2012 Payback
ICWA	1.7	1.4
Ahtna Language Building	2.3	1.7
Transportation	3.6	3.0
Administrative/Accounting	4.1	3.1
Health & Social Services	6.3	4.9
Ya Ne Dah Ah School	8.2	6.2
Shop & ESD Offices	9.3	6.5
Combined Payback	6.8	4.7


Estimated Annual Savings
Shop & ESD Offices
Ya Ne Dah Ah School
Health & Social Services
Administrative/Accounting
Ahtna Language Building
ICWA
Transportation
$-
$500.00
$1,000.00
$1,500.00
$2,000.00
$2,500.00
$3,000.00
$3,500.00
$4,000.00
$4,500.00
2012 Estimated Annual Savings
2010 Estimated Annual Savings


Payback
Combined Payback
Shop & ESD Offices
Ya Ne Dah Ah School
Health & Social Services
Administrative/Accounting
Transportation
Ahtna Language Building
ICWA
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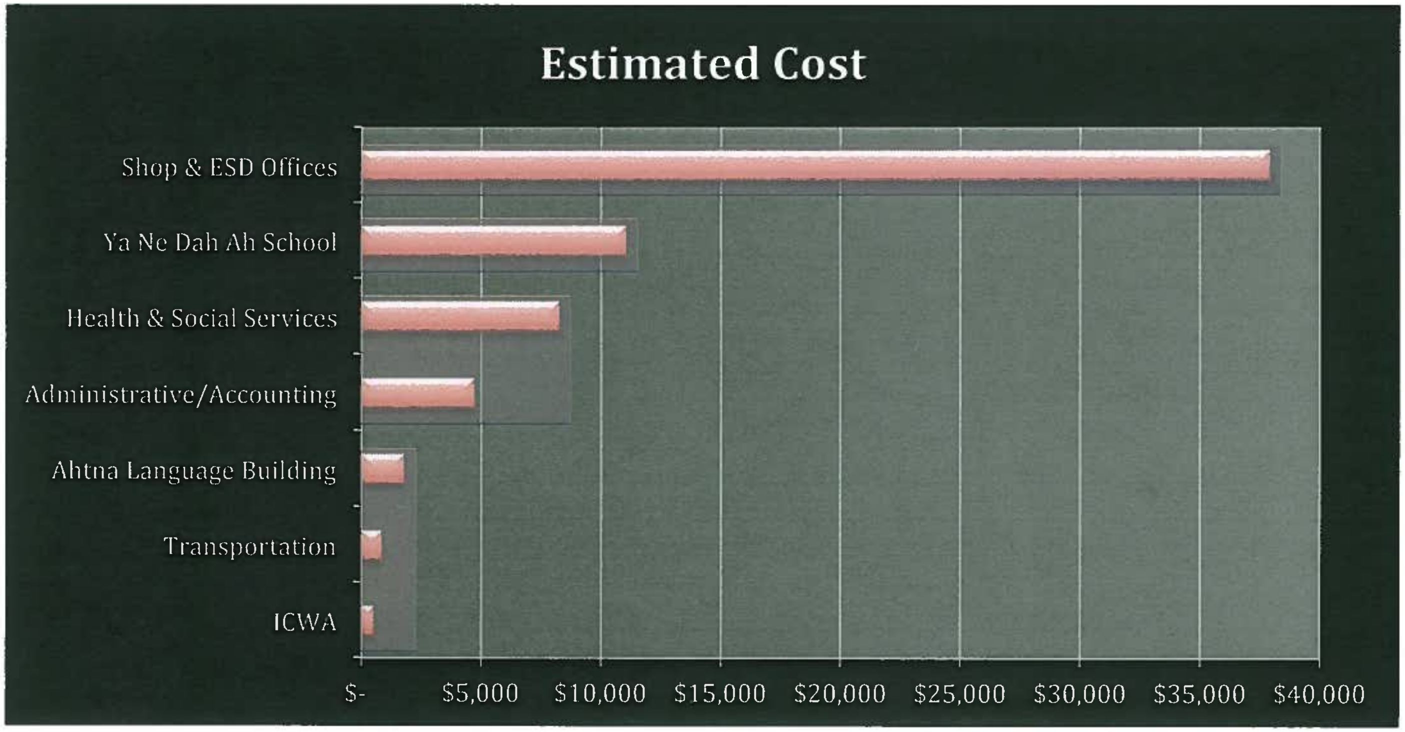
2012 Payback
2010 Payback


Estimated Cost
Shop & ESD Offices
Ya Ne Dah Ah School
Health & Social Services
Administrative/Accounting
Ahtna Language Building
Transportation
ICWA
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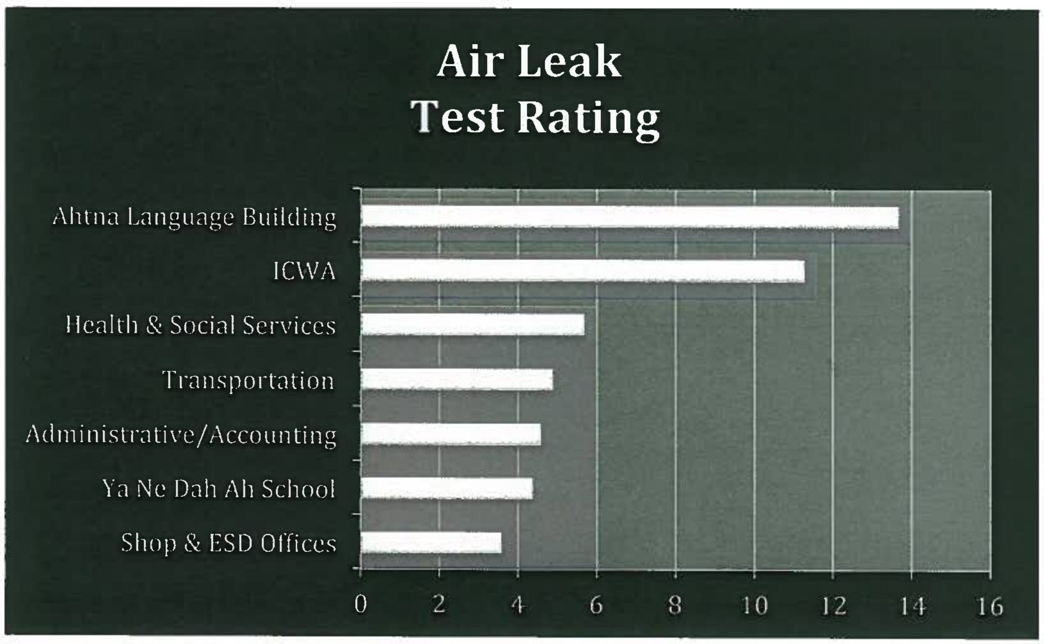
Air Leak
Test Rating
Ahtna Language Building
ICWA
Health & Social Services
Transportation
Administrative/Accounting
Ya Ne Dah Ah School
Shop & ESD Offices
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6
8
10
12
14
16