Comprehensive Energy Audit
For
Oscarville Health Clinic

Prepared For

Native Village of Oscarville

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Native Village of Oscarville. The authors of this report are Carl Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM), and Kyle Monti.

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted over the past several months by the Energy Projects Group of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy efficiency measures. Discussions of site specific concerns and an Energy Efficiency Action Plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Energy Projects Group gratefully acknowledges the assistance of Marita Stevens of the Yukon-Kuskokwim Health Corporation and Alexandria Henry of the Native Village of Oscarville.

1. EXECUTIVE SUMMARY

This report was prepared for the Native Village of Oscarville. The audit focused on the Oscarville Health Clinic. The scope of this report is a comprehensive energy study which included an analysis of building shell, interior and exterior lighting systems, HVAC systems, and plug loads.

Based on electricity and fuel oil prices in effect at the time of the audit, the annual energy costs for the building analyzed were $733.00 for electricity and $3441.00 for #1 oil resulting in a total energy cost of $4174.00 per year.

It should be noted that if this facility did not receive the power cost equalization subsidy, the annual electricity cost would have been $1,283 and the total annual energy cost would have been $4,724.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Oscarville Health Clinic. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.1
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]
1	Setback Thermostat: Small Health Clinic	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Small Health Clinic space.	$669	$200	49.93	0.3
2	Air Tightening: furnace exhaust	Perform air sealing to reduce air leakage by 189 cfm at 50 Pascals.	$228	$200	11.69	0.9
3	Ceiling w/ Attic: Health Clinic	Add R-38 fiberglass batts to attic with Standard Truss.	$230	$1,912	3.22	8.3
4	Lighting: Storage	Remove Manual Switching and Add new Occupancy Sensor	$15	$30	2.68	2.0
5	Lighting: Exam Room	Remove Manual Switching and Add new Occupancy Sensor	$9	$30	1.55	3.4
6	Lighting: Rest Room	Remove Manual Switching and Add new Occupancy Sensor	$7	$30	1.14	4.4
7	Above-Grade Wall: Health Clinic	Install R-25 rigid foam board to exterior and cover with T1-11 siding or equivalent.	$418	$10,125	1.11	24.2
8	Lighting: Pharmacy	Replace with FLUOR (2) T12 4' F40T12 40W Standard Magnetic and Remove Manual Switching and Add new Occupancy Sensor	$6	$30	1.07	5.1
	TOTAL, all measures		**$1,581**	**$12,557**	**2.38**	**7.9**

Table Notes:

[1] Savings to Investment Ratio (SIR) is a life-cycle cost measure calculated by dividing the total savings over the life of a project (expressed in today's dollars) by its investment costs. The SIR is an indication of the profitability of a measure; the higher the SIR, the more profitable the project. An SIR greater than 1.0 indicates a cost-effective project (i.e. more savings than cost). Remember that this profitability is based on the position of that Energy Efficiency Measure (EEM) in the overall list and assumes that the measures above it are implemented first.

[2] Simple Payback (SP) is a measure of the length of time required for the savings from an EEM to payback the investment cost, not counting interest on the investment and any future changes in energy prices. It is calculated by dividing the investment cost by the expected first-year savings of the EEM.

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $1,581 per year, or 37.9% of the buildings' total energy costs. These measures are estimated to cost $12,557, for an overall simple payback period of 7.9 years.

Table 1.2 below is a breakdown of the annual energy cost across various energy end use types, such as Space Heating and Water Heating. The first row in the table shows the breakdown for the building as it is now. The second row shows the expected breakdown of energy cost for the building assuming all of the retrofits in this report are implemented. Finally, the last row shows the annual energy savings that will be achieved from the retrofits.

Table 1.2
Annual Energy Cost Estimate

Description	Space Heating	Space Cooling	Water Heating	Lighting	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	$3,531	$0	$0	$410	$41	$0	$0	$0	$0	**$4,173**
With All Proposed Retrofits	$2,038	$0	$0	$322	$41	$0	$0	$0	$0	**$2,592**
SAVINGS	$1,493	$0	$0	$89	$0	$0	$0	$0	$0	**$1,581**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Oscarville Health Clinic. The scope of this project included evaluating the building shell, lighting and other electrical systems, and HVAC equipment. Measures were analyzed based on life-cycle-cost techniques, which includes the initial cost of the equipment, life of the equipment, annual energy cost, annual maintenance cost, and a discount rate.

2.2 Audit Description

Preliminary audit information was gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is used and what opportunities exist within a building. The entire site was surveyed to gain an understanding of how each building operates. Major Areas of interest are:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Building-specific equipment

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from Oscarville Health Clinic enable a model of the building's energy usage to be developed, highlighting the building's total energy consumption, energy consumption by specific building component, and equivalent energy cost. The analysis distinguishes the different fuels used on site, and analyzed their consumption in different activity areas of the building.

In addition, the methodology involves taking into account a wide range of factors specific to the building. These factors are used in the construction of the model. The factors include:

- Occupancy hours
- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

Data collected was processed using AkWarm© Energy Use Software to estimate energy savings for each of the proposed energy efficiency measures (EEMs). The recommendations focus on the building envelope; HVAC; lighting, plug load, and other electrical improvements; and motor and pump systems that will reduce annual energy consumption.

EEMs are evaluated based on building use and processes, local climate conditions, building construction type, function, operational schedule, existing conditions, and foreseen future plans. Energy savings are calculated based on industry standard methods and engineering estimations.

Our analysis provides a number of tools for assessing the cost effectiveness of various improvement options. These tools utilize **Life-Cycle Costing**, which is defined in this context as a method of cost analysis that estimates the total cost of a project over the period of time that includes both the construction cost and ongoing maintenance and operating costs.

Savings to Investment Ratio (SIR) - **Savings** divided by **Investment**

Savings includes the total discounted dollar savings considered over the life of the improvement. When these savings are added up, changes in future fuel prices as projected by the Department of Energy are included. Future savings are discounted to the present to account for the time-value of money (i.e. money's ability to earn interest over time). The **Investment** in the SIR calculation includes the labor and materials required to install the measure. An SIR value of at least 1.0 indicates that the project is cost-effective—total savings exceed the investment costs.

Simple payback is a cost analysis method whereby the investment cost of a project is divided by the first year's savings of the project to give the number of years required to recover the cost of the investment. This may be compared to the expected time before replacement of the system or component will be required. For example, if a boiler costs $12,000 and results in a savings of $1,000 in the first year, the payback time is 12 years. If the boiler has an expected life to replacement of 10 years, it would not be financially viable to make the investment since the payback period of 12 years is greater than the project life.

The Simple Payback calculation does not consider likely increases in future annual savings due to energy price increases. As an offsetting simplification, simple payback does not consider the need to earn interest on the investment (i.e. it does not consider the time-value of money). Because of these simplifications, the SIR figure is considered to be a better financial investment indicator than the Simple Payback measure.

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

It is important to note that the savings for each recommendation is calculated based on implementing the most cost effective measure first, and then cycling through the list to find the next most cost effective measure. Implementation of more than one EEM often affects the savings of other EEMs. The savings may in some cases be relatively higher if an individual EEM is implemented in lieu of multiple recommended EEMs. For example implementing a reduced operating schedule for inefficient lighting will result in relatively high savings. Implementing a reduced operating schedule for newly installed efficient lighting will result in lower relative savings, because the efficient lighting system uses less energy during each hour of operation. If multiple EEM's are recommended to be implemented, AkWarm calculates the combined savings appropriately.

Cost savings are calculated based on estimated existing costs for each measure. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers. Maintenance savings are calculated where applicable and added to the energy savings for each EEM.

2.4 Limitations of Study

All results are dependent on the quality of input data provided, and can only act as an approximation. In some instances, several methods may achieve the identified savings. This report is not intended as a final design document. The design professional or other persons following the recommendations shall accept responsibility and liability for the results.

3. Oscarville Health Clinic

3.1. Building Description

The 520 square foot Oscarville Health Clinic was constructed in 1980's, with a normal occupancy of three people. The number of hours of operation for this building average 3.9 hours per day, considering all seven days of the week.

Description of Building Shell

The building is on a post and pad foundation. The walls are 2 X 6 with R19 insulation, T1-11 exterior siding and paneling on the inside. Windows throughout the building are vinyl, double pane, and in fair condition. The roof is a cold roof with attic and the equivalent of R19 insulation above the ceiling and R-11 insulated sheathing.

Description of Heating and Cooling Plants

Forced air

Nameplate Information:	Becket Burner
Model 7505B	
Fuel Type:	#1 Oil
Input Rating:	90,000 BTU/hr
Steady State Efficiency:	75 %
Idle Loss:	1.5 %
Heat Distribution Type:	Air
Notes:	Appears to be as old as the building

Space Heating and Cooling Distribution Systems

The building heat acts as a single zone, with the boiler turned off during the summer months.

Description of Building Ventilation System

Building ventilation is accomplished by operable windows. As mentioned earlier, the windows are double pane, vinyl frame and in fair condition.

Lighting

The majority of the interior lighting is fluorescent with T12 lamps and magnetic ballasts.

Plug Loads

The plug loads in the building are significant, and include a server bank on 24/7, a number of computers and monitors, and a variety of copy and fax machines. Additionally there is a fair amount of medical equipment, which is used at varying levels based on medical staff in attendance and demand. There is also a refrigerator for use as a medical refrigerator.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh). The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges.

The fuel oil usage profile shows the fuel oil usage for the building. Fuel oil consumption is measured in gallons. One gallon of Fuel oil #1 is equivalent to approximately 132,000 BTUs of energy.

Electricity in Oscarville is provided by Bethel Utilities.

The average cost for each type of fuel used in this building is shown below in Table 3.1. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.1 – Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.24/kWh
#1 Oil	$ 5.29/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, the Native Village of Oscarville pays approximately $4,174 annually for electricity and fuel oil for the Oscarville Health Clinic.

Figure 3.1 reflects the estimated distribution of costs of the primary end uses based on the AkWarm© computer simulation. This figure also illustrates the savings potential of implementing the energy efficiency measures recommended. As can be expected, the largest energy use is for space heating.

Figure 3.1
Annual Energy Costs by End Use

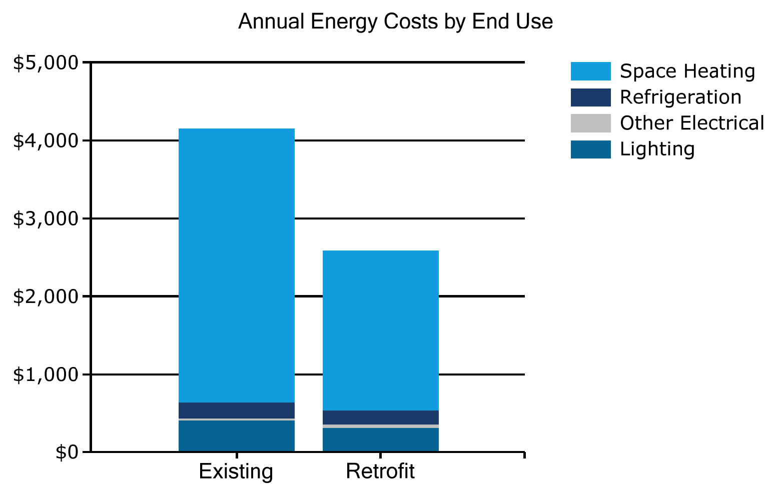


Figure 3.2 illustrates the annual energy costs by energy source. Fuel oil in the clinic is the largest cost, primarily due to the thermostat not being set back at night, the lack of insulation, and the air leaks in the building.

Figure 3.2
Annual Energy Costs by Fuel Type

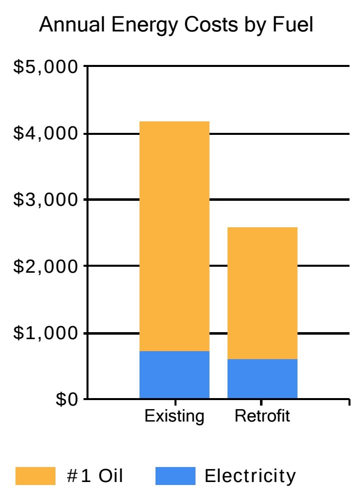
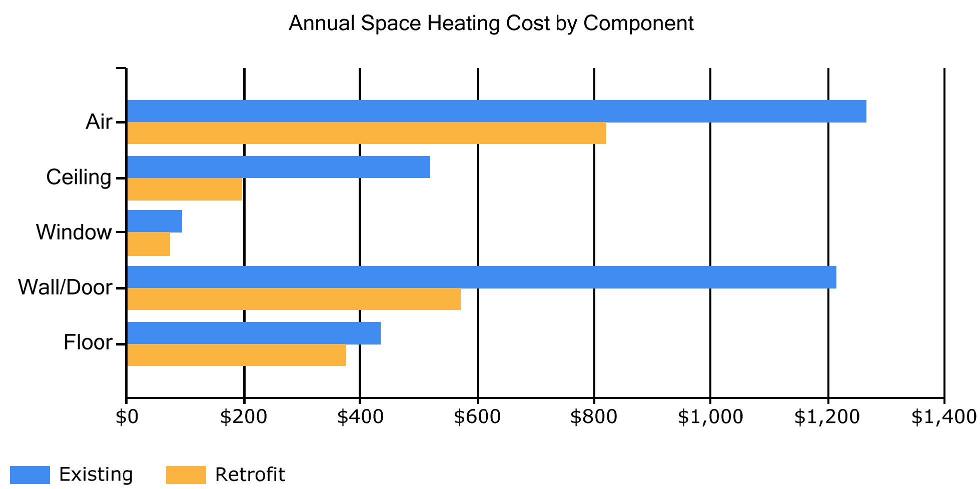


Figure 3.3 is a breakdown of the annual space heating cost by heat loss area. As can be seen, the largest loss is due to air leakage. There is a specific energy efficiency measure recommended to address this leakage. The net impact on energy costs of implementing all the energy efficiency recommendations is illustrated by the difference in existing versus retrofit usage.

Figure 3.3
Annual Space Heating Cost by Component



The tables below show AkWarm's estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	134	122	134	130	133	104	107	107	182	188	182	188
Other_Electrical	13	12	13	13	13	10	11	11	18	19	18	19
Refrigeration	68	62	68	66	68	66	68	68	66	68	66	68
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	55	49	47	33	19	11	9	11	15	29	40	54
Space_Cooling	0	0	0	0	0	0	0	0	0	0	0	0

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	95	85	82	58	34	20	16	20	27	51	69	93

3.2.2 Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (Btu) or kBtu, and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.
The site and source EUIs for this building are calculated as follows. (See Table 3.4 for details):

Building Site EUI = *(Electric Usage in kBtu + Gas Usage in kBtu + similar for other fuels)* / *Building Square Footage*

Building Source EUI = *(Electric Usage in kBtu X SS Ratio + Gas Usage in kBtu X SS Ratio + similar for other fuels)* / *Building Square Footage*

where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.4
Oscarville Health Clinic EUI Calculations

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	3,053 kWh	10,418	3.340	34,797
#1 Oil	650 gallons	85,858	1.010	86,717
Total		**96,277**		**121,514**
BUILDING AREA		520	Square Feet	
BUILDING SITE EUI		185	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		234	**kBTU/Ft²/Yr**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

3.3 AkWarm© Building Simulation

An accurate model of the building performance can be created by simulating the thermal performance of the walls, roof, windows and floors of the building. The HVAC system and central plant are modeled as well, accounting for the outside air ventilation required by the building and the heat recovery equipment in place.

The model uses local weather data and is trued up to historical energy use to ensure its accuracy. The model can be used now and in the future to measure the utility bill impact of all types of energy projects, including improving building insulation, modifying glazing, changing air handler schedules, increasing heat recovery, installing high efficiency boilers, using variable air volume air handlers, adjusting outside air ventilation and adding cogeneration systems.

For the purposes of this study, the Oscarville Health Clinic was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Oscarville was used for analysis. From this, the model was be calibrated to predict the impact of theoretical energy savings measures. Once annual energy savings from a particular measure were predicted and the initial capital cost was estimated, payback scenarios were approximated.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Oscarville. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.
• The heating and cooling load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in cooling/heating loads across different parts of the building.

The energy balances shown in Section 3.1 were derived from the output generated by the AkWarm© simulations.

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

The energy saving measures are summarized in Table 4.1. Please refer to the individual measure descriptions later in this report for more detail.

Table 4.1
Oscarville Health Clinic, Napaskiak, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Setback Thermostat: Small Health Clinic	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Small Health Clinic space.	$669	$200	49.93	0.3
2	Air Tightening: furnace exhaust	Perform air sealing to reduce air leakage by 189 cfm at 50 Pascals.	$228	$200	11.69	0.9
3	Ceiling w/ Attic: Health Clinic	Add R-38 fiberglass batts to attic with Standard Truss.	$230	$1,912	3.22	8.3
4	Lighting: Storage	Remove Manual Switching and Add new Occupancy Sensor	$15	$30	2.68	2.0
5	Lighting: Exam Room	Remove Manual Switching and Add new Occupancy Sensor	$9	$30	1.55	3.4
6	Lighting: Rest Room	Remove Manual Switching and Add new Occupancy Sensor	$7	$30	1.14	4.4

Table 4.1 Oscarville Health Clinic, Napaskiak, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
7	Above-Grade Wall: Health Clinic	Install R-25 rigid foam board to exterior and cover with T1-11 siding or equivalent.	$418	$10,125	1.11	24.2
8	Lighting: Pharmacy	Replace with FLUOR (2) T12 4' F40T12 40W Standard Magnetic and Remove Manual Switching and Add new Occupancy Sensor	$6	$30	1.07	5.1
	TOTAL, all measures		**$1,581**	**$12,557**	**2.38**	**7.9**

4.2 Interactive Effects of Projects

The savings for a particular measure are calculated assuming all recommended EEMs coming before that measure in the list are implemented. If some EEMs are not implemented, savings for the remaining EEMs will be affected. For example, if ceiling insulation is not added, then savings from a project to replace the heating system will be increased, because the heating system for the building supplies a larger load.

In general, all projects are evaluated sequentially so energy savings associated with one EEM would not also be attributed to another EEM. By modeling the recommended project sequentially, the analysis accounts for interactive affects among the EEMs and does not "double count" savings.

Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. When the building is in cooling mode, these items contribute to the overall cooling demands of the building; therefore, lighting efficiency improvements will reduce cooling requirements in air-conditioned buildings. Conversely, lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties and cooling benefits were included in the lighting project analysis.

4.3 Building Shell Measures

ENERGY AUDIT REPORT – ENERGY EFFICIENCY MEASURES					
1. Building Envelope					
Insulation					
Rank	**Location**	**Existing Type/R-Value**	**Recommendation Type/R-Value**	**Installed Cost**	**Annual Energy Savings**

3	Ceiling w/ Attic: Health Clinic	Framing Type: Standard Framing Spacing: 24 inches Insulated Sheathing: None Bottom Insulation Layer: R-19 Batt:FG or RW, 6 inches Top Insulation Layer: None Insulation Quality: Damaged Modeled R-Value: 20.1	Add R-38 fiberglass batts to attic with Standard Truss.	$1,912	$230
7	Above-Grade Wall: Health Clinic	Wall Type: Single Stud Siding Configuration: Just Siding Insul. Sheathing: None Structural Wall: 2 x 6, 16 inches on center R-19 Batt:FG or RW, 5.5 inches Window and door headers: Insulated Insulation Quality: Damaged Modeled R-Value: 15.2	Install R-25 rigid foam board to exterior and cover with T1-11 siding or equivalent.	$10,125	$418

4.3.1. Energy Efficiency Measure: Add or Replace Insulation

4.3.1.1 Improvement: Rank 3
Location: Ceiling w/ Attic: Health Clinic
Area (Feet²): 520
Existing Situation: Framing Type: Standard
Framing Spacing: 24 inches
Insulated Sheathing: None
Bottom Insulation Layer: R-19 Batt:FG or RW, 6 inches
Top Insulation Layer: None
Insulation Quality: Damaged
Modeled R-Value: 20.1

Recommended Measures: Add R-38 fiberglass batts to attic with Standard Truss.
Annual Energy Savings: $230
Installed Costs:
    Material Costs: Not Available
    Labor Costs: Not Available
    Total Estimated Costs: $1,912
Simple Payback (Years): 8
Auditor Comments: None

4.3.1.2 Improvement: Rank 7
Location: Above-Grade Wall: Health Clinic
Area (Feet²): 748
Existing Situation: Wall Type: Single Stud
Siding Configuration: Just Siding

Insul. Sheathing: None
Structural Wall: 2 x 6, 16 inches on center
R-19 Batt:FG or RW, 5.5 inches
Window and door headers: Insulated
Insulation Quality: Damaged
Modeled R-Value: 15.2

Recommended Measures: Install R-25 rigid foam board to exterior and cover with T1-11 siding or equivalent.
Annual Energy Savings: $418
Installed Costs:
- **Material Costs:** Not Available
- **Labor Costs:** Not Available
- **Total Estimated Costs:** $10,125

Simple Payback (Years): 24
Auditor Comments: None

4.3.4. Energy Efficiency Measure: Seal Air Leaks

Rank	Estimated Air Leakage	Recommended Air Leakage Target	Energy Auditor Comments	Cost	Savings
2	Air Tightness from Blower Door Test: 819 cfm at 50 Pascals	Perform air sealing to reduce air leakage by 189 cfm at 50 Pascals.	Seal around furnace exhaust stack	$200	$228

Many buildings, especially older ones, have air leaks allowing heated and cooled air to escape when the air pressure differs between the inside and outside of the building. Because these leaks allow unconditioned air to enter as conditioned air is lost, air leaks can be a significant waste of energy and money. They also make the building drafty. Many buildings have hidden air leaks requiring a weatherization technician to find and seal. It is recommended you seal the air leaks around the furnace exhaust stack and look for other obvious leaks. Buildings with indoor air pollution caused by combustion heating, tobacco smoking, or moisture problems, may require more ventilation than average buildings.

4.4 Heating Measures

4.4.1. EEM Heating Plants and Distribution Systems

A heating system is expected to last approximately 20-25 years, depending on the system. If the system is nearing the end of its life, it is better to replace it sooner rather than later to avoid being without heat for several days when it fails. This way, you will have time to compare bids, check references and ensure the contractors are bonded and insured.

4.4.1.1. EXISTING SYSTEMS

4.4.1.1.1 Forced air
Description: Becket Burner
Model 7505B heating plant fueled by #1 Fuel Oil, with a Natural draft.
Size : 90,000 BTU/h
Efficiency (Steady State & Idle): 75%

Portion of heat supplied by this unit: 100%
Notes: Appears to be as old as the building

4.4.2 Programmable Thermostat

Location	Existing Situation	Recommended Improvement	Install Cost	Annual Savings	Notes
Small Health Clinic	Existing Unoccupied Heating Setpoint: 70.0 deg F	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Small Health Clinic space.	$200	$669	

4.5 LIGHTING UPGRADES

The goal of this section is to present any lighting energy conservation measures that may also be cost beneficial. It should be noted that replacing current bulbs with more energy-efficient equivalents will have a small effect on the building heating and cooling loads. The building cooling load will see a small decrease from an upgrade to more efficient bulbs and the heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.5.1 Lighting Controls

Location	Existing Lighting Controls	Recommended Improvement	Install Cost	Annual Savings	Notes
Pharmacy	Manual Switching	Occupancy Sensor	$30	$6	occupancy sensor replacing the light switch on the wall.
Rest Room	Manual Switching	Occupancy Sensor	$30	$7	occupancy sensor replacing the wall switch.
Exam Room	Manual Switching	Occupancy Sensor	$30	$9	occupancy sensor replacing the wall switch.
Storage	Manual Switching	Occupancy Sensor	$30	$15	occupancy sensor replacing the wall switch.

Description:
In some areas the lighting is left on unnecessarily. In many cases the lights are left on because of the inconvenience to manually switch lights off when a room is left, or on when a room is first occupied. This is common in storage rooms occupied for only short periods and only a few times per day. In some instances lights are left on due to the misconception it is better to keep the lights on rather than to continuously switch lights on and off. Although increased switching reduces lamp life, the energy savings outweigh the lamp replacement costs. The payback

timeframe for when to turn the lights off is approximately two minutes. If the lights are off for at least a two minute interval, then it pays to shut them off.

Implementing Occupancy sensors will help to control lighting that is left on accidently. Replacement of existing broken fixtures is included in this cost.

Appendix A

Listing of Energy Conservation and Renewable Energy Websites

Lighting
Illumination Engineering Society - http://www.iesna.org/

Energy Star Compact Fluorescent Lighting Program - www.energystar.gov/index.cfm?c=cfls.pr_cfls

DOE Solid State Lighting Program - http://www1.eere.energy.gov/buildings/ssl/

Caliper Program – http://www1.eeere.energy.gov/buildings/ssl/caliper.html

Solid State Lighting Gateway Demonstrations – http://www1/eere/energy.gov/buildings/ssl/gatewaydemos.html

DOE office of Energy Efficiency and Renewable Energy - http://apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?c=lighting.pr_lighting

Hot Water Heaters

Tank less DHW Heaters -
http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12820

Heat Pump Water Heaters -
http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12840

AHRI –Residential Water Heaters - http://ari.org/Content/ResidentialWaterHeaters_594.aspx

American Council for Energy-Efficient Economy -
http://www.aceee.org/consumerguide/waterheating.htm#heatpump

Solar Water Heating

DOE Energy and Efficiency and Renewable Energy Solar Energy Technologies Program –
http://www1.eere.energy.gov/solar/solar_heating.html

FEMP Federal Technology Alerts – http://www.eere.energy.gov/femp/pdfs/FTA_solwat_heat.pdf
www.eere.energy.gov.femp/pdfs/FTA_para_trough.pdf

FEMP Case Studies – www.eere.energy.gov/femp/technologies/renewable_casestudies.html

Solar Radiation Data Manual – http://rredc.nrel.gov/solar/pubs/redbook

Plug Loads

DOE office of Energy Efficiency and Renewable Energy – http:apps1.eere.energy.gov/consumer/your workplace/

Energy Star – http://www.energystar.gov/index.cfm?fuseaction=find_a_product

Top 10 energy efficient desktop PCs – http://crave.cnet.co.uk/cnetuk/crave/greentech/0,250000598,10001753,00.htm

The Greenest Desktop Computers of 2008 - http://www.metaefficient.com/computers/the-greenest-pcs-of-2008.html

Wind

AWEA Web Site – http://www.awea.org

- AWEA Small wind toolbox: www.awea.org/smallwind/

NWTC Web Site – http:www.nreal.gov/wind

National Wind Coordinating Collaborative – http:www.nationalwind.org

Utility Wind Interest Group site: http://www.uwig.org

WPA Web Site – http://www.windpoweringamerica.gov

Homepower Web Site: http://homepower.com

Windustry Project: http://www.windustry.com

Best Links: www.freash-energy.org

Solar

NREL – http://www.nrel.gov/rredc/

Firstlook – http://firstlook.3tiergroup.com

TMY or Weather Data – http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/

State and Utility Incentives and Utility Policies - http://www.dsireusa.org