Final Technical Report

Award Recipient: Sault Sainte Marie Tribe of Chippewa Indians

Project Title: Sault Tribe Building Efficiency Energy Audits

Project Locations: Tribal Administration Building (I), 523 Ashmun St., Sault Ste. Marie, MI 49783
Tribal Administration Building (II), 531 Ashmun St., Sault Ste. Marie, MI 49783
Community Recreation Center, 2 Ice Circle, Sault Ste. Marie, MI 49783
Tribal Health Center, 2864 Ashmun St., Sault Ste. Marie, MI 49783
Joseph K Lumsden Bahweting School, 1301 Marquette St., Sault Ste. Marie, MI 49783
Tribal Health Clinic/Community Center, 5698 W. Highway US-2, Manistique, MI 49854
Tribal Health Clinic / Community Center, 622 W. Superior St., Munising, MI 49862
Motorpool / Inland Department Building, 199 W. 3 Mile, Sault Ste. Marie, MI 49783
Advocacy Resource Center, 2769 Ashmun St., Sault Ste. Marie, MI 49783

DOE Award/Contract Number: DE-EE0002520

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Project Reporting Period: 01/01/10 – 06/30/13

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Executive Summary

Federally recognized in 1972, the Sault Ste. Marie Tribe of Chippewa Indians is centered in the eastern Upper Peninsula and northern Lower Peninsula of Michigan. The Tribe currently has a membership of approximately 40,000, with approximately 13,000 members residing in the Upper Peninsula of Michigan and with over 2,000 members residing on trust land in the Tribe's low income housing.

The Tribe's land holdings are primarily in the Eastern Upper Peninsula of Michigan, of which 1,600 acres are held in trust. The Tribe's governmental offices are located in Sault Ste. Marie, with its furthest tribal communities located 180 miles northwest and 120 miles southwest of Sault Ste. Marie. Tribal communities located outside of the Sault Ste. Marie home base are located in remote areas of their county on approximately 10-20 acres. Housing development sites range between 10-150 homes. Most of the service areas have small community centers although the centers are located within 1-2 miles from each housing site. Public transportation is non-existent with the exception of limited taxi service and limited county transportation authority busing that is not available in all areas.

The Tribe administers several membership programs such as health, education, social service, housing, law enforcement, judicial, fisheries, legal, eldercare, and internal administrative services. Funding for a majority of membership services is received through self-governance BIA funding, grants, and profits from casinos and other enterprise businesses owned and operated by the Tribe.

As part of the Tribe's long-standing interest in energy conservation and the feasibility of renewable energy options, the Tribe is working to reduce energy consumption and expenses in Tribally-owned, governmental buildings and low income housing sites. Conducting energy audits of Tribally-owned facilities helps to define the extent and types of energy efficiency improvements needed, establish a basis for energy priorities, strategies and action plans, and provide a benchmark for measuring improvements from energy efficiency implementations.

Implementation of prioritized energy efficiency improvements and renewable energy options will integrate with the cultural, social, and long-term goals of the Tribe by protecting the environment and natural resources, improving the economic well-being of Tribal members and families through reducing housing expenses and by reallocating resources to providing additional support for direct services for Tribal members.

In 2002, the Tribe demonstrated its commitment to researching energy options by applying for and receiving a DOE grant to conduct a feasibility study of wind energy as a renewable source of electricity for Tribal buildings and housing sites. While the grant findings, based on the lower power costs and higher technological investment requirements of that time, did not support further development, interest continued at the Tribal Board of Directors' level to pursue options for improving building efficiencies, consider renewable energy sources for building heating and cooling, and re-visit the feasibility of wind energy and other renewable energy sources to generate electric power for Tribal governmental buildings and housing sites.

In 2009, the Tribe applied to the DOE for funding to conduct energy audits of Tribally-owned governmental buildings and was awarded a grant in 2010 in the amount of $95,238 to fund the energy audits of seven governmental buildings and cover travel expenses for attending required DOE annual program reviews. Competitive pricing during the procurement process for an energy auditor resulted in lower energy audit costs, allowing the Tribe to request two additional governmental building energy audits. The DOE approved the request, increasing the project sites to the nine governmental buildings listed on the cover page of this report.

Following energy auditor procurement, background clearances and contract development, the Tribe mobilized for the energy audits by gathering one year of electric and gas utility information per building for the energy auditor, by contacting and coordinating energy audit inspections with building occupants, and by providing supplemental building operation and facilities management information as needed.

Throughout the project period, the Tribe conducted regular progress meetings with the Tribal energy team and energy auditor, processed energy auditor payment requests, submitted required grant reporting, attended and presented project updates at the DOE annual program reviews and reviewed completed energy audit reports.

The Tribe has recognized a general need for energy retrofitting of its governmental buildings. Reviewing the energy audit reports by building clarifies the extent and types of specific energy efficiency improvements needed to either prioritize for funding acquisition or to schedule for implementation utilizing existing resources.

To gain full value from this energy audits project, the Tribe's Facilities Management Department will utilize the energy audit report findings by building to establish their energy priorities and scheduling. As each building is retrofitted, the utilities usage diagrams in the applicable energy audit report can serve as a benchmark for measuring the energy usage reduction resulting from implementing recommended energy improvements.

The nine energy audit reports prepared by U. P. Engineers and Architects, Inc. are included in the section titled Energy Audit Reports with Thermal-Imaging Photographs. Due to electronic file size constraints, the reports are accompanied by selected thermal images to illustrate the value of infrared technology in displaying energy loss and for use as a visual aid in presentations.

There have been a couple of surprising lessons learned during the course of completing this energy audit project. Access to computerized utility usage data may be limited due to the type of metering equipment still in use by rural utility companies. Utilities may be periodically estimating meter readings, have seasonal gaps in data and may not have the capacity to provide computerized usage reporting. The Tribe experienced these utility data collection challenges. Considerable time was spent gathering and inputting monthly usage and cost data from paper invoicing. A recommendation to any organization considering conducting energy audits would be to contact their local utility companies to verify whether computerized reporting is available or whether additional time should be planned for utility data compilation.

Another lesson learned is that energy audits may reveal unexpected findings, such as unknown window openings buried in a wall causing heat loss, or detecting that heat loss from glass blocks in a specific building is less than the adjacent masonry blocks. Thermal imaging is particularly helpful for uncovering hidden energy inefficiencies. The Tribe would recommend requiring thermal imaging to be part of the energy audit process not only to bring forward invisible causes of energy loss, but as a visual aid for executive presentations.

The Tribe would like to acknowledge the U. S. Department of Energy for providing the funding and technical assistance that has made this project possible, and the Tribal Board of Directors for their ongoing support of improving energy efficiencies in Tribal governmental buildings and housing sites.

Project Overview

The Tribe is working to reduce energy consumption and expense in Tribally-owned governmental buildings and low income housing sites. In 2009, the Tribe applied to the U. S. Department of Energy for funding to conduct energy audits of Tribally-owned governmental buildings. Findings from the energy audits would define the extent and types of energy efficiency improvements needed, establish a basis for energy priorities, strategies and action plans, and provide a benchmark for measuring improvements from energy efficiency implementations. In 2010, the DOE awarded a grant in the amount of $95,238 to the Tribe to fund the energy audits of seven governmental buildings and to pay for travel expenses associated with attendance and participation at the DOE annual program reviews.

Following a competitive procurement process for an energy auditor, which resulted in lower energy audit costs, the Tribe requested approval from DOE to add two governmental building energy audits. The DOE approved the request, increasing the project sites to the following nine Tribally-owned governmental buildings:

1. Tribal Administration Building (I), 523 Ashmun St., Sault Ste. Marie, MI 49783
2. Tribal Administration Building (II), 531 Ashmun St., Sault Ste. Marie, MI 49783
3. Community Recreation Center, 2 Ice Circle, Sault Ste. Marie, MI 49783
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After the energy auditor procurement, the selected energy auditor successfully passed DOE debarment and Sault Tribe background clearances. The energy audits contract was awarded to U. P. Engineers and Architects, Inc. of Sault Ste. Marie, Michigan. The Tribe mobilized for the energy audits by providing the energy auditor with one year of electric, gas and water utility invoice copies per building, as well as supplemental building information, such as operating hours. The Tribe also contacted building occupants to coordinate scheduling for the on-site energy audit inspections and arranged for facilities management personnel to guide the energy auditor through the buildings and answer questions regarding building systems.

The Tribe conducted regular meetings with the Tribal energy team and energy auditor to monitor project progress and approve energy auditor payment requests. The energy team also prepared and submitted required quarterly performance progress and financial reporting and presented project updates at the 2010, 2011 and 2012 DOE annual program reviews in Denver, Colorado. As the energy auditor completed reports for each building, the Tribe’s energy team reviewed the findings and the thermal imaging photographs with Tribal Facilities Management Department. The energy audit findings have provided valuable data and recommendations for establishing efficiency priorities and work order scheduling, as well as benchmarking utility usage to compare to after energy efficiency improvements are implemented.

Objectives

Conducting energy audits of the governmental buildings helps define the extent of need for energy efficiency improvements, providing a basis for long-term energy plan strategies and a benchmark for measuring the success of future energy improvements implementation.

The nine Tribally-owned governmental buildings designated for energy audits include a diverse mix of governmental use, such as Tribal Administration, community gatherings, health and human services, advocacy resource center, charter school, recreational activities, natural resources, and governmental fleet maintenance. Building locations span three counties in the Upper Peninsula of Michigan – Alger, Chippewa and Schoolcraft counties.

In preparation for the energy audits, a project team was assembled, consisting of a Project Director, serving as the Business and Technical Contact for this grant, the Chief Financial Officer, who oversees the Facilities Management Department, and assigned project staff. During preliminary work sessions, the project team, with support from the Sault Tribe Board of Directors, identified 9 Tribally-owned governmental buildings, as listed on the cover page of this report. Designating these buildings and compiling supplemental building data, such as location, size and energy-related information, were completed in preparation for developing a Request for Proposal (RFP) to procure a qualified energy auditor to conduct the specified energy audits.

Additional objectives performed during the Energy Audit project included:

As per established Tribal procurement policies and procedures, preparing and advertising the Request for Proposal for a qualified energy auditor to conduct the specified energy audits; scheduling and conducting pre-bid building inspections; working with the Tribal Purchasing Department during the public bid opening, analyzing submittals, and recommending award to Tribal Board of Directors for approval; working with the Tribal Legal Department for contract preparation and acceptance; conducting a pre-project start-up meeting with selected energy auditor to sign contract, review administrative requirements, accounting procedures and finalize project schedule; working with the contracted energy auditor to perform site inspections, provide building and pertinent energy data, supply contact information, and assist with energy audits as needed; conducting scheduled progress meetings with energy auditor and project team to review project details, findings and analysis reports, develop strategies for addressing energy audit findings, process billings, monitor budget compliance, and prepare project communications, including written monthly updates to the Executive Office and Tribal Board of Directors, required quarterly grant progress reports and annual attendance at the DOE Program Reviews in Denver, Colorado; working with energy auditor and project team to complete project close-out checklists, finalize strategies for addressing energy audit findings, process final billing, close-out and prepare report on budget compliance, and prepare final project communications, including presentation of energy audit project to the Executive Office and Tribal Board of Directors, required final comprehensive grant report and attendance at the 2010, 2011, 2012 and 2013 DOE Program Reviews in Denver, CO.

Description of Activities Performed

During the first phase of the project, the project team procured a qualified energy auditor to conduct energy audits of the nine designated Tribally-owned governmental buildings in three counties across the Upper Peninsula of Michigan. Energy audits were prioritized to address buildings in descending order from the highest to the lowest energy consumption. Prioritization varied slightly based on availability of personnel and other scheduling considerations.

The Tribe followed established Tribal procurement policies and procedures to secure the services of a qualified energy auditor to conduct the energy audits, perform related analysis, and to produce and submit written findings per building as completed. Procurement activities included advertising a Request for Proposal for an energy auditor to conduct specified energy audits; scheduling and conducting pre-bid building inspections; working with Tribal Purchasing Department to conduct the public bid opening, analyzing submittals, recommending award to Tribal Board of Directors for approval; and working with the Tribal Legal Department for contract preparation and acceptance. To mobilize for the energy audits, the project team conducted a pre-project start-up meeting with the selected energy auditor, U. P. Engineers and Architects, Inc., to sign the contract, review administrative requirements, accounting procedures and finalize the energy audits schedule.

The energy auditor performed site inspections and conducted nine energy audits with assistance from the project team. The Project Director and project team coordinated arrangements for personnel interviews and site inspections, supplied copies of supplemental building data, records, etc., and prepared administrative reporting and communications with the Tribal membership. Energy audits included collection of pertinent data through interviews with Facility Management and on-site operations personnel, by site inspections, and utility records analysis, evaluation of the technical and economic viability of building efficiency improvement options, and determination and selection of feasible conservation options. The Project Director, project team and qualified energy auditor worked closely to review findings and energy improvement options throughout the project. The energy audit findings were reviewed as a basis for prioritizing and addressing building efficiency improvements and as a foundation for the Tribe’s long-term comprehensive energy plan.

The project team conducted progress meetings with the energy auditor to review project status and resolve project issues, review energy audit findings and analysis reports, develop strategies for addressing energy audit findings, and process billings. The project team also met to monitor budget compliance and prepare project communications, including updates to the Executive Office and Tribal Board of Directors, other project communications, required reporting and presentations. Project progress and financial status were documented in quarterly reports submitted electronically to DOE. Project status was also presented at the 2010, 2011 and 2012 Annual Tribal Energy Program Reviews held each fall in Denver, Colorado.

Energy Audit Reports & Thermal-Imaging Photographs

The nine energy audit reports prepared by U. P. Engineers and Architects, Inc. are included in this section, as listed below.

NOTE: Due to electronic file size constraints, reports are accompanied by selected thermal images to illustrate the value of infrared technology in displaying energy loss and for use as a visual aid in presentations.

1. Tribal Administration Building (I), 523 Ashmun Street, Sault Ste. Marie, MI 49783
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Energy Audit
Tribal Administration
523 Ashmun Street
Sault Ste. Marie, MI

December 2012

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Summary

The building located at 523 Ashmun Street in Sault Ste. Marie, MI was built in 1949. The facility was purchased in 1993 and renovated for Tribal Administration. The facility consists of a basement, and 3 floors with approximately 28,870 square foot of space which includes reception areas, office (all floors are used for offices), conference, mechanical and electrical room and various components (elevator) and storage spaces etc.

Existing Building Envelope Profile

Wall Construction: The east exterior wall is comprised of an 8” block interior/drywall finish with a partial brick and brick tile veneer. The remaining walls are block and brick construction, with the south wall (1st floor and basement only) shared with the adjacent Tribal Administration Building at 531 Ashmun Street.

Ceiling Construction: The ceilings are a combination of open structure, acoustical ceiling tile and gypsum board. All of the ceilings are in good condition. Insulation above the lay-in ceilings is not installed.

Roof Construction: The roof construction is a built up roofing system consisting of a corrugated metal deck, 1/2 inch recovery board, 2-1/2 inch rigid insulation and rubber membrane. The rubber membrane is a continuous and fully adhered CARLISLE 60-mill EPDM (rubber membrane). The roof is in good condition.

Floor Construction: The basement floor base is a 4” inch concrete slab on grade without perimeter insulation. The remaining floor treatment is a combination of padded carpet and tile.

Window and Door Construction: The front exterior windows are double glazed metal frame type, non-operable. Window framing show signs of aging and have visible gaps at the joints. Weather stripping around the windows is consistent and in fair condition. The rear windows are double hung, double pane metal framed and are in fair condition. There are no windows on either the north or south sides. Exterior doors are metal frame, insulated, with 75% or more double pane glazing. Weather stripping on the exterior doors is in good condition. Fire doors separate 523 and 531 Ashmun in the basement.

Existing Mechanical Systems Profile

Heating, Ventilation and Air Conditioning:

1. The primary building mechanical space HVAC system is horizontal fan coil units with heating and cooling coils, plenum returns and outdoor air hard ducted to each fan coil unit from a central air handler located on the second floor. The heating coils for the fan coil units and air handler are hot water type, provided by three Weil McLain PFG-8 hot water heating boilers, 487,000 btu input each, located in the basement mechanical room. The hot water heating system includes an expansion tank, two hot water heating pumps (1 hp each), air separator and accessories. The cooling coils for the fan coil units and air handler are chilled water types, provided by a chiller located in the basement mechanical room and a 60 ton evaporator located on the roof. The chilled water system includes an expansion tank, two chilled water pumps (2 hp each) and accessories. There are additional hot water convectors and cabinet unit heaters for spot heating in vestibules and stairways. There is a separate split system cooling unit for the computer room with condenser located on the roof.

2. An air handling unit located on the second floor provides fresh air to the fan coil units, with air tempering provided by a hot water and chilled water coil.

3. General exhaust for the bathrooms and general areas is provided by roof mounted downblast type roof fans mounted on roof curbs. Control of the exhaust fans is on a time schedule using existing building management system.

Plumbing Systems:

1. A natural gas fired water heaters (50 gallon capacity) is located on the second floor. Hot water return piping is not installed. Domestic hot and cold water piping is copper. Insulation is installed on both systems and is in good condition. The main water and sanitary service are located on west side of building and are connected to city water and sanitary systems. The main storm system is located on north side of the building and is connected to the city storm system.

2. The plumbing fixtures are comprised of tank type water closets, single handle lavatories without low flow aerators, urinals with ¾" flush valves, several sinks with single handle control and service sinks.

Temperature Controls Systems: The original pneumatic temperature control system was replaced with a Delta building management system. The Delta control system monitors and controls space temperature, discharge and incoming air temperatures and hot water and chilled water temperatures.

Special Systems: The building is fully sprinkled with the fire protection riser and accessories located in the basement meter room. The fire alarm system is Alert Electronics.

Existing Electrical Systems Profile

Lighting Systems:

The majority of interior lights are 4' linear fluorescent. Fixtures have recently been upgraded to T8 lamps and electronic ballasts throughout. Lamps are Osram/Sylvania 25-watts, with color temperature of 4100K. Electronic Ballasts are instant start, GE UltraMax.

Power Systems:

The building is served from an exterior pad-mount transformer owned by Cloverland Electric (formerly Edison Sault). The main switchboard is 1200-amp, 208Y/120-volt, 3-phase, 4-wire and is located in main electrical room in the basement. Many of the electrical branch panels are also located in the main electrical room, with additional panels located on each floor throughout the building.

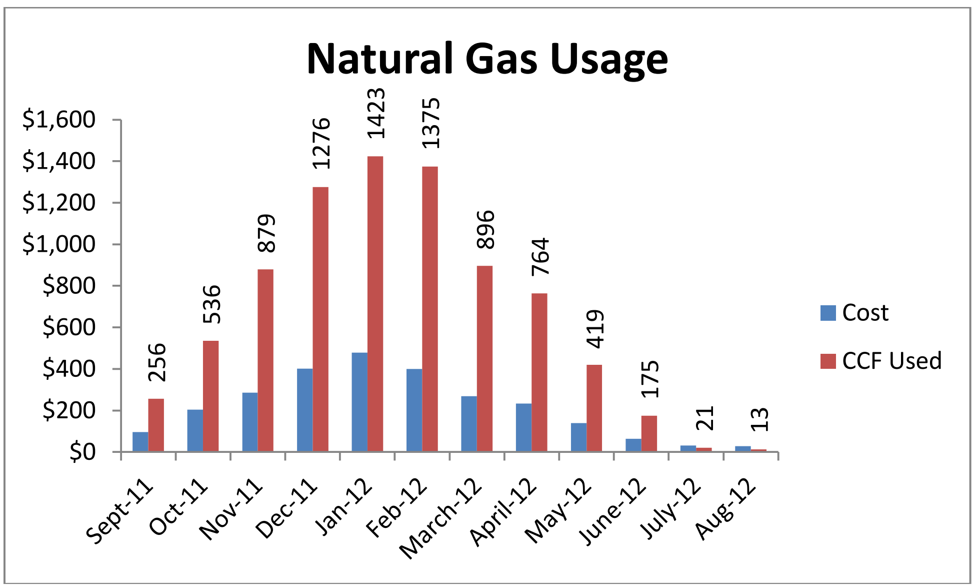
Existing Energy Consumption and Energy Cost Analysis

Natural Gas Usage

The following graphical data represents the monthly natural gas usage and costs. Information as shown is for the billing period of September 2011 to August 2012.

Month	Cost	CCF
Sept-11	$96	256
Oct-11	$204	536
Nov-11	$285	879
Dec-11	$402	1,276
Jan-12	$478	1,423
Feb-12	$399	1,372
March-12	$269	896
April-12	$233	764
May-12	$139	419
June-12	$63	175
July-12	$31	21
Aug-12	$28	13
Totals	$2,627	8,030

Natural Gas ECI:	$0.09	per sq ft/yr
Natural Gas ECU:	27,814	BTU/sq ft
Average Cost per CCF:	$0.33	$/CCF

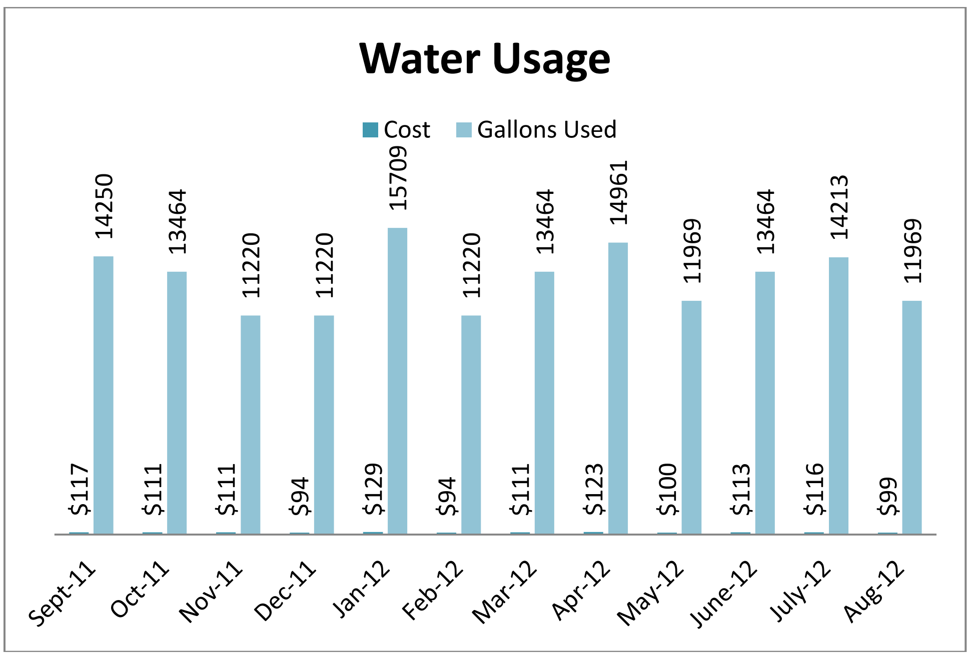


Water Usage

The following data is a graphical representation of the monthly and annual water usage and costs.

Month	Cost	Gallons
Sept-11	$117	14,250
Oct-11	$111	13,464
Nov-11	$111	11,220
Dec-11	$94	11,220
Jan-12	$129	15,709
Feb-12	$94	11,220
Mar-12	$111	13,464
Apr-12	$123	14,961
May-12	$100	11,969
June-12	$113	13,464
July-12	$116	14,213
Aug-12	$99	11,969
Totals	$1,318	157,123

Cost per sq ft:	$0.05	per sq ft/yr
Average Usage per Fixture:	4,489	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon

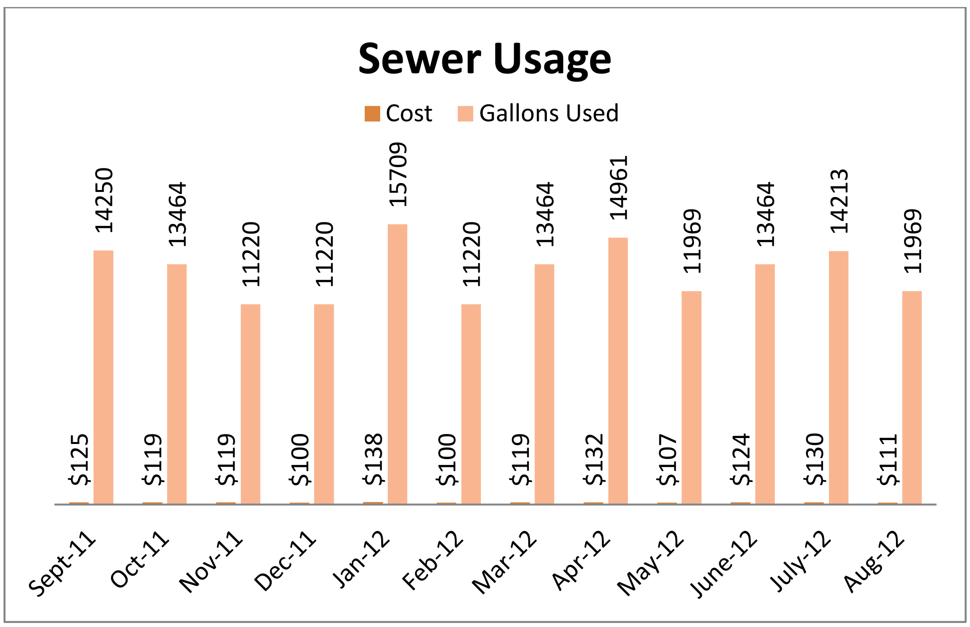


Sewer Usage

The following data is a graphical representation of the monthly and annual sewer usage and costs.

Month	Cost	Gallons
Sept-11	$125	14,250
Oct-11	$119	13,464
Nov-11	$119	11,220
Dec-11	$100	11,220
Jan-12	$138	15,709
Feb-12	$100	11,220
Mar-12	$119	13,464
Apr-12	$132	14,961
May-12	$107	11,969
June-12	$124	13,464
July-12	$130	14,213
Aug-12	$111	11,969
Totals	$1,424	157,123

Cost per sq ft:	$0.05	per sq ft/yr
Average Usage per Fixture:	4,489	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon

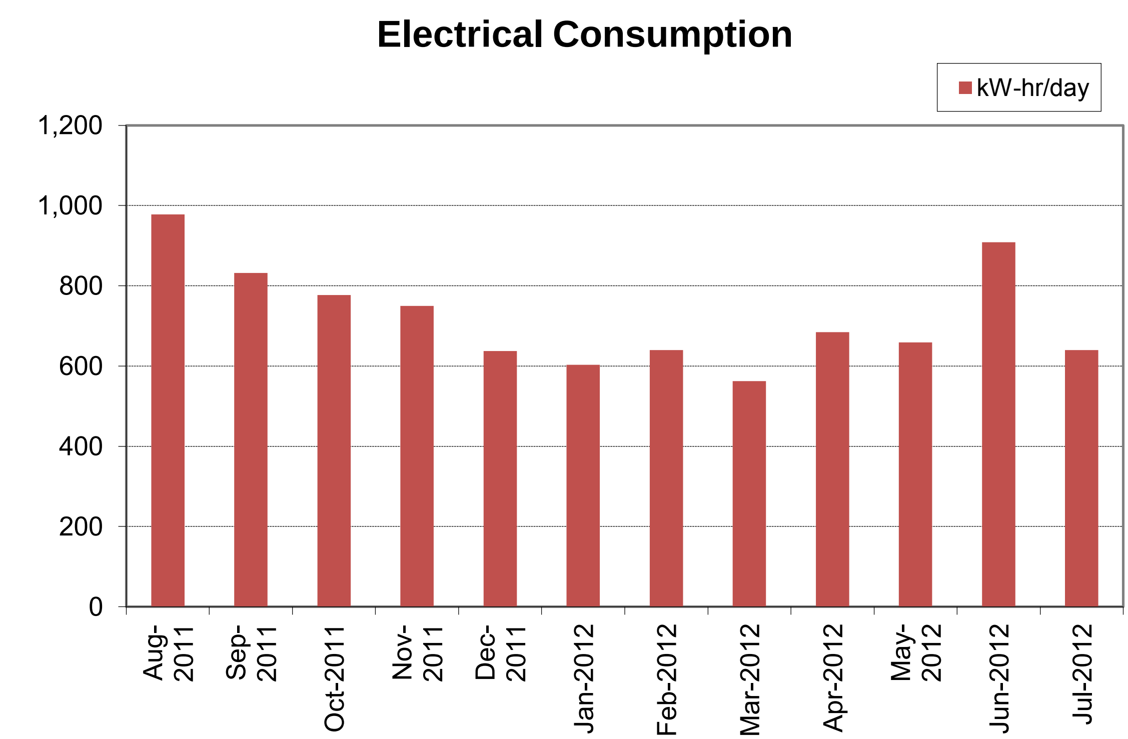


Electrical Usage: The following summary shows the past year's electrical energy use:

Electrical Consumption

		Period	Cost	Usage	
# days	kW-hr/day	**Month**	**Cost**	**kWh**	**cost/day**
31	978	Aug-2011	$3,294	30,320	$106
30	832	Sep-2011	$2,713	24,960	$90
31	777	Oct-2011	$2,618	24,080	$84
27	750	Nov-2011	$2,202	20,240	$82
30	637	Dec-2011	$2,081	19,120	$69
35	603	Jan-2012	$2,337	21,120	$67
29	640	Feb-2012	$2,055	18,560	$71
32	563	Mar-2012	$1,993	18,000	$62
29	684	Apr-2012	$2,196	19,840	$76
30	659	May-2012	$2,187	19,760	$73
31	908	Jun-2012	$3,112	28,160	$100
31	640	Jul-2012	$2,173	19,840	$70
average:	723	Totals	$28,960	264,000	$79 average

Electrical ECI:	$1.00	per sq ft/yr
Electrical ECU:	31,439	BTU/sq ft
Average Cost per kWh:	$0.11	$/kWh



Energy Improvement Recommendations

Building:

Windows: The existing windows show significant signs of weathering and should be replaced with a high efficient system, such as a thermally insulated metal frame construction type window with 1" argon filled low-E glazing.

Doors: The existing exterior doors are in fair condition. Weather stripping should be replaced or repaired and consideration should be given to re-hanging the man doors.

Ceilings: The roof system is in fair condition and no additional energy improvements are recommended. The interior ceiling space, specifically the second floor would experience some energy improvements with an additional of a layer of insulation above the ceiling.

The most significant or surprising "find" by using the thermal imaging camera was the large amount of heat loss detected through the upper south exterior wall (above roof of building 531). The excess heat loss should be examined more closely, and additional insulation should be added to the wall to save on lost energy.

HVAC:

1. The existing hot water boilers, rated at 80-82% efficiency should be replaced with higher efficiency type condensing boilers.
2. Hot water supply and return piping insulation should be examined. Sections of missing and/or hanging insulation should be replaced.
3. Ductwork insulation should be examined and repaired to maintain continuous coverage at all seams and fittings.
4. The ventilation system currently uses a direct outside air intake to the air handling unit on the second floor to provide fresh air to the fan coil units. A significant energy savings could be realized by installing an energy recovery ventilator on the air handler. This would reduce the amount of cooling and heating tonnage required to temper the outside air prior to being treated by the heating and cooling coils and discharged to the space.
5. Variable frequency drives should be considered for controlling the hot water and chilled water pumps. A savings in electrical usage would be realized by operating the pumps only at the speeds necessary to maintain the heating and cooling loads during part load operation.
6. The continuous operation of the exhaust system should be replaced with a system that operates the fans on motion sensors.
7. The fan coil units are in fair condition. Consideration should be given to replacing the units within the next ten years. The typical service life for these units is 25-30 years and more frequent maintenance will be required as the units' age. Also, parts will be become more difficult to obtain.

Plumbing:

1. Low flow aerators (0.5 gpm) should be installed on all faucets.
2. Alternate flow controls for sink and lavatories, such as motion sensor or timed faucets should be considered.
3. Low flow water closets (1.0 gpm or less) and waterless urinals should be considered.
4. A hot water return system should be installed. This will reduce the amount of water usage by providing adequate hot water at faucets in a timely fashion.

General: Consider upgrading all appliances to Energy Star rated type appliances. Energy star appliances typically use 15% less energy than non-rated appliances.

Renewable Energy Opportunities:

1. Due to the location of the building and available roof space, solar energy for hot water heating and/or electricity production is recommended.
2. In addition, wind assisted energy reclamation is a possibility.

Electrical Systems:

Many spaces in the building could benefit from motion sensors to turn off lights during un-occupied times of the day. For smaller offices, storage rooms, and similar smaller spaces a passive infrared wall box motion sensor would be recommended. For larger open rooms, ceiling mount passive infrared sensors would be appropriate. Dual technology ceiling sensors are recommended for bathrooms and other spaces with partitions.

In a few areas, lamps and ballasts were not upgraded during the past project and should be addressed.

In addition, it is recommended to replace exterior lighting and interior recessed “can” lights with LED technology for longer life and more efficient energy use.

Alternative Energy Opportunities:

Solar:

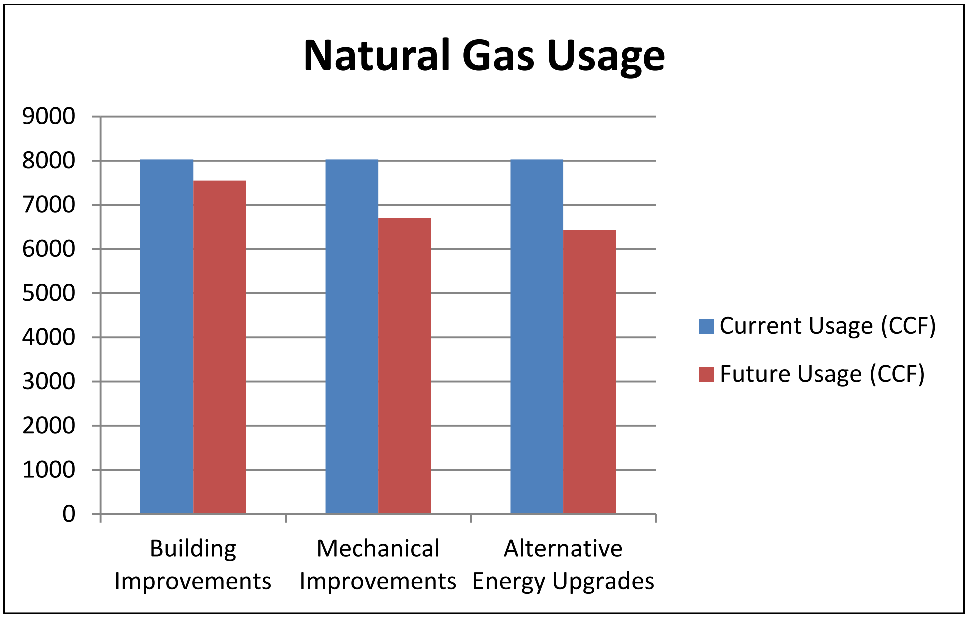
There is opportunity at this site for the utilization of solar energy for either hot water heating or electrical usage. A passive system of roof mounted direct and indirect solar arrays will offset gas and electrical usage and reduce CO2 emissions. The roof presently has only a few pieces of mechanical equipment, so location and footprint of the solar system equipment is only limited to the available roof area.

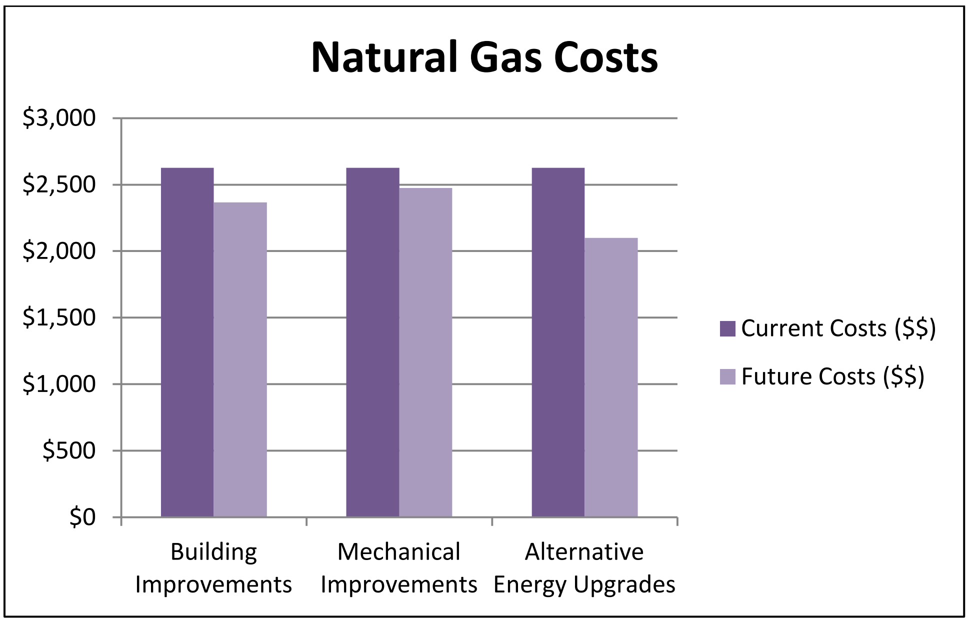
Potential Energy Cost Savings

Natural Gas:

The following data is a comparison of the existing natural gas usage and annual costs with the future improvements made per following:

1. Building improvements: New windows, improved weather sealing at doors and windows, added insulation.
2. Mechanical Improvements: Upgraded hot water heating boilers, repaired hot water piping insulation.
3. Alternative Energy Upgrades: Use of solar energy for hot water heating with existing hot water boilers and accessories to remain for secondary heating source.



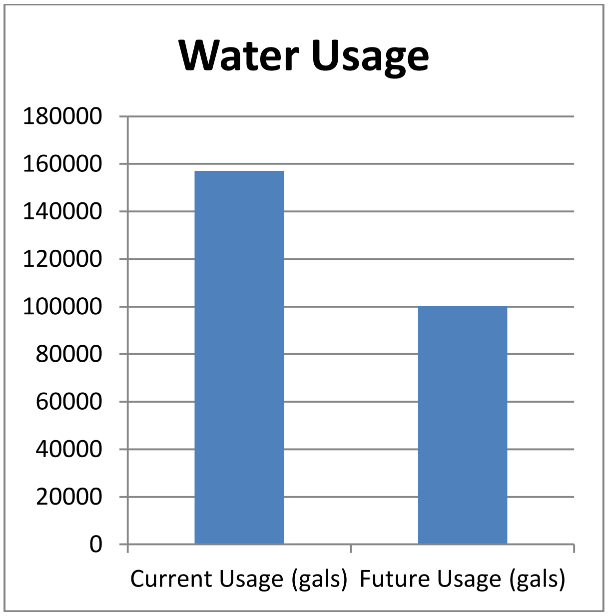


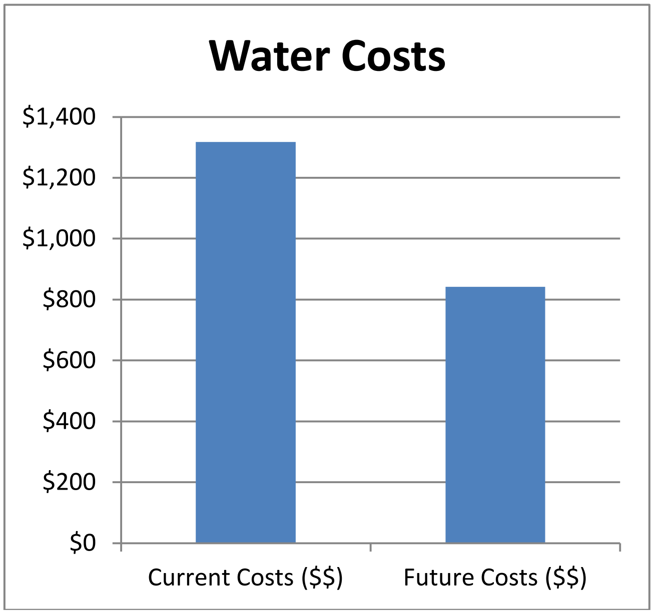
Energy Improvement Opportunity	ECI (per sq ft/yr)	ECU (BTU/sq ft)
Building Improvements	$0.08	26,233
Mechanical Improvements	$0.09	23,280
Alternative Energy Upgrades	$0.07	22,321

Water

The following is a comparison of the existing water usage and costs and the future water usage and costs with improvements made per the following:

1. Installation of low flow fixtures, waterless urinals and sensor operated faucets.
2. Installation of low flow aerators on sinks and lavatories.





Electrical Systems:

As part of the building energy analysis, UPEA has identified 76 locations where motions sensors could be added to reduce lighting energy consumption. Installation of motion sensors is estimated to save approximately $3000 per year of electrical energy.

The installation of approximately 20kW of rooftop solar (PV) electric panels & associated equipment (inverters, charge controllers, etc.) is estimated to reduce the building's annual electric bill by approximately $4000.

Thermal Imaging Data

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. The most significant or surprising "find" by using the thermal imaging camera was the large amount of heat loss detected through the upper south exterior wall (above roof of building 531). The excess heat loss should be examined more closely, and additional insulation should be added to the wall to save on lost energy.

References

Existing exterior wall U-value: 0.43 Btu/hr/sq ft/deg F
Existing roof U-value: 0.121 Btu/hr/sq ft/deg F
Existing window U-value: 0.55 Btu/hr/sq ft/deg F
Existing ACH: 0.85

Definitions and Abbreviations

ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME: American Society of Mechanical Engineers
ACH: Air changes per hour; measure of number of times air is exchanged in space.
BTU: British Thermal Units
GPF: Gallons per fixture
ECI: Energy Cost Index; measure of annual cost of energy measured in total square foot per of building.
ECU: Energy Conservation and Utilization index; measure of energy used per total square foot of building.
CCF: Measure of natural gas usage (equivalent to 100,000 cubic feet).
R-Value: Measure of resistance of an insulating or building material to heat flow.
U-Value: Measure of heat flow through an insulating or building material.
SHGC: Solar heat gain coefficient; measure of solar radiation passing through a window or skylight.

Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Software

HAP 4.06: Hourly Analysis Program, Carrier, Inc.
REVIT 2011: Computer Aided Design Software
FLIR Tools, Version 2.2: FLIR E40 Infrared Camera analysis software

Air System Sizing Summary for Tribal Admin 523 HVAC

Project Name: S10-12262 Tribal Admin 523 — 12/12/2012
Prepared by: UPEA — 10:26AM

Air System Information

Air System Name	Tribal Admin 523 HVAC		Number of zones	1	
Equipment Class	UNDEF		Floor Area	28800.0	ft^2
Air System Type	SZCAV		Location	Sault Ste Marie, Michigan	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Sum of space airflow rates		Calculation Months	Jan to Dec	
Space CFM	Individual peak space loads		Sizing Data	Calculated	

Central Cooling Coil Sizing Data

Total coil load	22.5	Tons	Load occurs at	Jul 1400	
Total coil load	269.6	MBH	OA DB / WB	82.3 / 68.8	°F
Sensible coil load	269.6	MBH	Entering DB / WB	76.1 / 68.0	°F
Coil CFM at Jul 1400	26697	CFM	Leaving DB / WB	66.5 / 65.0	°F
Max block CFM	26697	CFM	Coil ADP	65.5	°F
Sum of peak zone CFM	26697	CFM	Bypass Factor	0.100	
Sensible heat ratio	1.000		Resulting RH	68	%
ft^2/Ton	1282.0		Design supply temp.	58.0	°F
BTU/(hr-ft^2)	9.4		Zone T-stat Check	1 of 1	OK
Water flow @ 10.0 °F rise	53.94	gpm	Max zone temperature deviation	0.0	°F

Central Heating Coil Sizing Data

Max coil load	461.4	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	26697	CFM	BTU/(hr-ft^2)	16.0	
Max coil CFM	26697	CFM	Ent. DB / Lvg DB	62.3 / 78.7	°F
Water flow @ 20.0 °F drop	46.17	gpm			

Supply Fan Sizing Data

Actual max CFM	26697	CFM	Fan motor BHP	10.97	BHP
Standard CFM	26005	CFM	Fan motor kW	8.70	kW
Actual max CFM/ft^2	0.93	CFM/ft^2	Fan static	1.50	in wg

Outdoor Ventilation Air Data

Design airflow CFM	2328	CFM	CFM/person	19.40	CFM/person
CFM/ft^2	0.08	CFM/ft^2			

FLIR

Measurements	°F
Sp1	53.1

Parameters	
Emissivity	0.95
Refl. temp.	68 °F

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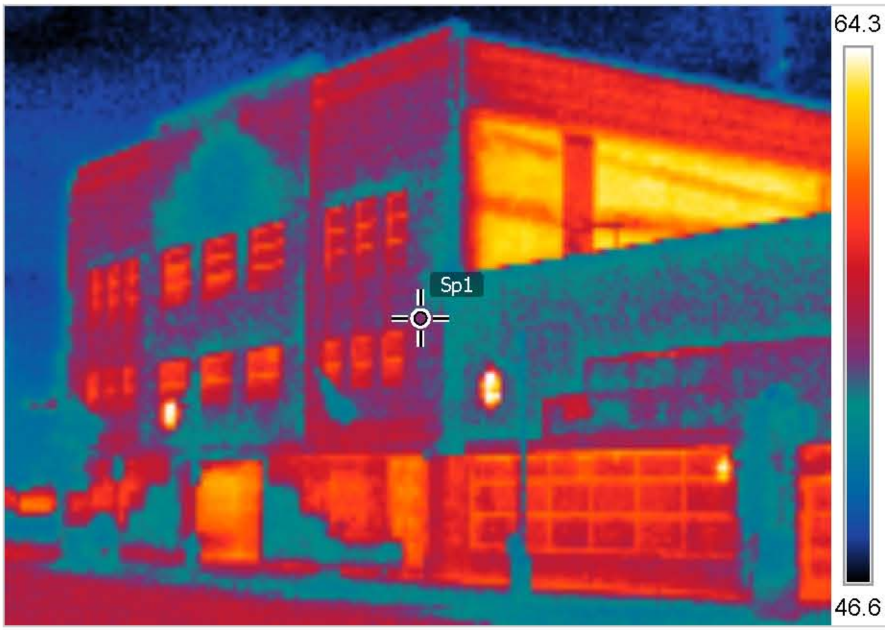

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FLIR

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Parameters	
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Refl. temp.	68 °F

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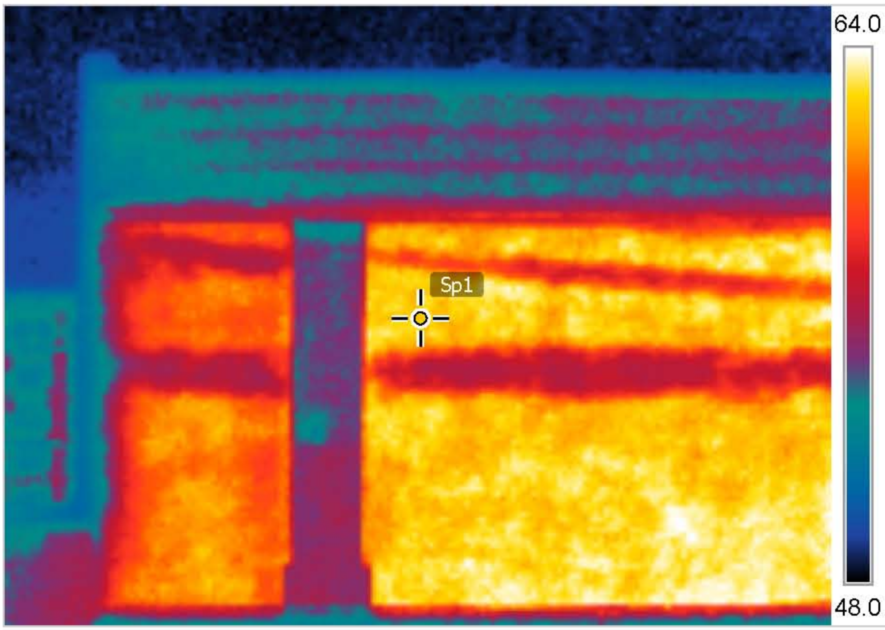

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UPEA ENGINEERS & ARCHITECTS

Energy Audit
Tribal Administration
531 Ashmun Street
Sault Ste. Marie, MI

October, 2012

Table of Contents

Summary

The building located at 531 Ashmun Street in Sault Ste. Marie, MI was built in 1965. The facility was purchased in 1995 and thereafter renovated for Tribal Administration. The building consists of approximately 41,922 square feet of space. The lower level currently contains office and conference space for various departments, mechanical, electrical, computer rooms and various components along with storage spaces etc. 1^{st} floor or main level currently houses Ojibway Cultural Information Center, River of History Museum and the Sault Tribe Gaming Commission. The building shares "common walls" on the north and south sides, approximately 100 feet, between the Tribal Administration Building 523 and Austin's Oak with the east front entrance exposed. The rear of the building has approximately 125 feet of north and south exposure, with the rear west entrance fully exposed. The overall building height to the roof deck is 16 feet 6 inches. There are two exterior double doors located at the east and west entrances, four doors total. A commercial kitchen was added in 1998.

Existing Building Envelope Profile

Wall Construction: The exterior walls are comprised of two wall systems with an 8" block interior/drywall finish. The east and west lower exterior wall treatment is a partial brick and brick tile veneer, with the upper treatment consisting of stucco. The composite R value for the front and side exterior walls is 16.03 hr-sq ft-deg F/btu. The north and south exposed exterior wall construction is brick with an R value of 16.85 hr-sq ft-deg F/btu. The interior walls are metal stud construction with painted drywall finishes.

An interior mechanical chase located in the basement along the north exterior wall is not insulated.

Ceiling Construction: The ceilings are a combination of open structure, ACT and gypsum board. All of the ceilings are in good condition. There are missing ACT sections in the kitchen area.

Roof Construction: The roof construction is a built up roofing system consisting of a corrugated metal deck, 1/2 inch recovery board, 2-1/2 inch rigid insulation and rubber membrane. The rubber membrane is a continuous and fully adhered CARLISLE 60-mill EPDM (rubber membrane). The roof is in good condition. The R value for this system including outside and inside surface resistance is 8.29 hr-sq ft-deg F/BTU.
The roof has ten skylights with 14 inch high roof curbs that are in good condition. The thermal values for the skylights have a U value of 0.45 BTU/hr-sq ft-deg F, SHGF of 0.21.

Floor Construction: The basement floor base is a 4" inch concrete slab on grade without perimeter insulation. The floor treatment is a combination of padded carpet and tile. The second floor is a 4" concrete planks over steel bar joists. The floor treatment is a combination of padded carpet and tile.

Window and Door Construction: The exterior windows are double glazed metal frame type, non-operable. Window framing show signs of aging and have visible gaps at the joints. Weather stripping around the windows is consistent and in fair condition. The U value for the exterior windows is 0.550 BTU/hr-sq ft-deg F with an infiltration rate of 1 ACH. The exterior doors are metal frame, insulated, with 75% or more double pane glazing. The doors do not have a sealed weather stripping. They are in good operating condition, however do have visible gaps at the vertical seal joints. The U value for the doors is 0.20 BTU/hr-sq ft-deg F with an infiltration rate of 0.7 ACH.

Existing Mechanical Systems Profile

Heating, Ventilation and Air Conditioning Systems: The building is served by a hot water heating system, chilled water system and dedicated air handling units for ventilation and heating and cooling. Local exhaust is provided by down blast roof top exhaust fans, curb mounted. The terminal units are fan coil units, convectors and cabinet unit heaters.

Heating water is supplied by three natural gas fired, 82% efficient, Weil-Mclain model PFG-8, 427 MBH gas input boilers located in the basement mechanical room. The boilers are direct vent, primary/secondary piping. The piping insulation in the mechanical room is in fair condition. Two main heating pumps provide hot water distribution, each pump is 1 hp, 208v/3ph. The boilers, pumps, expansion tank and boiler room accessories were installed in 1996.

The chilled water system is an 80 ton Trane roof top condensing unit with matching evaporator located in basement mechanical room. Two main chilled water pumps provide chilled water distribution, each pump is 3 hp, 208v/3ph. The insulation located in the mechanical room is in fair condition, with some signs of wear. The chilled water piping insulation on the roof is in poor condition. The chiller system including pumps and accessories was installed in 1996.

Basement HVAC: The basement air delivery system is provided by ceiling concealed fan coil units with heating and chilled water coils for the occupied areas. Localized heating is provided by hot water convectors. Outdoor air is provided either directly to the fan coil units or through the plenum space by an air handling unit located in the basement mechanical room. This unit is a York model CSI32 and has both hot and chilled water coils and provides 1550 cfm.

First floor HVAC: The east half of the first floor is served by the same system as the basement. The west half of the first floor is served by four gas fired roof top air handlers. Three of the roof top units are Trane units with DX cooling. A separate Reznor roof top unit with a detached condenser serves the previous kitchen area. These units provide heating, cooling and ventilation for the occupied spaces and also have economizers. The units were installed in early 2000 are in excellent condition. Local heating is provided by hot water convectors installed in 1996.

The air terminals for both floors is through 4-way, 3-cone ducted steel ceiling differs and non-ducted ¾ inch core return air grilles, plenum returned to the fan coil units.

The exhaust fan operational schedule for the front half of the building is continuous. The exhaust fan operational schedule for the rear is based on a time schedule and run on 2 hr intervals up to a maximum of 8 hours continuously.

Plumbing Systems:

There are two domestic water heating systems. The first system serves primarily the previous kitchen and front area bathrooms. This consists of a single storage type gas fired water heater, 80 gallon capacity, Lochinvar 199. There is not a hot water return loop or pump system. The second system serves the rear area of the building and consists of a single gas fired water heater, 100 gallon capacity, Lochinvar 88. There is a hot water return loop on this system. Flow tests done at farthest fixtures resulted in hot water being delivered to the faucet in less than one minute which is acceptable. The insulation for both systems is in fair condition.

Water closets and urinals are flush valve types, 1.6 gpf or greater flows. All valves are in working condition. The sink faucets are single handle, manually controlled, standard flow types. Automatic control is not provided for any plumbing fixtures.

Temperature Controls Systems:

The building has two temperature control systems. The first floor front area is a pneumatic control system with stand alone non-programmable thermostats that control the roof top units. The first floor rear area and basement areas have a Delta direct digital control system. This area is maintained on an occupied/unoccupied schedule. The unoccupied schedule closes the outdoor air to the terminal units and provides limited cooling and heating capability and return air only. The Delta building management system was installed in 2001.

Special Systems: General description. There is a full fire sprinkler and alarm system with connection to Alert Electronics for notifications.

Existing Electrical Systems Profile

Lighting Systems:

The majority of interior lights are 4' linear fluorescent. Fixtures have recently been upgraded to T8 lamps and electronic ballasts throughout. Lamps are Osram/Sylvania 25-watts, with color temperature of 4100K. Electronic Ballasts are instant start, GE UltraMax.

Power Systems:

The building is served from an exterior pad-mount transformer owned by Cloverland Electric (formerly Edison Sault). The main switchboard is 1600-amp, 208Y/120-volt, 3-phase, 4-wire and is located in main electrical room in the basement. The majority of electrical branch panels are also located in the main electrical room, with additional panels in mechanical rooms.

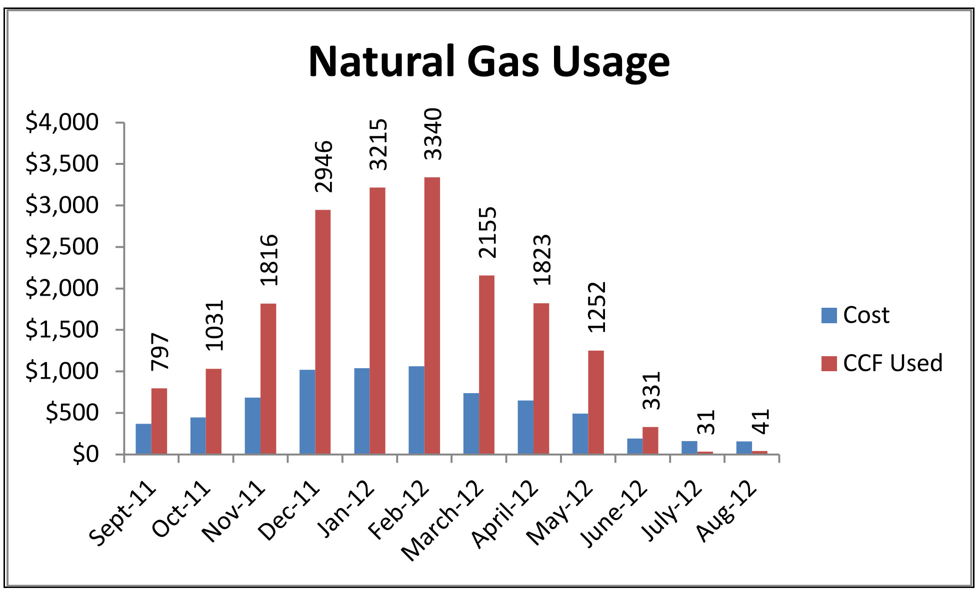
Existing Energy Consumption and Energy Cost Analysis

Natural Gas Usage

The following graphical data represents the combined monthly natural gas usage and costs for the separate gas meters. Information as shown is for the billing period of September 2011 to August 2012.

Month	Cost	CCF
Sept-11	$370	797
Oct-11	$447	1,031
Nov-11	$686	1,816
Dec-11	$1,021	2,946
Jan-12	$1,039	3,215
Feb-12	$1,061	3,340
March-12	$737	2,155
April-12	$649	1,823
May-12	$491	1,252
June-12	$191	331
July-12	$159	31
Aug-12	$156	41
Totals	$7,007	18,778

Natural Gas ECI:	$0.16	per sq ft/yr
Natural Gas ECU:	42,677	BTU/sq ft
Average Cost per CCF:	$0.37	$/CCF

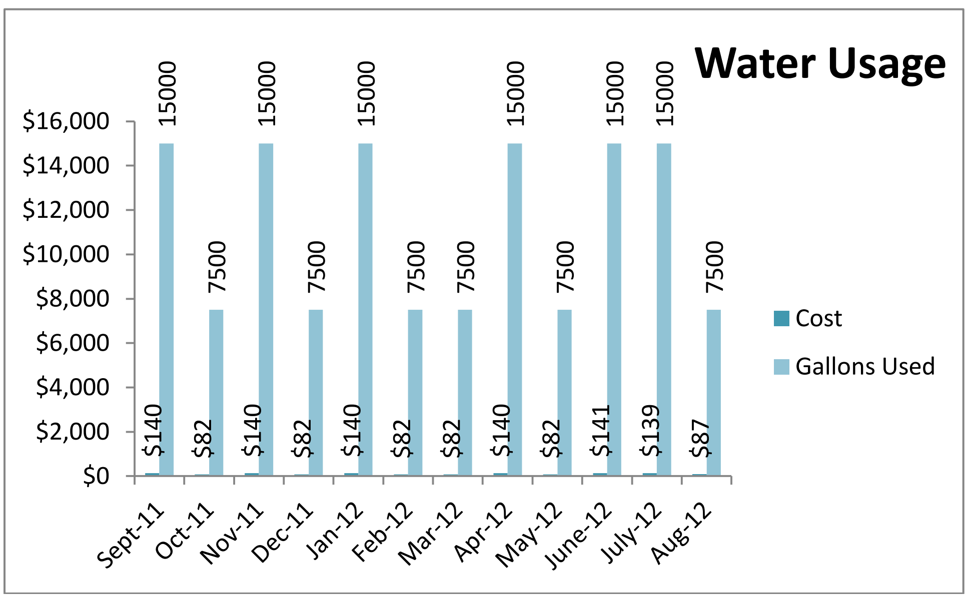


Water Usage

The following data is a graphical representation of the monthly and annual water usage and costs.

Month	Cost	Gallons
Sept-11	$140	15,000
Oct-11	$82	7,500
Nov-11	$140	15,000
Dec-11	$82	7,500
Jan-12	$140	15,000
Feb-12	$82	7,500
Mar-12	$82	7,500
Apr-12	$140	15,000
May-12	$82	7,500
June-12	$141	15,000
July-12	$139	15,000
Aug-12	$87	7,500
Totals	$1,335	135,000

Cost per sq ft:	$0.03	per sq ft/yr
Average Usage per Fixture:	3,553	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon

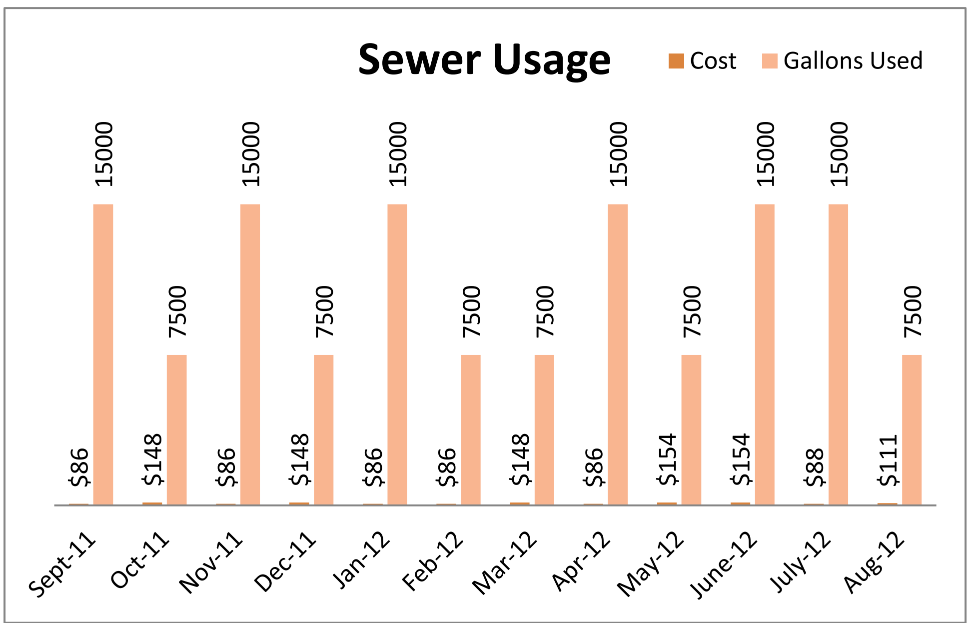


Sewer Usage

The following data is a graphical representation of the monthly and annual water usage and costs.

Month	Cost	Gallons
Sept-11	$148	15,000
Oct-11	$86	7,500
Nov-11	$148	15,000
Dec-11	$86	7,500
Jan-12	$148	15,000
Feb-12	$86	7,500
Mar-12	$86	7,500
Apr-12	$148	15,000
May-12	$86	7,500
June-12	$154	15,000
July-12	$154	15,000
Aug-12	$88	7,500
Totals	$1,418	135,000

Cost per sq ft:	$0.03	per sq ft/yr
Average Usage per Fixture:	3,553	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon



Electrical Usage: The following summary shows the past year's electrical energy use:

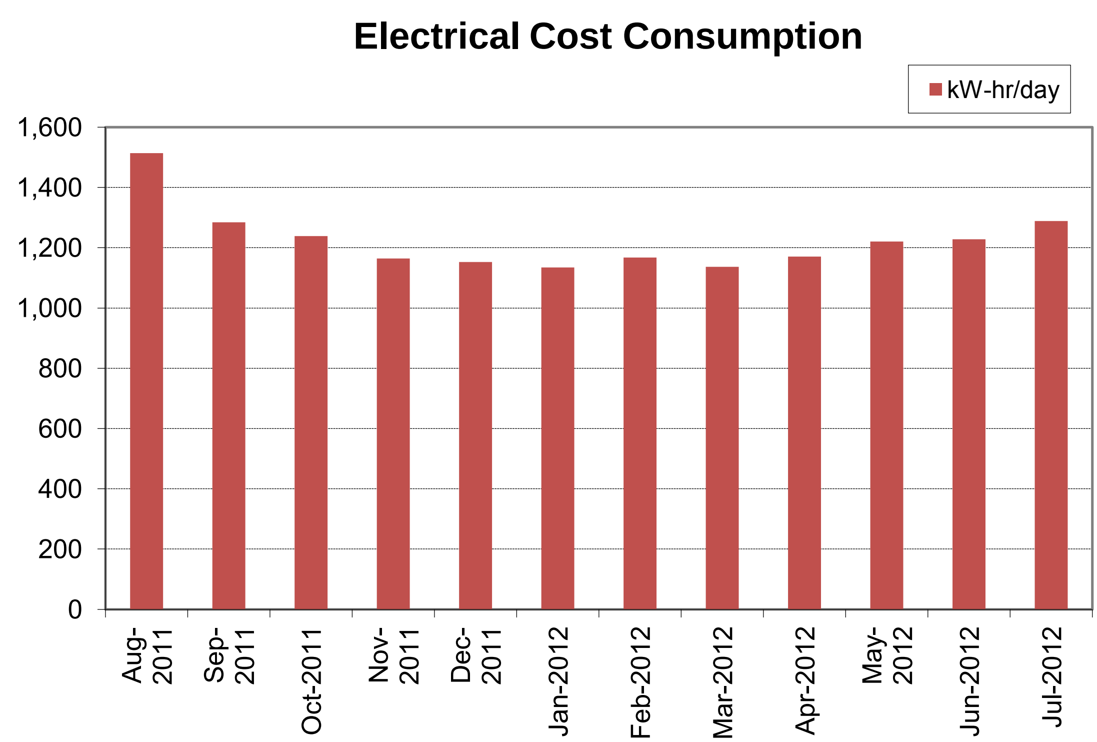
Electrical Consumption

# days	kW-hr/day	Period Month	Cost Cost	Usage kWh	cost/day
31	1,514	Aug-2011	$4,308	46,920	$139
30	1,284	Sep-2011	$3,583	38,520	$119
31	1,239	Oct-2011	$3,559	38,400	$115
27	1,164	Nov-2011	$2,963	31,440	$110
30	1,152	Dec-2011	$3,243	34,560	$108
35	1,135	Jan-2012	$3,799	39,720	$109
29	1,167	Feb-2012	$3,294	33,840	$114
32	1,136	Mar-2012	$3,503	36,360	$109
29	1,171	Apr-2012	$3,317	33,960	$114
30	1,220	May-2012	$3,549	36,600	$118
39	1,228	Jun-2012	$5,413	47,880	$139
23	1,289	Jul-2012	$2,901	29,640	$126
Average:	1,225	Totals	$43,432	447,840	$118

Square Footage 41922

kW-hr per sq ft per year = 10.7

Electrical ECI:	$1.04	per sq ft/yr
Electrical ECU:	36,727	BTU/sq ft
Average Cost per kWh:	$0.10	$/kWh



Energy Improvement Recommendations

Building:

Windows: It is recommended to upgrade/replace existing window frames and windows to a Double pane, low-e, argon filled glazing.

Doors: It is recommended to upgrade/replace weather-stripping & “sweeps” on exterior doors, especially at double entry doors to reduce infiltration air particularly for severe heating and cooling seasons.

Insulate exposed wall in basement: The infrared camera photos show significant heat loss through the basement exterior walls especially on the south and east sides of the building. Particularly on the south side, the heat is traveling up through masonry in wall even to the roof level. A proper and complete fix for this would involve extensive work excavating around the building, installing proper insulation, and backfill/restoration including re-pouring/repaving sidewalks and parking areas. It is likely that the extensive project cost would result in a very long payback period.

The addition of insulation to specific areas of the building will provide a measured reduction in overall heating and cooling losses. It is recommended that two inches of rigid insulation be installed on the interior of the exposed exterior pipe chase walls as this will add an R value of 8. Also, insulation installed above the first floor ceiling will provide an additional thermal barrier to heating/cooling losses through the plenum space and roof.

Mechanical Systems:

Replacement of the existing boilers with higher efficiency sealed combustion type boilers will reduce gas utility costs considerably. A modular boiler approach is recommended for this building due to the adverse zoning strategy. A system of two to three modular high efficient boilers with a heating control strategy that matches the building heating load more accurately will ensure that the energy use for heating water will be minimized.

The current system for part of the building uses a single air handling unit located in the basement mechanical room to provide the required ventilation for the terminal units in the basement and part of the first floor. It is recommended that a system of air to air energy recovery ventilators be used to provide ventilation for these units. This would eliminate the energy demands required for the existing air handling unit, specifically the heating and cooling demands required to condition direct outside air. The energy recovery ventilators could be used to recover energy from the direct exhaust systems (bathroom fans, etc.). It is recommended that several units be considered to concentrate the energy use as required.

Because the remaining part of the building is served by newer roof top units, it is recommended that a preventive maintenance schedule be implemented at this time focusing on the manufacturer’s recommended maintenance schedule. The systems should be inspected annually and improvements made to the system based on the standard life expectancy for this equipment. The addition of an air to air energy recovery system for the roof top units will reduce energy costs; however the payback period at this time will not result in a significant energy savings for an extended period of time when compared to the investment for this additional equipment.

Another area of opportunity for energy improvement is the pumping systems for both the main heating and chilled water systems. It is recommended that adjustable variable frequency drive systems be installed on the main heating and chilled water pumps. This will provide a decrease in electrical utility costs by allowing the pumps to operate at a speed that matches the building cooling and heating loads. The current system operates the pumps at full speed based, regardless of whether a full demand load is required. The secondary pumps should also be replaced with pumps that adjust flow and pressure loss automatically.

Piping insulation for both the heating and cooling systems should be replaced. Both insulation systems are in fair condition, with insulation missing or in poor condition in certain sections. Insulation for the heating piping should be 1 to 1-1/2 inch continuous molded glass fiber type with a vapor barrier jacket. The insulation for the chilled water piping should be 1/2 to 1 inch continuous molded glass fiber type with a vapor barrier jacket. Both insulation treatments should be sealed. This will result in less heating and cooling loss in the piping.

It is recommended that the pneumatic temperature control system as utilized for a part of the building be replaced and integrated into the existing direct digital controls system used for the remaining part of the building. The pneumatic system contributes to additional energy and maintenance costs for several reasons:

- The operation of the system using a compressor causes excess electrical usage.
- Maintenance of the control valves, tubing and compressor requires constant attention. In addition, replacement parts for this equipment are often difficult to obtain.
- The pneumatic temperature control system has in inherent lack of system control.

The exhaust system energy usage will be reduced by the installation of motion sensors at specific locations that are used to operate the fans only when necessary. The current exhaust fan operational control scheme requires the fans to run continuously, expending energy when not required.

Plumbing:

There are several opportunities for water conservation in the existing plumbing system. The water closets and urinals currently utilize medium to high flow type flush valves. Installation of low flow (1.1 to 1.3 gpf) flush valves is recommended. Utilization of an automatic system of flush operation is recommended, such as dual powered solar flush valves. The installation of waterless urinals as an alternate to flush valves for the urinals will also contribute to water conservation. The lavatory trim is currently a single lever manual operation. It is recommended that these be replaced with either a sensor valve or push-button type valve. In addition, low-flow aerators installed on the valves will limit flow and conserve water usage.

The domestic hot water heating system uses storage type gas fired hot water heaters. Storage type tank water heaters have stand-by heat losses in the tank, and as result energy is continually used to reheat the water in the tank to the designed discharge hot water temperature. It is recommended that these be replaced with one of the following:

- An indirect hot water heating system incorporated into the buildings heating system. The building heating system would be used to provide the heating source for the domestic hot water through the use of a fluid-to-fluid heat exchanger.
- A central tankless or on demand domestic hot water heating system. This would eliminate the stand-by losses as experienced with the traditional storage tank system.

Electrical Systems:

Many spaces in the building could benefit from motion sensors to turn off lights during un-occupied times of the day. For smaller offices, storage rooms, and similar smaller spaces a passive infrared wall box motion sensor would be recommended. For larger open rooms, ceiling mount passive infrared sensors would be appropriate. Dual technology ceiling sensors are recommended for bathrooms and other spaces with partitions.

Daylight harvesting control should be evaluated for the main corridor areas and other spaces that have plenty of natural light during daylight hours.

In a few areas, lamps and ballasts were not upgraded during the past project and need to be addressed. Specifically, the fluorescent “up-lights” in the atrium areas are of an older in-efficient type. Also, the Cultural Center has at least 10 2x4 3-lamp light fixtures still utilizing 40-watt T12 lamps (and presumably magnetic ballasts), along with 12 track heads utilizing incandescent lamps. The museum has a total of approximately 80 incandescent and PAR type spot or flood lights that could be replaced with CFL or LED technology.

Alternative Energy Opportunities:

Solar:

There is opportunity at this site for the utilization of solar energy for either hot water heating or electrical usage. A passive system of roof mounted direct and indirect solar arrays will offset gas and electrical usage and reduce CO2 emissions. Location and footprint of the solar system equipment will be limited due to the existing roof mounted equipment.

Potential Energy Cost Savings

The following analysis is an estimate of the potential energy savings in usage and annual utility costs. The building was modeled using the current construction and systems. The building was then modeled using the improvements as mentioned in this report, using a consolidation of all the improvements per system or building construction. The improvements in energy costs use the current utility rates as a base and do not take into consideration increased costs or adjustments due to inflation or building usage. Potential savings in usage and cost are based solely on the specific improvements and do not reflect the combined savings if more than one of the recommended improvements are made.

The building improvements will result in the following estimated savings:

- ECI: $0.15 per sq ft/yr
- ECU: 40, 968 Btu/sq ft

The mechanical improvements will result in the following estimated savings:

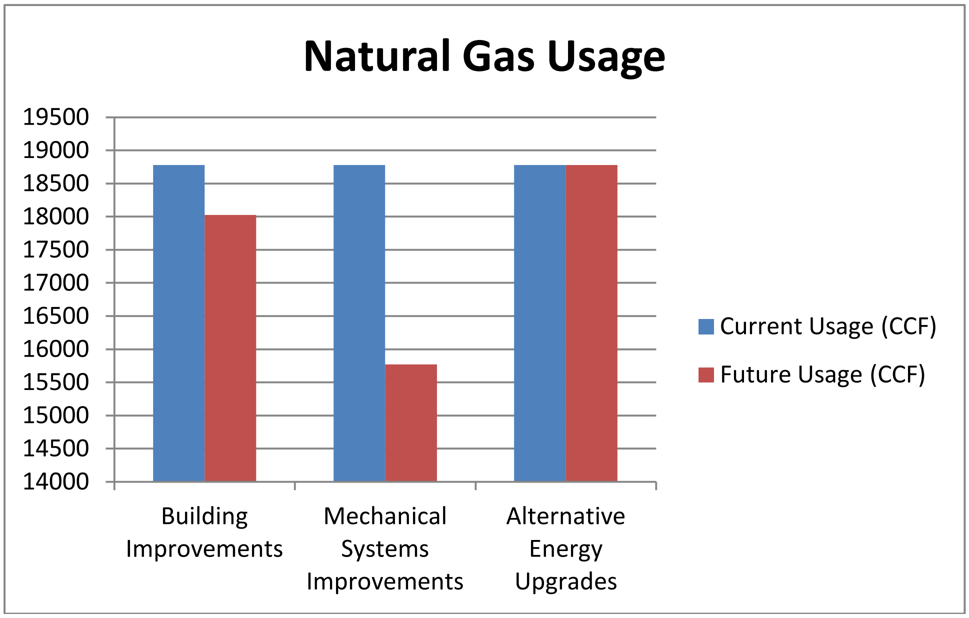
- ECI: $0.13 per sq ft/yr
- ECU: 35, 848 Btu/sq ft

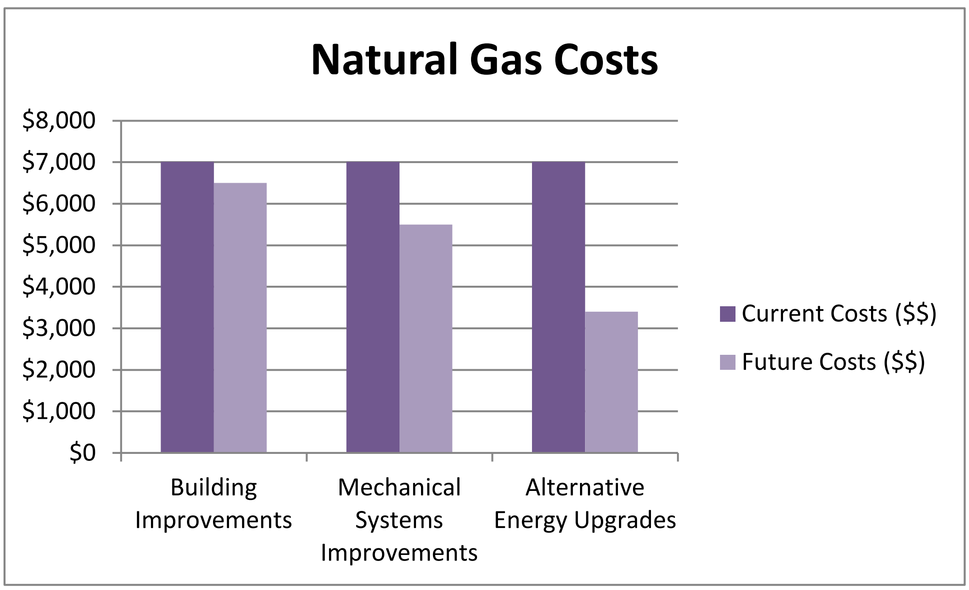
The alternative energy improvements will result in the following estimated savings:

- ECI: $0.08 per sq ft/yr
- ECU: 42, 677 Btu/sq ft

Natural Gas

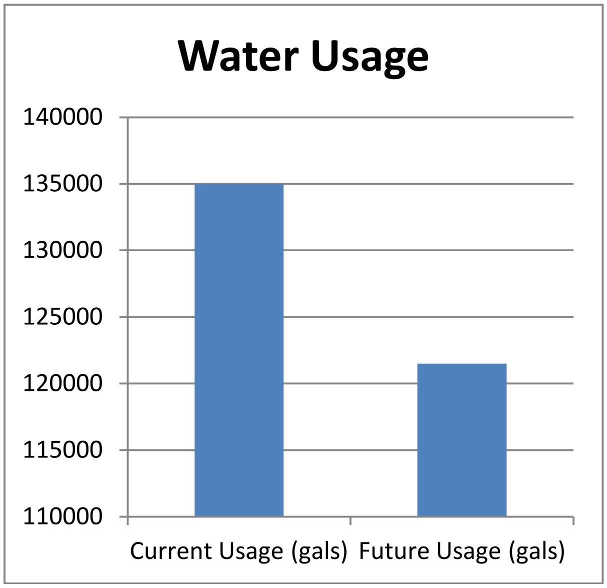
Energy savings on natural gas usage are based on the installation of high efficiency boilers, pipe and ceiling insulation, replacement of windows and doors, added insulation at ceiling and exposed walls, indirect fired water heaters and solar energy used for heating.

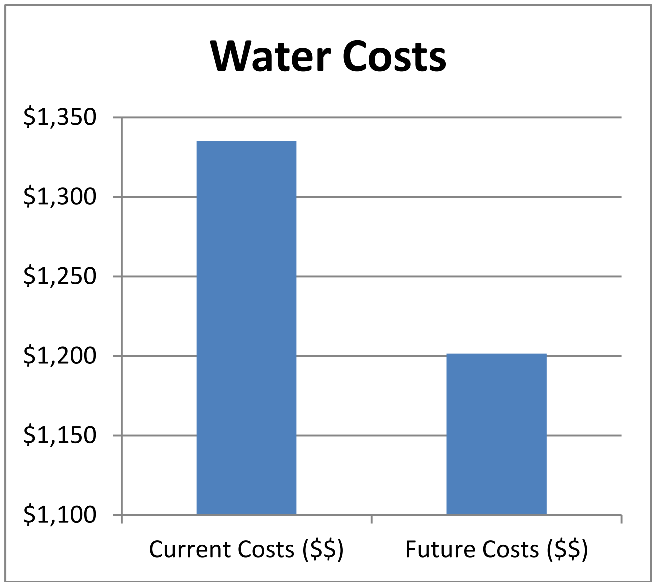




Water

Energy savings on water consumption are based on waterless urinals, low flow flush valves and optic sensor faucet operation.





Electrical Systems:

As part of the building energy analysis, UPEA has identified 24 locations on the lower floor and 65 locations on the main (or street) floor where motions sensors should be added to reduce lighting energy consumption. Installation of motion sensors is estimated to save approximately $1250 per year of electrical energy.

The museum lighting is recommended to be upgraded to more energy efficient type, along with controls that will light levels when no visitors are present. Lighting improvements in the museum are predicted to save approximately $850 per year of electrical energy.

The installation of approximately 20kW of rooftop solar (PV) electric panels & associated equipment (inverters, charge controllers, etc.) is estimated to reduce the building's annual electric bill by approximately $4000.

Thermal Imaging Data

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. The most significant or surprising "find" by using the thermal imaging camera was the large amount of heat loss detected at the top of basement wall and exterior grade line. It is quite evident especially on 2 sides of the building that insulation should be added to the basement wall. However, this typically involves considerable excavation & restoration work at the building exterior and would result in an extended payback period.

References

Existing wall U-value: 0.053 Btu/hr/sq ft/deg F
Existing roof U-value: 0.045 Btu/hr/sq ft/deg F
Existing window U-value: 0.588 Btu/hr/sq ft/deg F
Existing ACH: 0.62

Definitions and Abbreviations

ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME: American Society of Mechanical Engineers
ACH: Air changes per hour; measure of number of times air is exchanged in space.
BTU: British Thermal Units
GPF: Gallons per fixture
ECI: Energy Cost Index; measure of annual cost of energy measured in total square foot per of building.
ECU: Energy Conservation and Utilization index; measure of energy used per total square foot of building.
CCF: Measure of natural gas usage (equivalent to 100,000 cubic feet).
R-Value: Measure of resistance of an insulating or building material to heat flow.
U-Value: Measure of heat flow through an insulating or building material.
SHGC: Solar heat gain coefficient; measure of solar radiation passing through a window or skylight.

Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Testing Equipment

Software

HAP 4.06: Hourly Analysis Program, Carrier, Inc.
REVIT 2011: Computer Aided Design Software

Air System Sizing Summary for Tribal Admin 531 HVAC

Project Name: S10-12262 Tribal Admin 531 — 10/16/2012
Prepared by: UPEA — 11:32AM

Air System Information

Air System Name	Tribal Admin 531 HVAC		Number of zones	1	
Equipment Class	UNDEF		Floor Area	66000.0	ft²
Air System Type	SZCAV		Location	Sault Ste Marie, Michigan	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Sum of space airflow rates	Calculation Months	Jan to Dec
Space CFM	Individual peak space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	46.0	Tons	Load occurs at	Jul 1400	
Total coil load	552.2	MBH	OA DB / WB	82.3 / 68.8	°F
Sensible coil load	486.7	MBH	Entering DB / WB	77.3 / 65.4	°F
Coil CFM at Jul 1400	26324	CFM	Leaving DB / WB	59.7 / 58.6	°F
Max block CFM	26324	CFM	Coil ADP	57.7	°F
Sum of peak zone CFM	26324	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.881		Resulting RH	54	%
ft²/Ton	1434.2		Design supply temp.	58.0	°F
BTU/(hr-ft²)	8.4		Zone T-stat Check	1 of 1	OK
Water flow @ 10.0 °F rise	110.50	gpm	Max zone temperature deviation	0.0	°F

Central Heating Coil Sizing Data

Max coil load	630.3	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	26324	CFM	BTU/(hr-ft²)	9.5	
Max coil CFM	26324	CFM	Ent. DB / Lvg DB	54.9 / 77.7	°F
Water flow @ 20.0 °F drop	63.06	gpm			

Supply Fan Sizing Data

Actual max CFM	26324	CFM	Fan motor BHP	10.81	BHP
Standard CFM	25642	CFM	Fan motor kW	8.58	kW
Actual max CFM/ft²	0.40	CFM/ft²	Fan static	1.50	in wg

Outdoor Ventilation Air Data

Design airflow CFM	4710	CFM	CFM/person	31.40	CFM/person
CFM/ft²	0.07	CFM/ft²			

FLIR

Measurements	°F
Sp1	57.3

Parameters	
Emissivity	0.95
Refl. temp.	68 °F

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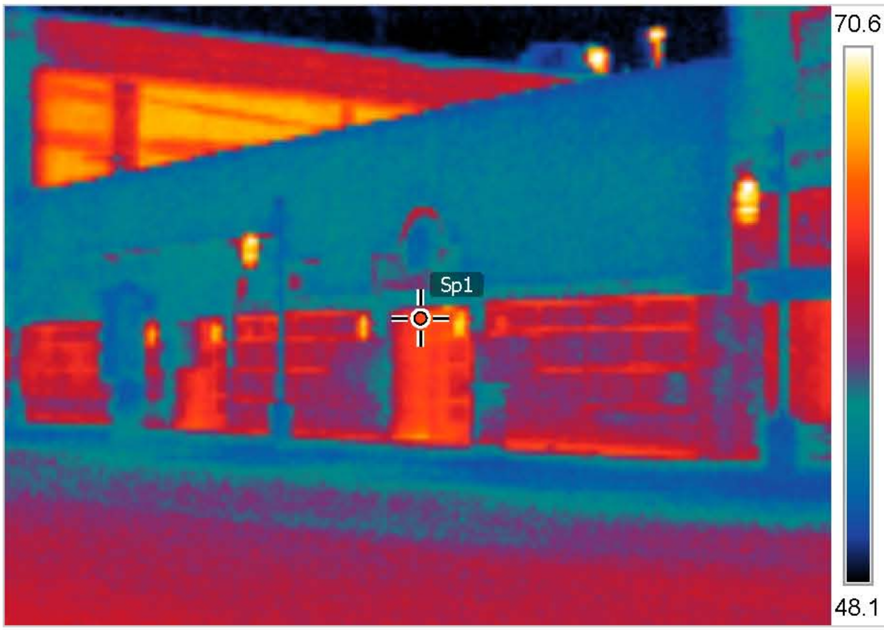

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FLIR

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Sp1	62.6

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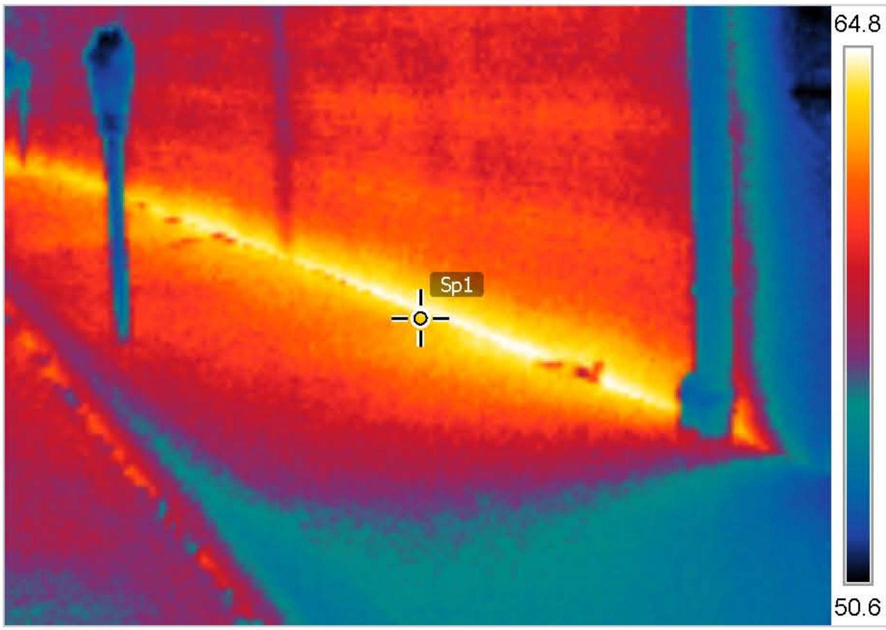

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UPEA ENGINEERS & ARCHITECTS

Energy Audit
Chi-Mukwa Community Recreation Center
Two Ice Circle
Sault Ste. Marie, MI 49783

December 2012

Table of Contents

Summary

Chi Mukwa or Big Bear Community Recreation Center was built in 1995. This facility is approximately 150,000 square feet and has 2 floors. The center includes a retail area, basketball, volley ball, aerobic and weight rooms, 2 ice rinks, dressing rooms and offices along with many other amenities. The building is conveniently located adjacent to Tribal Housing, Pow Wow Grounds and the Niigaanagiizhik Ceremonial building.

Existing Building Envelope Profile

Wall Construction: The exterior wall profile consists of two construction types. The upper wall is a pre-engineered wall panel system with finish insulation. The lower wall is 8" concrete block without insulation. The exterior walls show signs of moisture in the wall cavity which has caused the insulation to migrate to the bottom of the wall structure. Several interior panels were loose and wet insulation was visible. Exterior walls showed signs of moisture and discoloring at several locations. The interior walls and partitions are a combination of painted block and stud frame with gyp board construction.

Roof Construction: The roof system is continuous and is a PVC membrane roofing system with two layers of poly-rigid insulation. The roof appeared to be in fair condition however significant spots of moss or mold was evident, especially along the roof membrane seems.

Floor Construction: The lower level floor is concrete slab on grade without insulation. The R-value is 1.11. The upper level floor is 8" pre-cast concrete planking. The floor finishes are exposed concrete, carpet, tile and VCT. The floors are in good condition.

Window and Door Construction: There are four door types:

- Aluminum, 1" insulated, with glass over 75%
- Aluminum, ¼" clear glass over 75%
- Hollow metal
- FRP faced door

There are two overhead doors at the North side of the building.

The side, front doors and overhead doors are in fair condition with weather stripping missing and visible gaps noticed. The interior double doors to the ice rink also had visible gaps as cold air was felt coming out of the ice rink area.

The windows are in good condition.

Existing Mechanical Systems Profile

HVAC

General Description: The HVAC systems are comprised of air handling units with hot water/chilled water coils, air handling heat exchangers with hot water/chilled water coils, fan coil units, hot water heating systems including a snow melt system, chilled water cooling system, infra-red heating, hot water unit heaters, hot water cabinet unit heaters and roof mounted/ceiling/inline exhaust fans. Following is a summary of the systems and the spaces that they serve:

- The hot water heating system is comprised of two natural gas fired Weil McLain boilers, 1,430,000 btu each installed. One boiler is located in the north mechanical room and the other was moved to the mezzanine area near the west ice rink. The hot water heating system includes two primary circulation pumps. 5 horsepower each, expansion tank, air separator and accessories. The system provides hot water to the air handlers, air exchangers, cabinet unit heaters and unit heaters. The pumps show signs of rusting at the flanges and need maintenance. The pipe insulation is in good condition.

- The cooling system is chilled water provided by a central air cooled reciprocating chiller, 139 ton capacity located at north side of building. The chilled water system includes two primary circulation pumps rated at 10 horsepower each, expansion tank, air separator and accessories located in the north mechanical room. The system provides chilled water to the air handlers and air exchangers. The pumps show signs of rust and need maintenance. The pipe insulation is in good condition.

- Indoor air handling units provide heating, cooling and ventilation for the volleyball court, basketball court, lobby area, pro shop, second floor viewing area and exercise room. The duct distribution system including insulation was sealed and in good condition.

- Indoor air heat exchangers serve the locker rooms and front upper office areas. Space temperature is controlled by horizontal fan coil units above the ceilings.

- The ice arenas are served by roof mounted desiccant dehumidifier, sidewall exhaust fans and roof ventilators. Gas fired infrared heating is installed above the seating areas. The infrared heating system causes the ice surface to melt when in operation.

- Exhaust fans provide exhaust for bathrooms, janitors' closet, weight room, ice equipment room and ice rinks. Fans that were visible are in good condition.

- The snowmelt system includes two boilers and is used for the front entrance. The boilers, aboveground piping, manifolds and controls are in good condition.

Plumbing

- The domestic hot water delivery system is provided by a single gas fired water heater, Lochinvar model RWN 399, 399,000 btu input with an additional hot water storage tank, Lochinvar, model RNA0318. The storage tank showed signs of leakage at the bottom and top. The building has a three full loop hot water return systems with hot water return pumps for each loop. All the domestic water piping is insulated and in fair condition.

- The plumbing fixtures are flush valve urinals, flush valve water closets and push-button faucet lavatories. The fixtures examined are in good shape.

Temperature Controls

General Description: The temperature control system is a Delta controls DDC system. Each space or zone is controlled by a non-programmable thermostat. The control system monitors control points at the boiler system and air handling systems.

Special Systems

- There are two full commercial kitchens, with exhaust and make-up air systems.
- There is an ice surface system for both rinks. The ice making equipment is located in the north refrigeration room.

Existing Electrical Systems Profile

Lighting Systems

The majority of interior lights are 4' linear fluorescent. Fixtures have recently been upgraded to T8 lamps and electronic ballasts throughout. Lamps are Osram/Sylvania, with color temperature of 4100K. Electronic Ballasts are instant start, GE UltraMax. Exterior lighting consists of several metal halide recessed "can" fixtures at the main entrance, a few wall-pack lights and several pole mounted fixtures for the parking lot area.

Power Systems

The building is served from an exterior pad-mount transformer owned by Cloverland Electric (formerly Edison Sault). The main switchboard is 1600-amp, 480Y/277-volt, 3-phase, 4-wire and is located in main electrical room above the compressor area. There are several dry-type transformers which provide power to various 208 and 120-volt loads. Many of the electrical branch panels are also located in the main electrical room, with additional panels located on each floor throughout the building. A 30kW natural gas backup generator provides some emergency power for lighting and exit signs.

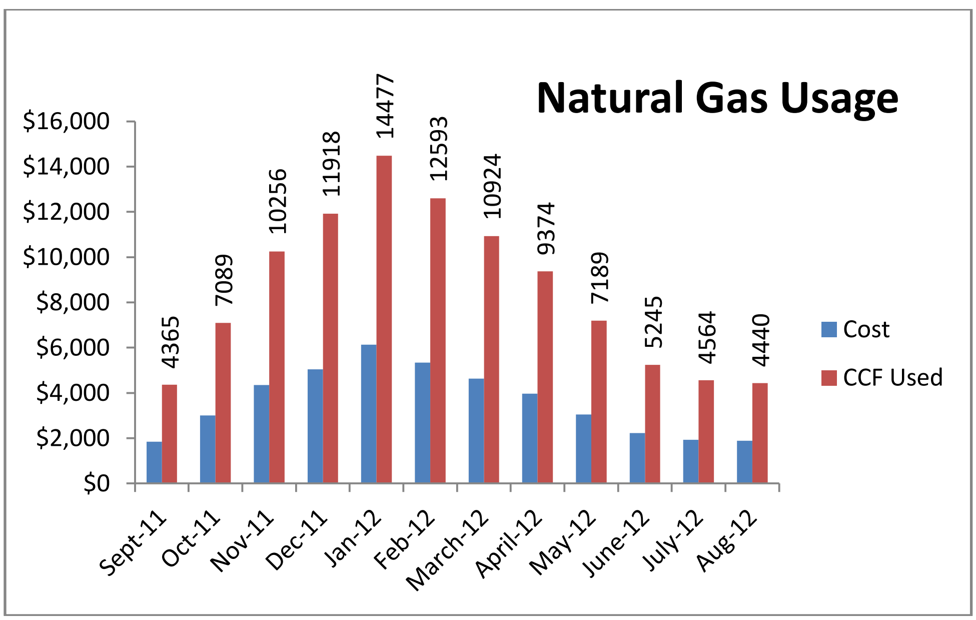
Existing Energy Consumption and Energy Cost Analysis

Natural Gas Usage

The following graphical data represents the monthly natural gas usage and costs. Information as shown is for the September 2011 to August 2012 billing period.

Month	Cost	CCF
Sept-11	$1,849	4,365
Oct-11	$3,003	7,089
Nov-11	$4,345	10,256
Dec-11	$5,049	11,918
Jan-12	$6,133	14,477
Feb-12	$5,335	12,593
March-12	$4,628	10,924
April-12	$3,971	9,374
May-12	$3,046	7,189
June-12	$2,222	5,245
July-12	$1,934	4,564
Aug-12	$1,881	4,440
Totals	$43,396	102,434

Natural Gas ECI:	$0.29	per sq ft/yr
Natural Gas ECU:	68,289	BTU/sq ft
Average Cost per CCF:	$0.42	$/CCF

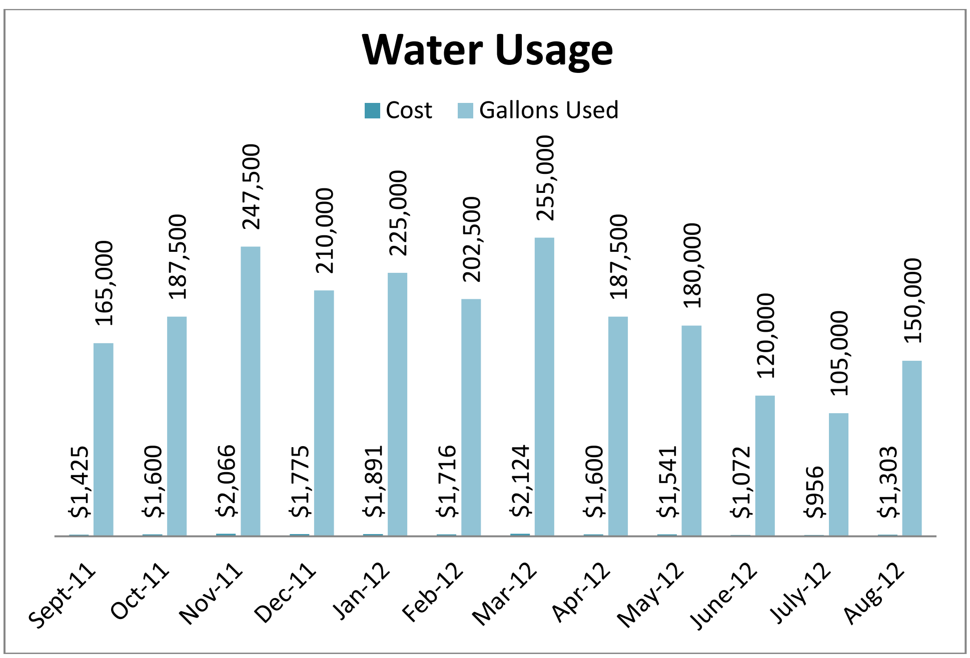


Water Usage

The following data is a graphical representation of the monthly and annual water usage and costs. Information as shown is for the September 2011 to August 2012 billing period.

Month	Cost	Gallons
Sept-11	$1,425	165,000
Oct-11	$1,600	187,500
Nov-11	$2,066	247,500
Dec-11	$1,775	210,000
Jan-12	$1,891	225,000
Feb-12	$1,716	202,500
Mar-12	$2,124	255,000
Apr-12	$1,600	187,500
May-12	$1,541	180,000
June-12	$1,072	120,000
July-12	$956	105,000
Aug-12	$1,303	150,000
Totals	$19,069	2,235,000

Cost per sq ft:	$0.13	per sq ft/yr
Average Usage per Fixture:	16,314	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon

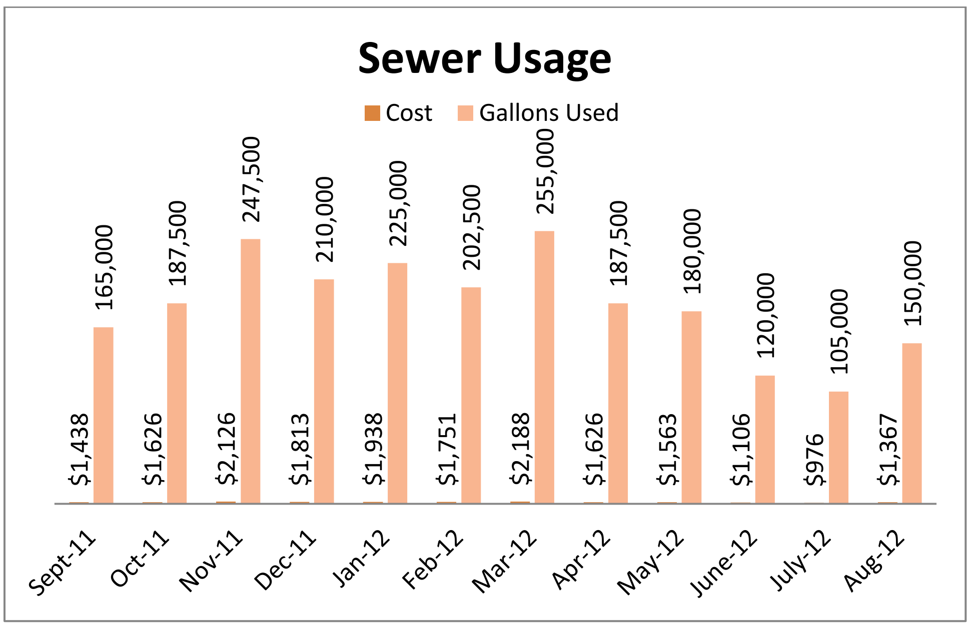


Sewer Usage

The following data is a graphical representation of the monthly and annual sewer usage and costs. Information as shown is for the September 2011 to August 2012 billing period.

Month	Cost	Gallons
Sept-11	$1,438	165,000
Oct-11	$1,626	187,500
Nov-11	$2,126	247,500
Dec-11	$1,813	210,000
Jan-12	$1,938	225,000
Feb-12	$1,751	202,500
Mar-12	$2,188	255,000
Apr-12	$1,626	187,500
May-12	$1,563	180,000
June-12	$1,106	120,000
July-12	$976	105,000
Aug-12	$1,367	150,000
Totals	$19,518	2,235,000

Cost per sq ft:	$0.13	per sq ft/yr
Average Usage per Fixture:	16,314	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon

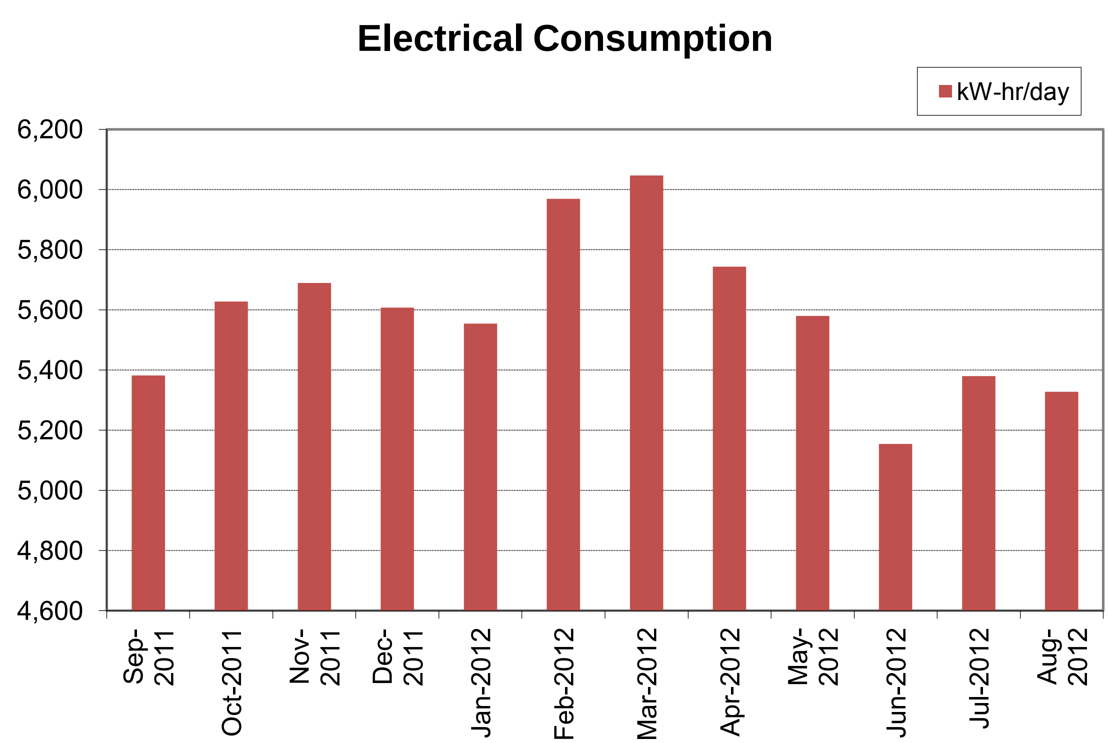


Electrical Usage: The following summary shows the past year's electrical energy use:

Electrical Consumption

# days	kW-hr/day	Period Month	Cost Cost	Usage kWhr	cost/day	
33	5,382	Sep-2011	$15,503	177,600	$470	
29	5,628	Oct-2011	$14,261	163,200	$492	
28	5,689	Nov-2011	$13,944	159,300	$498	
29	5,607	Dec-2011	$14,218	162,600	$490	
35	5,554	Jan-2012	$17,286	194,400	$494	
29	5,969	Feb-2012	$15,498	173,100	$534	
32	6,047	Mar-2012	$17,218	193,500	$538	
28	5,743	Apr-2012	$14,527	160,800	$519	
30	5,580	May-2012	$15,078	167,400	$503	
33	5,155	Jun-2012	$15,286	170,100	$463	
30	5,380	Jul-2012	$14,360	161,400	$479	
33	5,327	Aug-2012	$15,601	175,800	$473	
average:	5,588	Totals	$182,780	2,059,200	$496	average

Electrical ECI:	$1.22	per sq ft/yr
Electrical ECU:	47,197	BTU/sq ft
Average Cost per kWh:	$0.09	$/kWh



Energy Improvement Recommendations

Building

- Doors:
    - Interior doors to ice rinks should be re-hung to seal completely. This will eliminate heat loss from the lobby area to the ice rinks.

- Exterior Walls:
    - Metal panel sections should have the insulation removed and replaced due to moisture and degradation of existing insulation. Insulation should be continuous in the wall cavity to maintain a minimum R-25 value per original design. A vapor barrier should be installed with weep holes to prevent moisture collection in the future.
    - Block wall sections: Consideration should be given to the addition of a thermal barrier on the inside surface of the block wall, such as adding a layer of rigid insulation with interior covering or a furred frame wall with cavity insulation.

- Interior Walls: Walls adjacent to the ice rinks should be finished to the roof deck and insulated. This will prevent heat loss from the heated areas to the ice rink.

- Roof:
    - Installation of additional rigid insulation should be considered between the joists.
    - Roof system joints should be examined and re-sealed.
    - A storm drainage system should be installed, such as a full perimeter rain and gutter system with conductors extended to grade. This will eliminate moisture from staining exterior walls and migrating into seams in the wall and roof connection points.

Mechanical

- Hot water heating system:
    - The existing gas fired hot water heating boilers should be replaced with a high efficient system consisting of multiple 90+ efficiency condensing gas fired boilers. The boilers should be staged to fire as required by the heating demands of the building. This will provide a reduction is natural gas usage and costs.
    - The main hot water heating circulation pumps should be inspected and a preventative maintenance schedule implemented per the equipment manufacturers' recommendations.
    - Variable frequency drives should be installed on the pumps. This will result in a reduction of electrical energy use by adjusting the speed of the pumps to match the building load requirements.
    - A system test and balance should be done on the system, including replacement of control components to meet the design hot water flow requirements.
    - The existing gas fired boilers for the snow melt system should be replaced with higher efficiency condensing type boilers.

- Chilled water system:
    - The existing chilled water system should be inspected and a preventative maintenance schedule implemented per the equipment manufacturer's recommendations.
    - Variable frequency drives should be installed on the pumps. This will result in a reduction of electrical energy use by adjusting the speed of the pumps to match the building load requirements.
    - A system test and balance report should be done on the system including replacement of control components to meet the design chilled water flow requirements.

- Air handlers and air exchangers:
    - Filters and components should be inspected and maintained in accordance with a preventative maintenance schedule determined by equipment manufacturers.
    - Energy recovery ventilators should be installed for the air handling units. This will reduce the mixed air temperature to the air handler and result in a reduction in the required heating and cooling load requirements.
    - Variable frequency drives could be installed on all fans.

- Fan coil units:
    - Filters and components should be inspected and maintained in accordance with a preventative maintenance schedule determined by equipment manufacturer.

- Dehumidification unit:
    - Filters and components should be inspected and changed in accordance with a preventative maintenance schedule as determined by equipment manufacturer.
    - Consideration should be given to replace the unit with a new high efficient unit and air distribution system. This will result in improved dehumidification performance and reduction in electrical energy use.

- Infrared heating in ice rinks:
    - The current tube type infrared heating system should be replaced with spot heating infrared type system. This will localize the heating spaces and reduce the condensation produced on the ice surface and also result in the reduction of the operation of the dehumidification system.

- Exhaust systems:
    - Control of the exhaust systems should be based on motions sensors or timers. This will eliminate the continuous operation of the equipment and result in a reduction in electrical energy use.

<u>Temperature Controls</u>

- Programmable thermostats should be installed for all zones.
- Consideration for replacement of the existing temperature control system should be considered. An enhanced fully functional building management system will integrate all of the HVAC, dehumidification and lighting systems and result in significant energy savings.

<u>Plumbing</u>

- Fixtures:
    - Water closets and flush valves should be replaced with low flow type fixtures and flush valves.
    - Urinals should be replaced with either waterless type urinals or low flow flush valves.
    - Lavatories and sinks should have low flow aerators installed on the faucets.
    - Lavatories and sinks should have sensor operated controls installed on the faucets.
    - Shower faucets should be replaced with sensor operated or push button type control faucets.

- Hot water heater and storage tank:
    - Hot water heater, storage tank, pumps and accessories should be inspected and maintained in accordance with a preventative maintenance schedule determined by the equipment manufacturer.
    - Hot water heater should be replaced with a high efficient type condensing heater.
    - Storage tank should be replaced with multiple storage tanks installed in a series configuration. This will reduce the amount of hot water required based on demand.

Special Systems

- Ice production equipment should be inspected and maintained in accordance with a preventative maintenance schedule determined by equipment manufacturer.

Electrical

Electrical Systems:

Several spaces in the building could benefit from motion sensors to turn off lights during un-occupied times of the day. For smaller offices, storage rooms, and similar smaller spaces a passive infrared wall box motion sensor would be recommended. For larger open rooms, ceiling mount passive infrared sensors would be appropriate. Dual technology ceiling sensors are recommended for bathrooms and other spaces with partitions. Bathrooms and Locker rooms were specifically identified during the site visit as areas that should have motion sensors installed.

In a few areas, lamps and ballasts were not upgraded during the past project and should be addressed. Specifically, it is recommended to replace exterior lighting, including recessed “can” lights with LED technology for longer life and more efficient energy use.

Renewable Energy Opportunities

- Solar
  - With the large amount of available roof space, solar energy for electricity production and/or hot water heating would be a viable opportunity to offset some utility costs.

- Geothermal system:
  - There is opportunity for a ground source geothermal heating and cooling system. The system would require ground wells and accessories to be installed and would provide geothermal energy to serve the heating and cooling requirements provided by the boilers and chiller. The system would require the replacement of fan coil units with heat pumps, possible replacement of the air handlers, additional controls and accessories. The boilers and chiller system could remain as a secondary source of heating and cooling.
  - Additional tax incentives may be realized with a geothermal system.

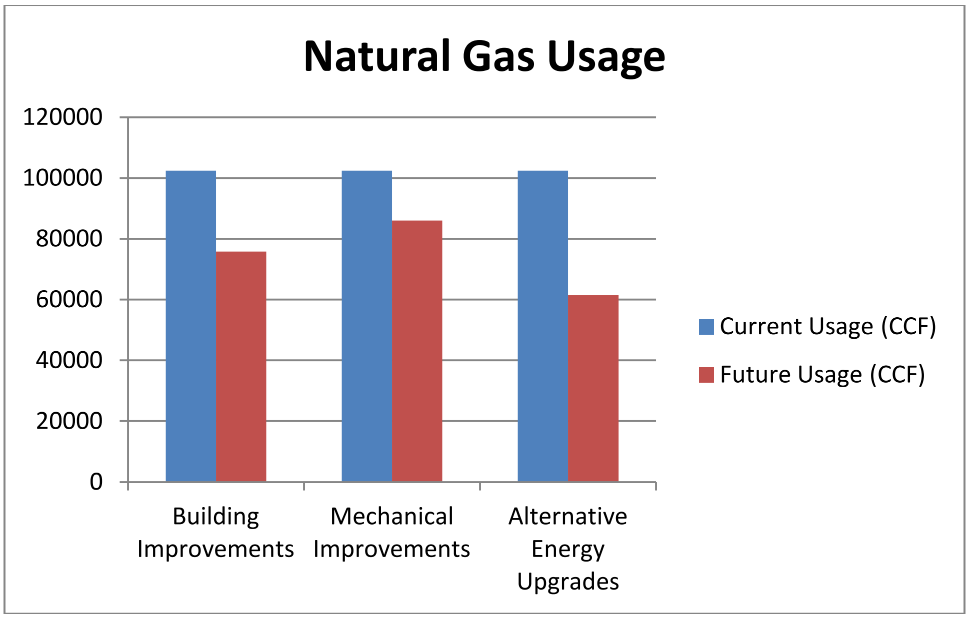
- Heat reclamation:
  - There is opportunity for a heat reclamation system generated from the ice production equipment. Additional ductwork and controls would be required.

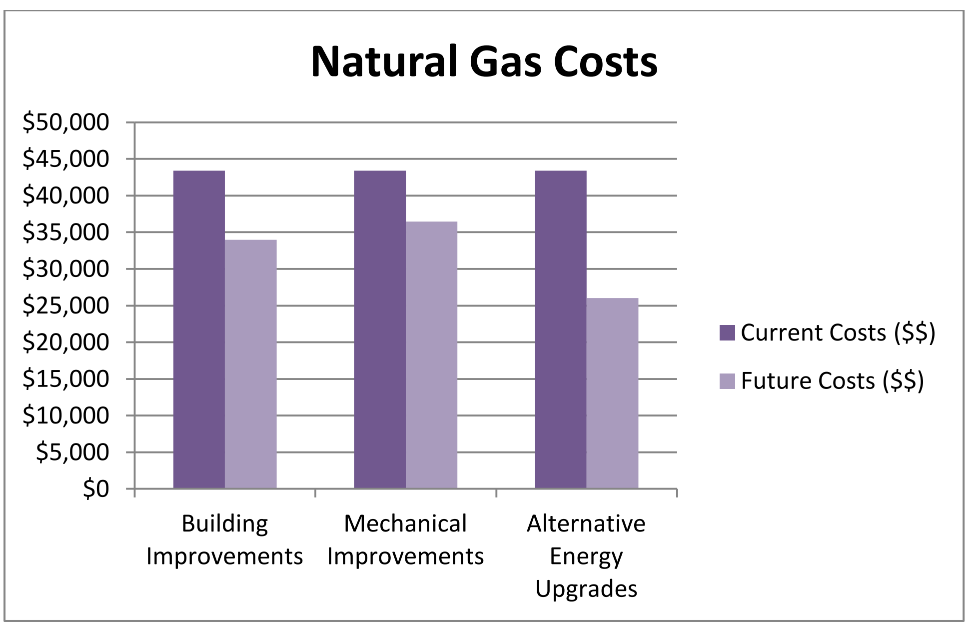
Potential Energy Cost Savings

Natural Gas

The following energy cost savings data is a summary of the following improvements. Improvements are independent of each other:

- Building improvements include addition of wall and roof insulation, replacement and improvement of doors and maintaining separation between ice rinks and heated spaces.
- Mechanical improvements include the replacement of boilers, replacement of ice rink infrared heating, and building management system improvements.
- Alternative energy upgrades include the installation of a geothermal system.



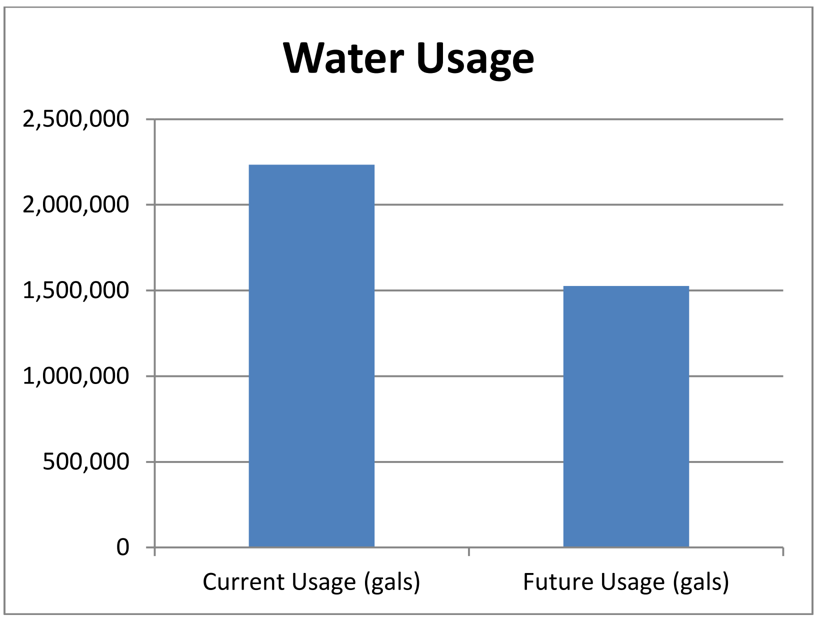


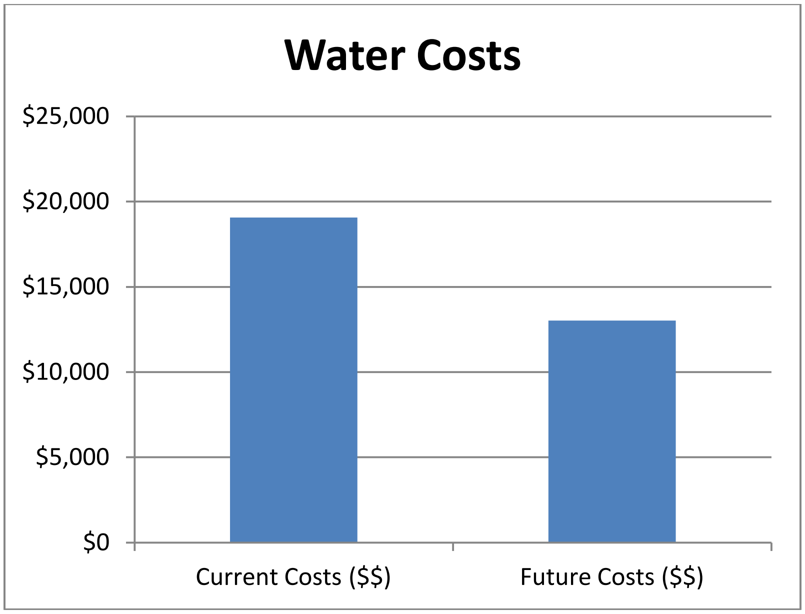
Energy Improvement Opportunity	ECI (per sq ft/yr)	ECU (BTU/sq ft)
Building Improvements	$0.23	50,534
Mechanical Improvements	$0.24	57,363
Alternative Energy Upgrades	$0.17	40,974

Water

The following energy cost savings data is a summary of the following improvements. Improvements are independent of each other:

- Low flow water closets and flush valves.
- Waterless urinals.
- Sensor control on lavatories and showers.
- Low flow aerators on lavatories and sinks.





Electrical Systems:

The installation of motion sensors to control interior lighting could result in approximately $3000 per year of electrical savings. Additionally, upgrading exterior light fixtures to LED type could save another $1000 per year.

The installation of approximately 60kW of rooftop solar (PV) electric panels & associated equipment (inverters, charge controllers, etc.) is estimated to reduce the building's annual electric bill by approximately $12,000.

Thermal Imaging Data

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. There was not very many significant or surprising "finds" by using the thermal imaging camera for this building. The camera did not locate any areas of excessive heat loss.

Exterior doors have typical heat loss, particularly double doors at main entrance. Weather stripping and door sweeps should be examined periodically and replaced when excessive wear and/or damage is found.

The photos do show examples of some hot and cold surfaces especially on the refrigeration and heating equipment, much of which is to be expected for that type of equipment.

References

Existing exterior wall U-value: 0.42 Btu/hr/sq ft/deg F
Existing roof U-value: 0.031 Btu/hr/sq ft/deg F
Existing window U-value: 0.55 Btu/hr/sq ft/deg F
Existing ACH: 0.35

Definitions and Abbreviations

ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME: American Society of Mechanical Engineers
ACH: Air changes per hour; measure of number of times air is exchanged in space.
BTU: British Thermal Units
GPF: Gallons per fixture
ECI: Energy Cost Index; measure of annual cost of energy measured in total square foot per of building.
ECU: Energy Conservation and Utilization index; measure of energy used per total square foot of building.
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Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Software

HAP 4.06: Hourly Analysis Program, Carrier, Inc.
REVIT 2011: Computer Aided Design Software
FLIR Tools, Version 2.2: FLIR E40 Infrared Camera analysis software

Air System Sizing Summary for Chi Mukwa System

Project Name: S10-12262 #3 Chi Mukwa — 12/14/2012
Prepared by: UPEA — 10:22AM

Air System Information

Air System Name	Chi Mukwa System	Number of zones	1	
Equipment Class	UNDEF	Floor Area	240000.0	ft²
Air System Type	SZCAV	Location	Sault Ste Marie, Michigan	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Sum of space airflow rates	Calculation Months	Jan to Dec
Space CFM	Individual peak space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	40.5	Tons	Load occurs at	Jul 1500	
Total coil load	485.6	MBH	OA DB / WB	83.0 / 69.0	°F
Sensible coil load	485.6	MBH	Entering DB / WB	75.0 / 67.1	°F
Coil CFM at Jul 1500	158128	CFM	Leaving DB / WB	72.1 / 66.1	°F
Max block CFM	158128	CFM	Coil ADP	71.8	°F
Sum of peak zone CFM	158128	CFM	Bypass Factor	0.100	
Sensible heat ratio	1.000		Resulting RH	67	%
ft²/Ton	5931.3		Design supply temp.	58.0	°F
BTU/(hr-ft²)	2.0		Zone T-stat Check	1 of 1	OK
Water flow @ 10.0 °F rise	97.16	gpm	Max zone temperature deviation	0.0	°F

Central Heating Coil Sizing Data

Max coil load	3929.0	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	158128	CFM	BTU/(hr-ft²)	16.4	
Max coil CFM	158128	CFM	Ent. DB / Lvg DB	68.8 / 92.4	°F
Water flow @ 20.0 °F drop	393.11	gpm			

Supply Fan Sizing Data

Actual max CFM	158128	CFM	Fan motor BHP	86.61	BHP
Standard CFM	154029	CFM	Fan motor kW	68.71	kW
Actual max CFM/ft²	0.66	CFM/ft²	Fan static	2.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	0	CFM	CFM/person	0.00	CFM/person
CFM/ft²	0.00	CFM/ft²			

UPEA ENGINEERS & ARCHITECTS

Chi Mukwa (Big Bear) Rec Center [Building #3]
Infrared Camera photos taken with FLIR E40 Camera
October 2, 2012 and November 27, 2012

Measurements °F

Sp1	35.7

Parameters

Emissivity	0.95
Refl. temp.	68 °F

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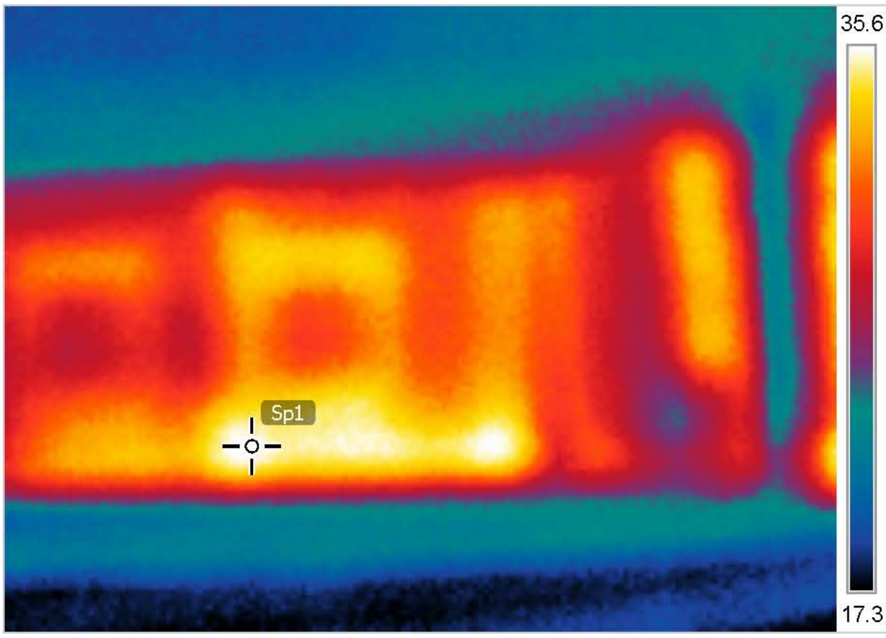

IR_0682.jpg

11/27/2012 10:13:39 AM

DC_0683.jpg

Chi Mukwa (Big Bear) Rec Center [Building #3]
Infrared Camera photos taken with FLIR E40 Camera
October 2, 2012 and November 27, 2012

Measurements	°F
Sp1	28.5

Parameters	
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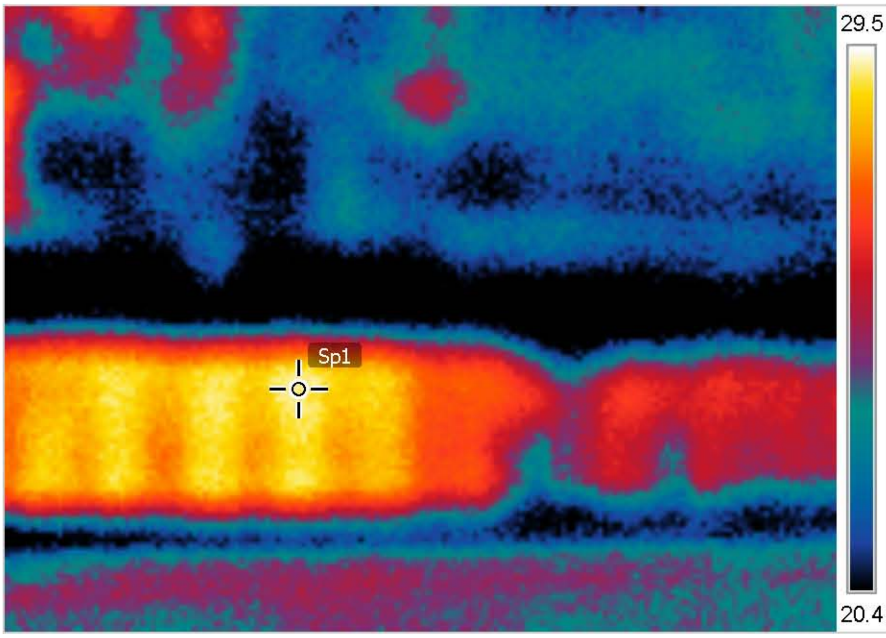
11/27/2012 10:15:28 AM



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11/27/2012 10:15:28 AM

DC_0699.jpg

Energy Audit
Tribal Health Center
2864 Ashmun Street
Sault Ste. Marie, MI

December 2012

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Attachments:

Thermal Images

Floor Plans

Summary

The Tribal Health Center in Sault Ste. Marie is a 3 story facility. This building contains 49,950 square feet and houses a Pharmacy and Health Care Center including x-ray and other necessary equipment for a full staff of Doctors, Nurses, Dental, Optical and Health Administration. Renovations/improvements have been made to the building to improve health care to patients such as Pharmacy, Counseling Services, etc.

Existing Building Envelope Profile

Wall Construction: The exterior walls are 6" steel studs with exterior sheathing and brick veneer. Exterior wall cavity insulation is fiberglass batt.

Roof Construction: The roof is original ballasted membrane over 5" of rigid insulation with a very low parapet at the perimeter. Roof access is good, with a steep stair from north-east stairway 3rd floor level. The roof membrane and ballast appear to be in good to fair condition, with very few reported sign of leaks. The membrane is quickly reaching close to its expected life; replacement should be planned in the next 5-10 years.

Floor Construction: Floors are constructed of concrete. Coverings are a mixture of carpet and tile.

Window and Door Construction: Exterior windows are aluminum frames with double glass. Exterior doors are metal with metal frames except the main front entrance is aluminum storefront type. There is considerable air leakage and heat loss at the main front vestibule, and some water leakage issues. Three insulated overhead doors are located on the north-east side of the building. One is a loading dock type with poor air seals.

Existing Mechanical Systems Profile

HVAC

General Description: The HVAC systems are comprised of ceiling mounted heat pumps with ducted air distribution system, hot water cabinet unit heaters, ceiling mounted unit heaters, make-up air handlers and local exhaust fans.

- The hot water heating system is a single Raypack, model H3-1826A natural gas fired boiler located in the first floor boiler room. The hot water loop serves unit heaters, cabinet unit heaters and heating coils in the make-up air handlers. A single one horsepower pump provides hot water circulation. Additional accessories in the hot water system include an expansion tank, air separator, air vents, outdoor reset, temperature and pressure gauges. The piping insulation is in poor condition, several section of piping are exposed and insulation is not sealed.

- The cooling system is a liquid evaporative cooler exterior to the building near the boiler room. The cooling water piping serves the heat pumps. The cooling system is chemically treated.

- The heat pump system (core system) is served by one 15 horsepower pump and circulates heating/cooling water to the heat pumps. The heat pump supply air distribution system is ducted. The heat pump return air system is open ended with the ceiling space used as a return plenum.

- Make-up air handling units are located on each floor and provide ventilation. The units have cooling and heating coils and discharge ventilation air to the plenum spaces above the ceiling. A heat exchanger is used to provide hot water to the heating coils with the secondary side containing glycol. Electric steam humidifiers are located at each floor and serve the air handling units.

- Exhaust fans are primarily inline type and provide general exhaust for toilet room, janitor's closets and other rooms. Exhaust is discharged through the sidewall of the building. The exhaust fans for general ventilation are controlled by the building management system and operate on a time schedule. The hood exhaust operates continuously.

- A separate air conditioning system is used for the IT room and is in fair condition.

Plumbing

- The original domestic hot water heater is a direct gas fired type heater, Raytherm model WH2-0133, gas input of 136 MBH with 136 gph recovery rate. A second electric hot water heater (Rheem model 81V80D) and storage tank was added. Hot water recirculation loops and pumps are installed on both heaters.

- The plumbing fixtures are flush valve urinals and flush valve water closets. The lavatories and sinks are a combination of dual faucet, single faucet and sensor control type. The fixtures examined are in good condition. Several lavatories and sinks were tested for hot water flow demand with an average time for hot water delivery at 27 seconds.

Temperature Controls Systems

General Description: The temperature control system is a Delta direct digital control building management system. Several terminal units such as cabinet unit heaters are not part of the building management system.

Existing Electrical Systems Profile

Lighting Systems:

Exterior lighting consists of pole mounted "shoe-box" fixtures, perimeter "wall-pack" fixtures, and 8 open recessed downlights with incandescent lamps under the front canopy. Exterior lighting is control via timer.

Building interior lighting is mainly linear fluorescent and some open recessed downlights. Most of the fluorescent fixtures are 3-lamp, 2x4 lensed "troffer" type, with a few areas having decorative linear either of the perimeter wallwash or indirect type. Approximately 95% of interior lighting was upgraded to energy efficient type in the past year. Most linear lamps are ECO-type Osram/Sylvania 25-watt. Electronic Ballasts are mostly GE UltraMax, instant start, normal light output. Almost all recessed downlights have been retrofitted with self-ballasted twist-type compact fluorescent lamps.

Lighting control is primarily manual, with standard wall-box light switches for most spaces. The main corridor lighting control is via circuit breakers at panels on each floor. The maintenance staff has installed wall-box motion sensors in many public restrooms, and some of the newly renovated spaces also have motion sensors.

Power Systems: The building's electric power is from Cloverland Electric (Formerly Edison Sault) via a 300kVA pad-mount transformer at 208Y/120-volts, 3-phase, 4-wire. The main switchboard is 2000-amps. Back-up power for the building is provided from a 350kW diesel generator and automatic transfer switch. Electrical branch panels fed from the main switchboard are located at various locations on all floors through-out the building. Major electrical loads include a 40-hp hydraulic elevator pump, an outdoor evaporative cooling tower with 25-hp fan, 5 heating/cooling water pumps totaling 25-hp, and approximately 49 heat pumps.

Special Systems: The building is provided with Telephone and Data/Telecommunication wiring systems including backbone cabling and outlet jacks at convenient locations. The building also has Fire Alarm and Nurse Call Systems in accordance with requirements for a typical health care facility.

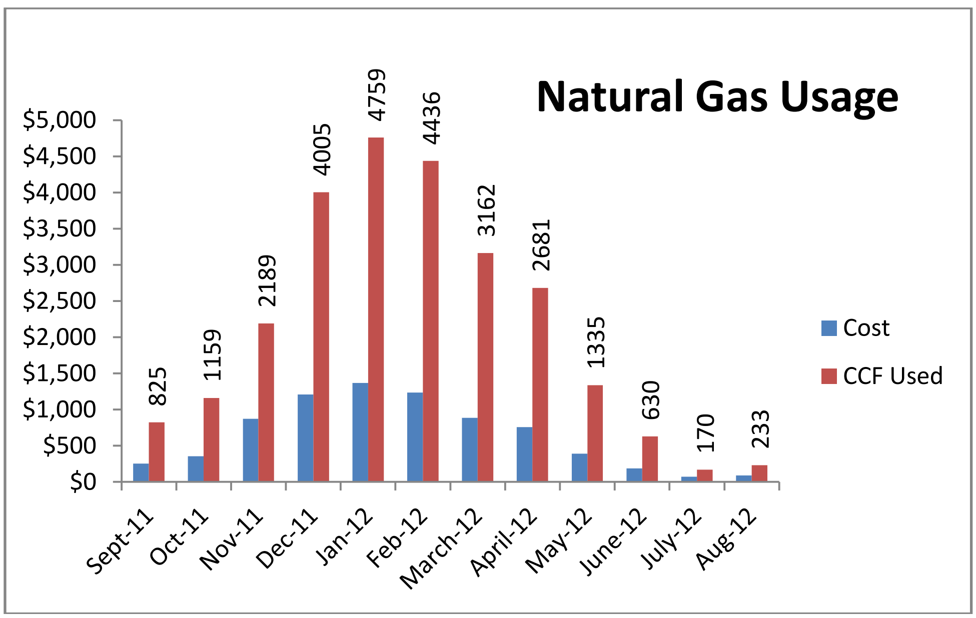
Existing Energy Consumption and Energy Cost Analysis

Natural Gas Usage

The following graphical data represents the monthly natural gas usage and costs for the September 2011 through August 2012 billing period.

Month	Cost	CCF
Sept-11	$255	825
Oct-11	$355	1,159
Nov-11	$872	2,189
Dec-11	$1,208	4,005
Jan-12	$1,369	4,759
Feb-12	$1,235	4,436
March-12	$887	3,162
April-12	$756	2,681
May-12	$389	1,335
June-12	$189	630
July-12	$71	170
Aug-12	$92	233
Totals	$7,678	25,584

Natural Gas ECI:	$0.15	per sq ft/yr
Natural Gas ECU:	51,219	BTU/sq ft
Average Cost per CCF:	$0.30	$/CCF

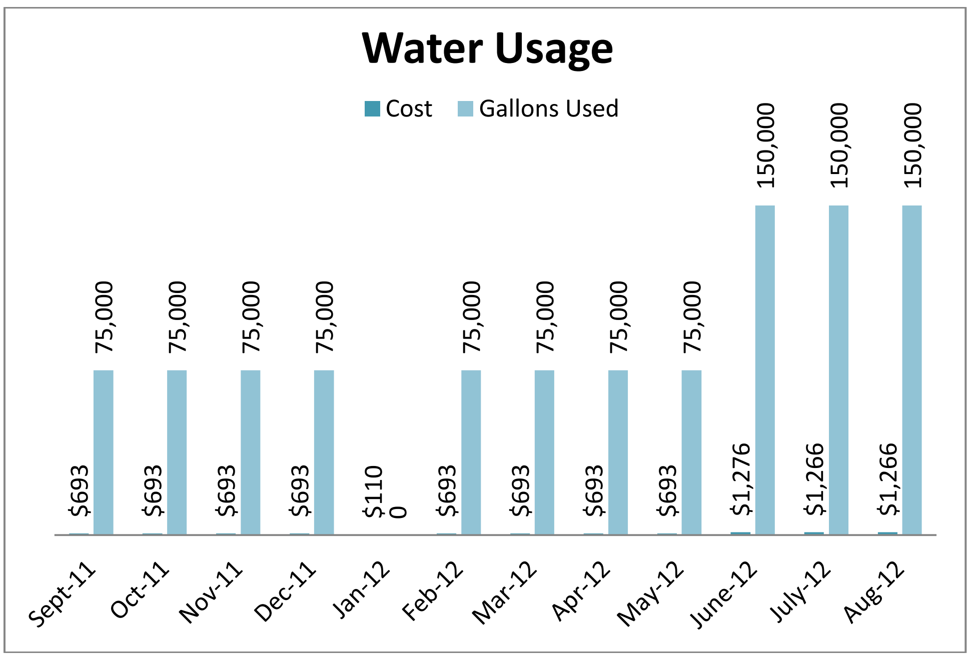


Water Usage

The following graphical data represents the monthly water usage and costs for the September 2011 through August 2012 billing period.

Month	Cost	Gallons
Sept-11	$693	75,000
Oct-11	$693	75,000
Nov-11	$693	75,000
Dec-11	$693	75,000
Jan-12	$110	0
Feb-12	$693	75,000
Mar-12	$693	75,000
Apr-12	$693	75,000
May-12	$693	75,000
June-12	$1,276	150,000
July-12	$1,266	150,000
Aug-12	$1,266	150,000
Totals	$9,462	1,050,000

Cost per sq ft:	$0.19	per sq ft/yr
Average Usage per Fixture:	9,211	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon

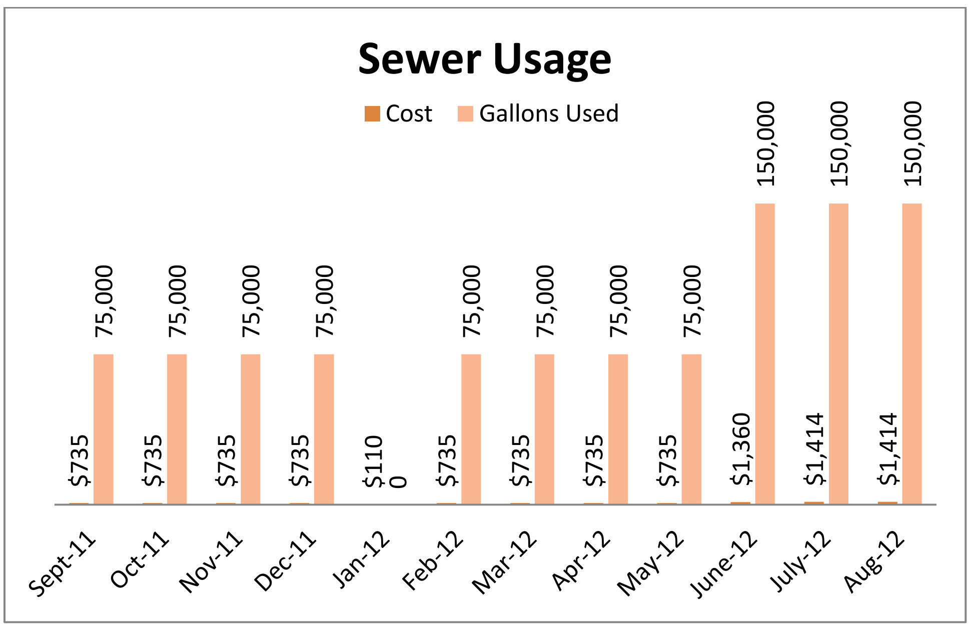


Sewer Usage

The following data is a graphical representation of monthly and annual sewer usage and costs for the September 2011 to August 2012 billing period.

Month	Cost	Gallons
Sept-11	$735	75,000
Oct-11	$735	75,000
Nov-11	$735	75,000
Dec-11	$735	75,000
Jan-12	$110	0
Feb-12	$735	75,000
Mar-12	$735	75,000
Apr-12	$735	75,000
May-12	$735	75,000
June-12	$1,360	150,000
July-12	$1,414	150,000
Aug-12	$1,414	150,000
Totals	$10,178	1,050,000

Cost per sq ft:	$0.20	per sq ft/yr
Average Usage per Fixture:	9,211	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon



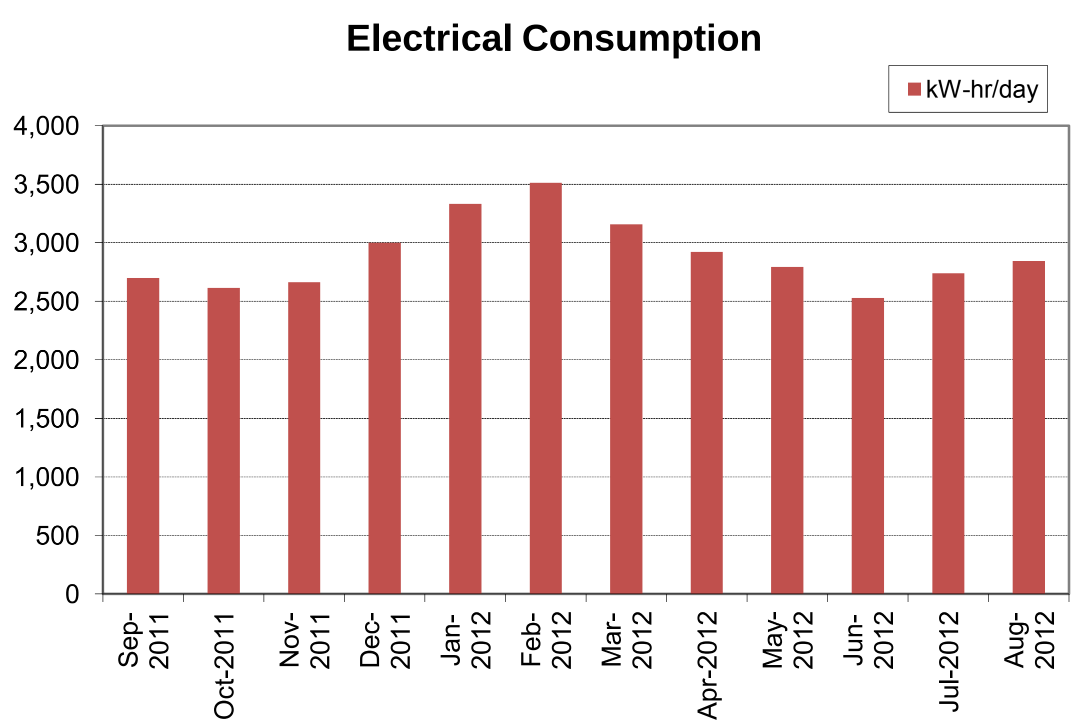
Electrical Usage: The following summary/charts show actual electrical use for the past year:

Electrical Consumption

# days	kW-hr/day	Period Month	Cost Cost	Usage kWh	cost/day	
32	2,696	Sep-2011	$7,664	86,280	$239	
29	2,615	Oct-2011	$6,779	75,840	$234	
28	2,661	Nov-2011	$6,667	74,520	$238	
29	3,000	Dec-2011	$7,740	87,000	$267	
35	3,333	Jan-2012	$10,517	116,640	$300	
29	3,513	Feb-2012	$9,268	101,880	$320	
32	3,158	Mar-2012	$9,169	101,040	$287	
28	2,923	Apr-2012	$7,530	81,840	$269	
30	2,792	May-2012	$7,689	83,760	$256	
33	2,527	Jun-2012	$7,644	83,400	$232	
30	2,740	Jul-2012	$7,450	82,200	$248	
33	2,844	Aug-2012	$8,433	93,840	$256	
average:	2,900	Totals	$96,551	1,068,240	$262	average

Square Footage	49950
kW-hr per sq ft per yr =	21.4

Electrical ECI:	$1.93	per sq ft/yr
Electrical ECU:	73,526	BTU/sq ft
Average Cost per kWh:	$0.09	$/kWh



Energy Improvement Recommendations

Building

- Doors:
  - Front entrance doors should be sealed and re-hung to reduce air leakage and heat loss through visible gaps. Weather stripping and sweeps should be examined and repaired.
  - Side doors should be sealed and re-hung. Several of the doors show signs of significant wear and should be replaced. Weather stripping and sweeps should be examined and repaired.
  - Overhead door sweeps should be examined and repaired.

- Exterior walls:
  - Walls with brick veneer finish should have visible separations sealed or caulked air tight.
  - Louver frames should be sealed and caulked air tight.
  - Sections of glass block are broken and should be replaced and sealed. Replacement of the glass block with an alternate material of a higher R value should be considered.

- Windows: Replacement of windows with a low-e or reflective type should be considered, specifically for the front entrance. This will reduce the cooling requirements for the lobby area during the cooling season. In addition, window weather stripping and seals should be examined and repaired.

- Roof: Additional insulation should be considered at time of next roof replacement. This will increase the existing R-value for the roof system.

Mechanical

- Hot water heating system:
  - The existing single hot water heating boiler should be replaced with a system of multiple high efficiency 90+ condensing type boilers. The boilers should be staged to fire and operate as required to meet the heating demands of the building as necessary. This will provide a reduction in natural gas usage and costs by providing part load operation of the system.
  - Main heating and cooling circulation pumps should be inspected and have a preventative maintenance program implemented. The pumps are near the end of their life expectancy and maintenance issues will increase over time. Replacement of the pumps should be a consideration in the future.
  - Variable frequency drives should be installed on the main heating and cooling pumps. This will result in a reduction in the use of electrical energy by varying the speed of the pumps to meet the building heating and cooling demands.
  - A system wide test and balance should be done, including inspection and replacement of the flow control components.

- Make-up air handling units:
  - Filters and components should be inspected and maintained in accordance with a preventative maintenance schedule determined by the equipment manufacturer.
  - Installation of variable frequency drives should be considered for the fan motors. This will operate the fan motors at slower speeds as necessary to maintain the minimum ventilation requirements. An occupied/unoccupied type schedule is an example where the fan could run at slower speed during unoccupied mode.

- Cooling system:
  - The cooling system is nearing the end its life expectancy and replacement of the unit should be considered in the near future.
  - A preventative maintenance program should implemented in accordance with the manufacturer’s recommendations.

- Heat pumps: The heat pumps should be inspected and maintained on a regular basis. A preventative maintenance schedule should be implemented. Units are nearing the end of their life expectancy and should be replaced as necessary.

- Exhaust fans should be controlled using motion sensors. This will eliminate the operation of fans for unoccupied spaces, conserve electrical energy and reduce wear on the equipment.

Temperature Controls

- Replacing the existing temperature control system with a fully integrated system to include additional control of terminal units, space conditions and lighting control should be considered.

Plumbing

- The existing domestic hot water boiler should be replaced with a high efficiency type condensing boiler.
- Fixtures:
    - Water closet flush valves should be replaced with low flow type flush valves.
    - Urinals could be replaced with waterless type urinals.
    - Lavatories and sinks should have low flow aerators installed on the faucets.
    - Manually operated faucets should be replaced with sensor operated type faucets.

Electrical Systems:

1. Retrofit remaining older T12 linear fluorescent to energy efficient T8 lamps and electronic ballasts.
2. Retrofit incandescent exterior recessed downlights at canopy to fluorescent or LED.
3. Add motion sensor controls to all office spaces.
4. Provide photocell or astronomic timer control for exterior lighting.
5. Replace exterior pole and building perimeter lighting with LED type.
6. Consider roof-mounted solar electric panels to offset some of the utility power.

Renewable Energy Opportunities

- Geothermal
    - There is opportunity for a ground source open or closed looped geothermal heating and cooling system. The system would require ground wells and accessories to be installed and would provide heating and cooling to replace the existing systems. Additional testing would be required to determine the feasibility of a geothermal system.
    - Additional tax incentives may be realized with the installation of a geothermal system.

Potential Energy Cost Savings

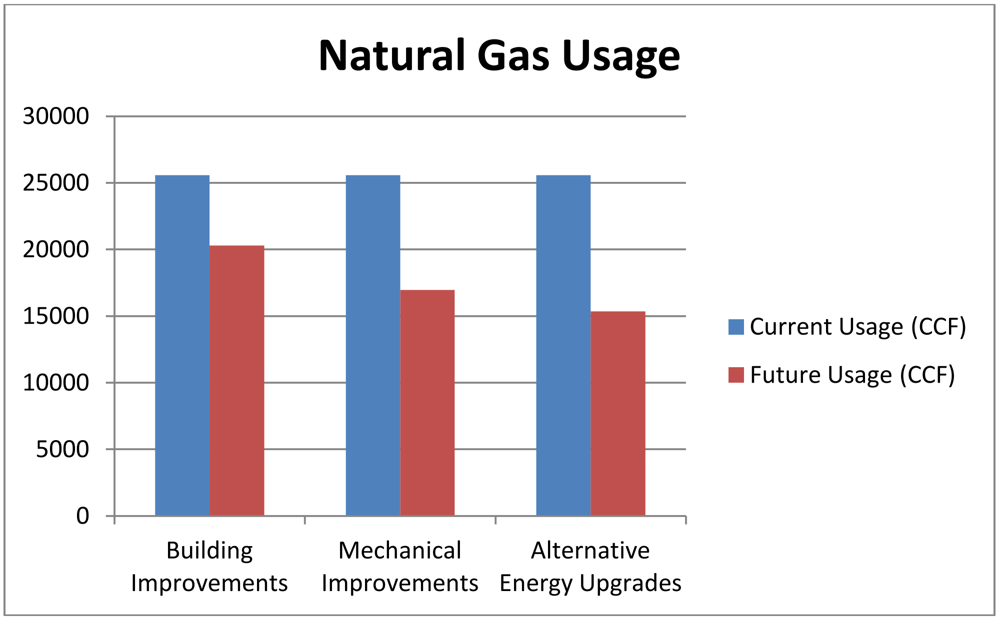
Natural Gas

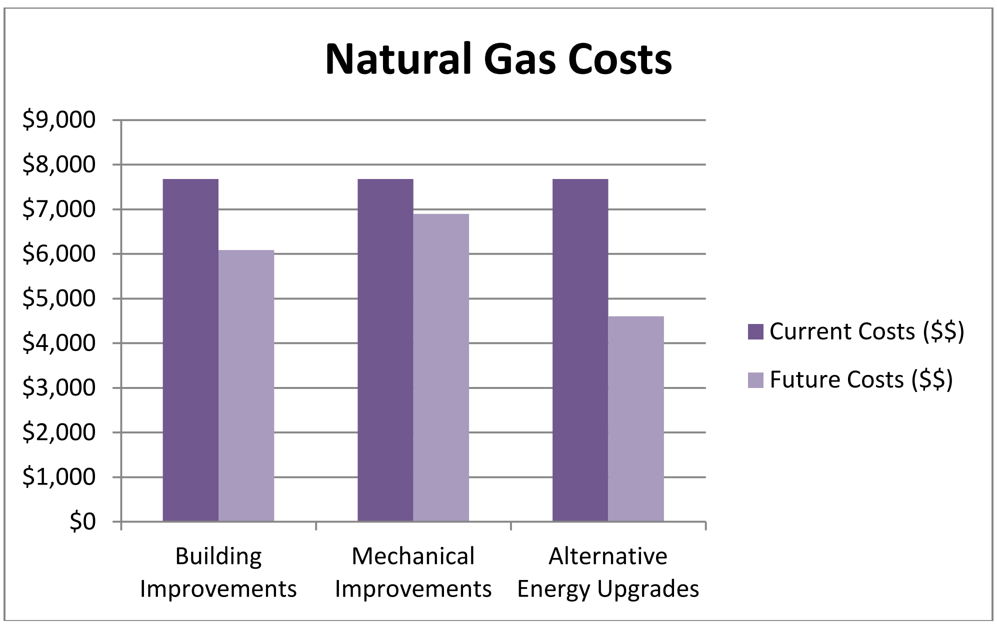
The following natural gas energy usage and cost savings is an estimate based on the following improvements (Improvements are independent of each other):

- Building Improvements:
    - Replacement of glass block windows with windows having an R-value of 19.
    - Addition of a layer of insulation at the roof.
    - Repair and replacement of exterior windows and doors.
    - Sealing exterior walls and louver frames.

- Mechanical Improvement:
    - Replacement of heating boilers with high efficient type boilers.
    - Replacement of domestic hot water boiler with high efficiency type boiler.
    - Completion of water and air systems testing and balancing.
    - Implementation of a comprehensive preventative maintenance program for all equipment.

- Alternative Energy Upgrades
    - The installation of a geothermal system.



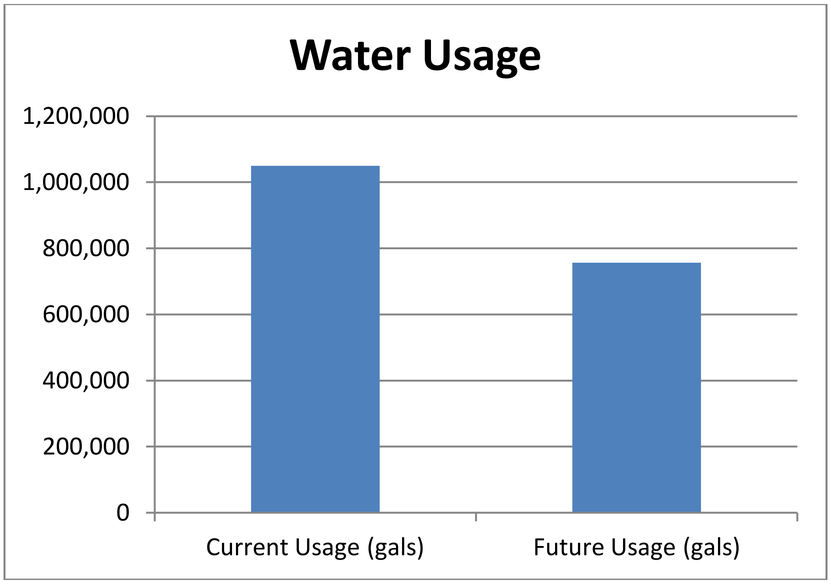


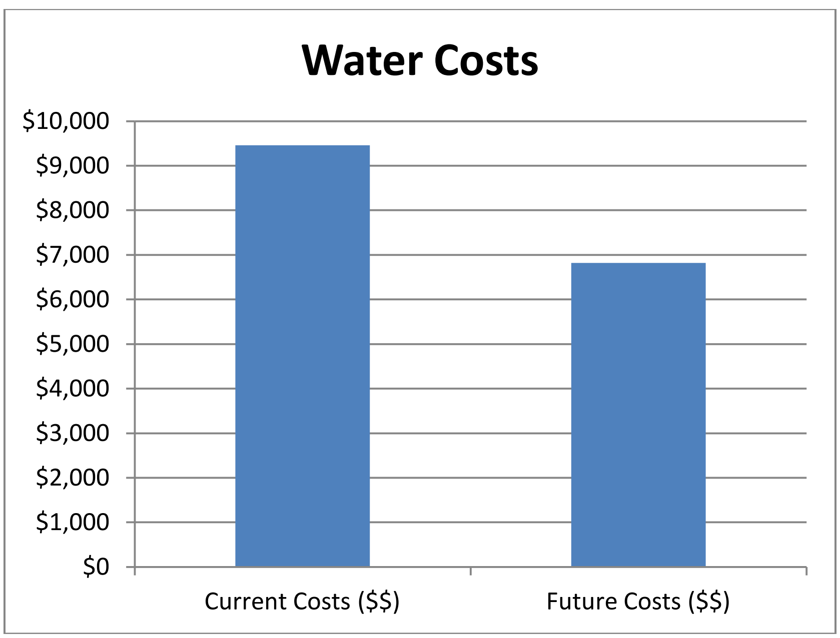
Energy Improvement Opportunity	ECI (per sq ft/yr)	ECU (BTU/sq ft)
Building Improvements	$0.12	40,628
Mechanical Improvements	$0.14	33,934
Alternative Energy Upgrades	$0.09	30,732

Water

The following water usage and cost savings is an estimate based on the following improvements:

- Replacement of existing water closets with low flow (1.1 gpf) flush valves.
- Installation of low flow aerators on sinks and lavatories.





Electrical Systems:

The installation of motion sensors to control interior lighting and other interior lighting improvements could result in approximately $3000 per year of electrical savings. Additionally, upgrading exterior light fixtures to LED type could save another $800 per year.

The installation of approximately 30kW of rooftop solar (PV) electric panels & associated equipment (inverters, charge controllers, etc.) is estimated to reduce the building's annual electric bill by approximately $6,000

Thermal Imaging Data

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. This building had very little excess heat loss detected. The most significant or surprising "find" by using the thermal imaging camera was heat loss detected through the lower single wythe masonry block below the glass block at the entrance. We were expecting to see heat loss through the glass block, but it appears the split face block has more losses. There is also 1 broken glass block that needs to be replaced; excess heat loss is evident from the broken area.

References

Existing wall U-value: 0.053 Btu/hr/sq ft/deg F
Exterior block window U-value: 0.34 But/hr/sq ft/deg F
Existing roof U-value: 0.045 Btu/hr/sq ft/deg F
Existing window U-value: 0.588 Btu/hr/sq ft/deg F
Existing ACH: 0.62

Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Software

HAP 4.06: Hourly Analysis Program, Carrier, Inc.
REVIT 2011: Computer Aided Design Software
AutoCAD MEP 2011: Computer Aided Design Software
FLIR Tools, Version 2.2: FLIR E40 Infrared Camera analysis software

Air System Sizing Summary for Default System

Project Name: TRIBAL HEALTH
Prepared by: UPEA

12/19/2012
05:47AM

Air System Information

Air System Name	**Default System**		Number of zones	**1**	
Equipment Class	**UNDEF**		Floor Area	**51822.0**	ft²
Air System Type	**SZCAV**		Location	**Sault Ste Marie, Michigan**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Sum of space airflow rates**	Calculation Months	**Jan to Dec**
Space CFM	**Individual peak space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**1121.5**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**30940**	CFM	BTU/(hr-ft²)	**21.6**	
Max coil CFM	**30940**	CFM	Ent. DB / Lvg DB	**58.8 / 93.2**	°F
Water flow @ 20.0 °F drop	**112.21**	gpm			

Supply Fan Sizing Data

Actual max CFM at Des Htg	**30940**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**30138**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/ft²	**0.60**	CFM/ft²	Fan static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**3784**	CFM	CFM/person	**54.06**	CFM/person
CFM/ft²	**0.07**	CFM/ft²			

FLIR

Measurements	°F
Sp1	55.9

Parameters	
Emissivity	0.95
Refl. temp.	68 °F

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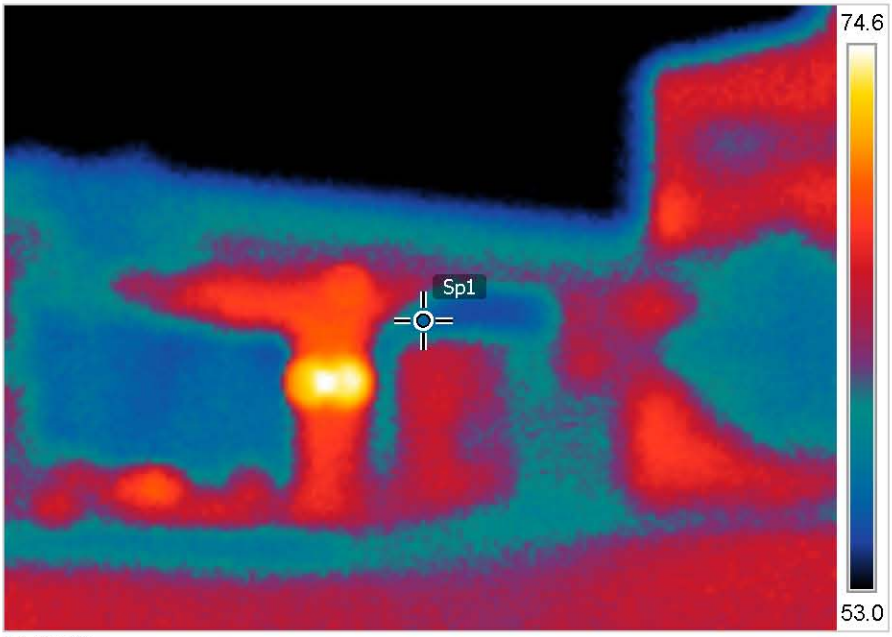

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DC_0267.jpg

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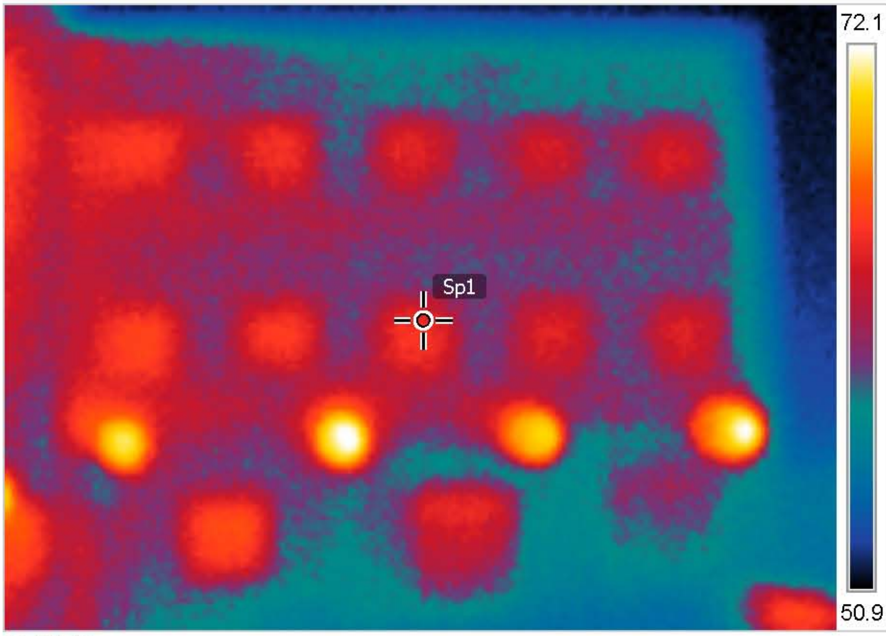

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DC_0275.jpg

FLIR

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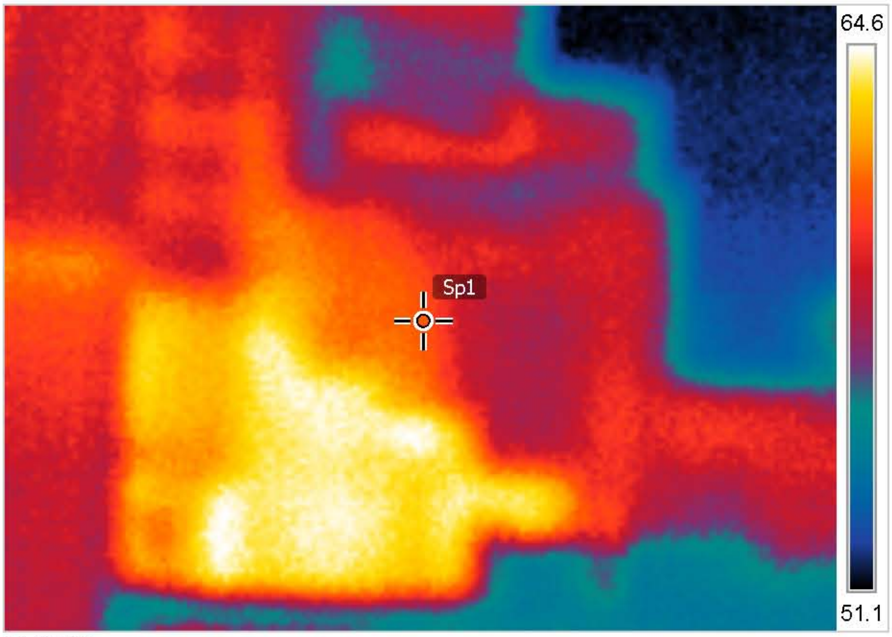

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UPEA ENGINEERS & ARCHITECTS

Energy Audit
Joseph K Lumsden Bahweting School
1301 Marquette Ave
Sault Ste. Marie, MI 49783

December 2012

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Summary

The Joseph K. Lumsden Bahweting Anishnabe School is a Bureau of Indian Affairs and a Michigan Charter school. The school houses kindergarten through 8th grades and currently operates in 6 separate buildings including a garage. All of the buildings are 1 floor with a crawl space. 4 of the buildings are modular type facilities. The main permanent structure is approximately 34,500 square feet and was built in 1962 with additions of a library, multipurpose room etc. added in 1995. A 9360 square foot ten room modular addition including restrooms will be included in this report.

Existing Building Envelope Profile

Wall Construction: The exterior walls of the main building are brick and block construction. Interior framing is assumed to be metal framing construction with batt insulation and gypsum board interior facing. The exterior walls of the modular units are partial brick veneer with wood siding and furred interior walls faced with gypsum board. Insulation in the wall cavity is assumed.

Roof Construction: The building roofs are typical “flat” commercial building type. The oldest portion of the building is EPDM and had a considerable amount of standing water. Drains should be checked and cleaned. Newer portions of the building roof are PVC type. All roofs are in good condition.

Floor Construction: Main building floors are concrete slab on grade. Coverings are a mixture of carpet and tile. The modular units are installed on block foundation with vented crawl space.

Window and Door Construction: Exterior windows are aluminum frames with double glass glazing. Exterior doors are metal with metal frames. There is considerable air and water leakage at the windows.

Existing Mechanical Systems Profile

HVAC

General Description (Main Building): The HVAC system consists of a central hot water heating plant, hot water unit ventilators with outside air intakes, central exhaust system, split system air conditioning units, roof mounted air handling units and self-contained exterior wall mounted heating/cooling units.

- The hot water heating system consists of four natural gas fired boilers, base mounted circulation pumps, expansion tank, air separator and accessories. Two of the boilers are not operational. The hot water heating system serves unit ventilators, unit heater and other terminal devices.

- Vertical unit ventilators are located in each classroom of the main building. The units contain a hot water coil and an outside air intake louver with a modulating damper.

- Several classrooms contain a split system air conditioning unit, with a wall mounted evaporator and roof mounted condensing unit.

- Gas fired roof mounted HVAC units provide heating, cooling and ventilation for the office and ancillary spaces.

- Indoor air handling units with heating and DX cooling coils provide heating, cooling and ventilation for the gym and multi-purpose rooms.

- Roof mounted downblast exhaust fans provide exhaust for bathrooms and air relief for the classrooms.

General Description (10 room modular addition): The HVAC system for each classroom consists of exterior wall mounted gas fired heating/electric cooling units ducted into each space with 3-cone ceiling diffusers and general return air grilles. The units are manufactured by Band, model WH483 and are in fair condition.

Plumbing

Main Building:

- Domestic hot water is provided by a gas fired storage tank type water heater located in the boiler room. There is no evidence of a hot water recirculation system in the main building. Piping insulation was not installed on the observed domestic hot and cold water piping.

- An additional gas fired hot water heater is installed to serve classrooms and the kitchen.

- There is a separate electric water heater for the modular unit bathrooms.

- Fixtures:
    - Water closets and urinals are floor/wall mounted with flush valves.
    - Lavatories wall mounted with manual single handle control.
    - Service sinks are floor mounted with two handle faucets.

Temperature Controls

General Description: The main building has a pneumatic control system with the control components located in the boiler. The modular units have local thermostats for each classroom.

Special Systems

- The main building has a commercial kitchen including commercial kitchen hood and make-up air unit. Hood exhaust and make-up air unit are in excellent condition.

Existing Electrical Systems Profile

Lighting Systems:

The majority of interior lights are 4' linear fluorescent. Fixtures have recently been upgraded to T8 lamps and electronic ballasts throughout. Lamps are 32-watts, with color temperature of 4100K. Electronic Ballasts are instant start, GE UltraMax. There are some exterior metal halide lights.

Power Systems:

The main school building is served from two exterior pad-mount transformers owned by Cloverland Electric (formerly Edison Sault). There is one service that feeds into a mechanical room on north side of the building and a second service (outdoor) on far east end of the building. The main switchboard is 1200-amp, 208Y/120-volt, 3-phase, 4-wire. The second (outdoor) service is fed from a 50kVA transformer with 240/120-volt, 1-phase, 3-wire secondary. Many of the electrical branch panels are also located in the main electrical room and in the old boiler room, with additional panels located in a few locations throughout the building.

Special Systems: The building is provided with Telephone and Data/Telecommunication wiring systems including backbone cabling and outlet jacks at convenient locations. The building also has Fire Alarm, Speaker/Sound/Intercom, Clock, and Security Camera Systems in accordance with requirements for a typical school facility.

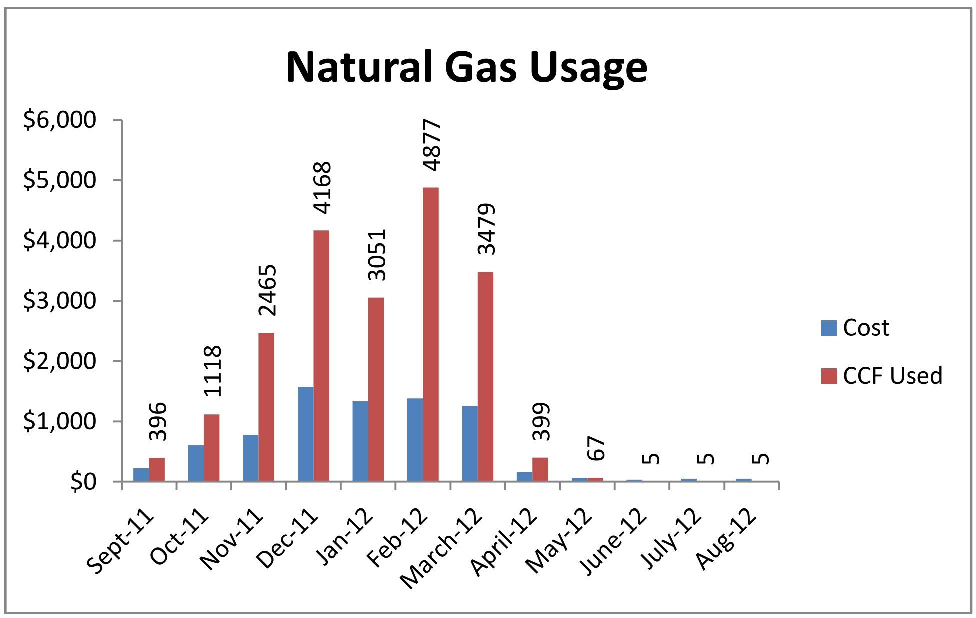
Existing Energy Consumption and Energy Cost Analysis

Natural Gas Usage

The following graphical data represents the monthly natural gas usage and costs for the September 2011 through August 2012 billing period, including the main building and modular units.

Month	Cost	CCF
Sept-11	$225	396
Oct-11	$608	1,118
Nov-11	$778	2,465
Dec-11	$1,573	4,168
Jan-12	$1,333	3,051
Feb-12	$1,380	4,877
March-12	$1,261	3,479
April-12	$159	399
May-12	$68	67
June-12	$32	5
July-12	$51	5
Aug-12	$51	5
Totals	$7,519	20,035

Natural Gas ECI:	$0.22	per sq ft/yr
Natural Gas ECU:	58,072	BTU/sq ft
Average Cost per CCF:	$0.38	$/CCF



Water Usage

The following graphical data represents the monthly water usage and costs for the September 2011 through August 2012 billing period, including the main building and modular units.

Month	Cost	Gallons
Sept-11	$264	22,500
Oct-11	$611	67,500
Nov-11	$514	67,500
Dec-11	$494	52,500
Jan-12	$378	37,500
Feb-12	$494	52,500
Mar-12	$494	52,500
Apr-12	$378	37,500
May-12	$494	52,500
June-12	$553	60,000
July-12	$179	15,000
Aug-12	$179	15,000
Totals	$5,032	532,500

Cost per sq ft:	$0.15	per sq ft/yr
Average Usage per Fixture:	7,948	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon

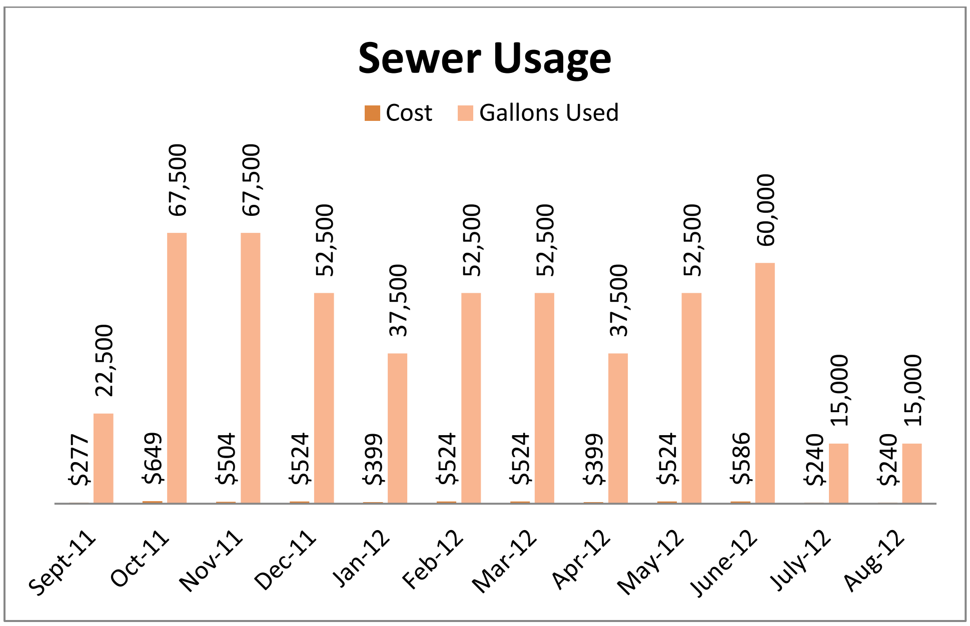
`

Sewer Usage

The following data is a graphical representation of monthly and annual sewer usage and costs for the September 2011 to August 2012 billing period, including the main building and modular units.

Month	Cost	Gallons
Sept-11	$277	22,500
Oct-11	$649	67,500
Nov-11	$504	67,500
Dec-11	$524	52,500
Jan-12	$399	37,500
Feb-12	$524	52,500
Mar-12	$524	52,500
Apr-12	$399	37,500
May-12	$524	52,500
June-12	$586	60,000
July-12	$240	15,000
Aug-12	$240	15,000
Totals	$5,390	532,500

Cost per sq ft:	$0.16	per sq ft/yr
Average Usage per Fixture:	7,948	gallons/fix
Average Usage Cost per Fixture:	$0.01	$/gallon

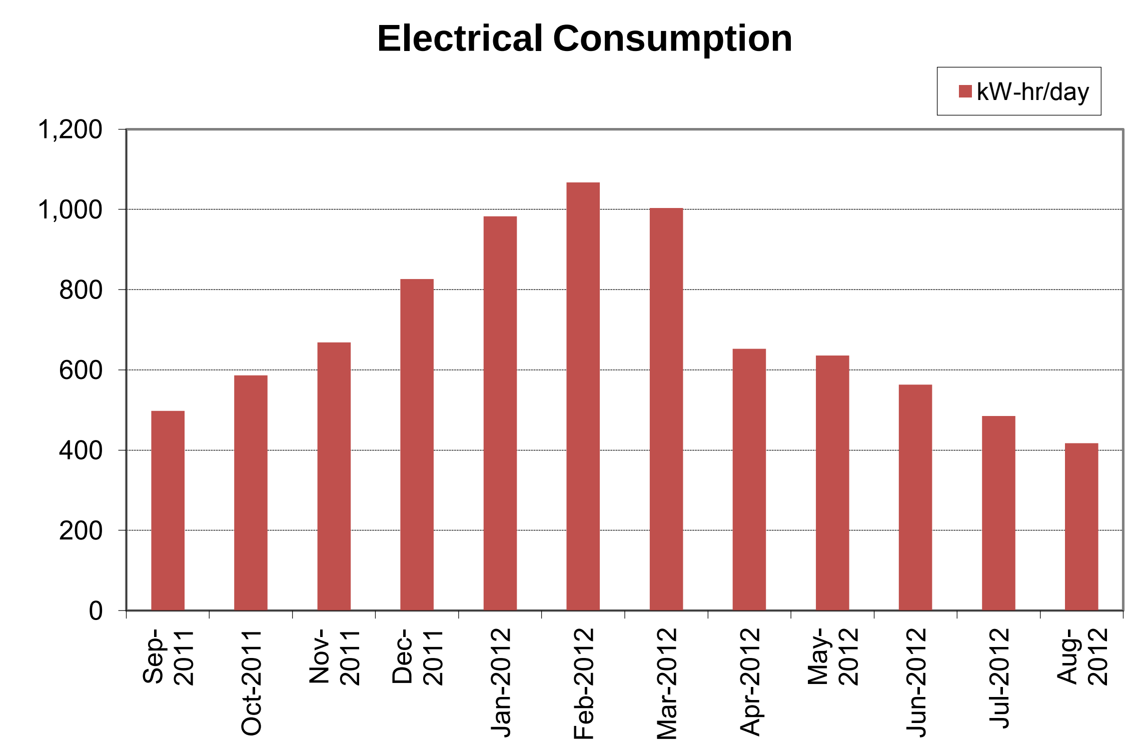


Electrical Usage: The following is electrical usage for the past year:

Electrical Consumption

		Period	Cost	Usage		
# days	kW-hr/day	**Month**	**Cost**	**kWh**	**cost/day**	
33	498	Sep-2011	$1,791	16,440	$54	
29	586	Oct-2011	$1,851	17,000	$64	
28	669	Nov-2011	$2,038	18,720	$73	
29	826	Dec-2011	$2,605	23,960	$90	
35	983	Jan-2012	$3,799	34,400	$109	
29	1,068	Feb-2012	$3,420	30,960	$118	
32	1,004	Mar-2012	$3,548	32,120	$111	
28	653	Apr-2012	$2,024	18,280	$72	
30	636	May-2012	$2,112	19,080	$70	
33	564	Jun-2012	$2,059	18,600	$62	
30	485	Jul-2012	$1,597	14,560	$53	
33	417	Aug-2012	$1,510	13,760	$46	
average:	699	Totals	$28,355	257,880	$77	average

Electrical ECI:	$0.82	per sq ft/yr
Electrical ECU:	25,698	BTU/sq ft
Average Cost per kWh:	$0.11	$/kWh



Energy Improvement Recommendations

Building

- Doors: Exterior doors should be examined. Weather stripping, seals and sweeps should be examined and repaired on a regular schedule. This will reduce infiltration and heat loss through the components.

- Exterior walls: Additional insulation should be added to the exterior walls for both the main building and the modular units, either blown in type or batt insulation.

- Ceilings: Additional insulation should be added above the ceilings. This will create a thermal barrier and reduce heat loss through the ceilings.

- Windows: The windows show significant signs of wear and should be replaced with a high efficient type window, such as 1 inch argon filled low-e type with 5 mm glass.

- Roof: An additional layer of insulation should be considered between the roof joists, or additional insulation can be added at the time when the roof membrane is replaced.

Mechanical

- General: Preventative maintenance schedules should be implemented for the boilers, pumps, unit ventilators, exhaust fans, air handling units and split system air conditioning units. This will increase life usage of the equipment and reduce future maintenance issues.

- Hot water heating system:
    - The existing heating is inefficient and should be replaced. This would include replacement of the boilers with high efficiency condensing type boilers staged to operate based on the building heating demands.
    - The main hot water circulation pumps should be replaced. The pumps show signs of significant wear.
    - Variable frequency drives should be installed on the main circulation pumps by varying pump speeds to match building heating loads. This will result in a reduction in electrical energy usage.
    - A system wide test and balance should be done, including inspection and replacement of the flow control components.

- Air handling units (Main building) and wall mounted air handling units (Modular):
    - Filters and components should be inspected and maintained in accordance with a preventative maintenance schedule determined by the equipment manufacturer.
    - Installation of variable frequency drives should be considered for the fan motors. This will operate the fan motors at slower speeds as necessary to maintain the minimum ventilation requirements.

- Unit ventilators:
    - Filters and components should be inspected and maintained in accordance with a preventative maintenance schedule determined by the equipment manufacturer.
    - Replacement of the unit ventilators should be considered in the near future. The units are near the end of their life expectancy and maintenance issues will increase over time.

Temperature Controls

- The existing temperature control system should be replaced with a building or energy management system. This will provide enhanced control of the electrical and gas usage.

Plumbing

- Fixtures:
  - Water closet flush valves should be replaced with low flow type flush valves.
  - Urinals flush valves should be replaced with sensor operated low flow type flush valves.
  - Lavatories and sinks should have low flow aerators installed on the faucets.
  - Manually operated faucets should be replaced with sensor operated type faucets.

Electrical Systems:

Many spaces in the building could benefit from motion sensors to turn off lights during un-occupied times of the day. For smaller offices, storage rooms, and similar smaller spaces a passive infrared wall box motion sensor would be recommended. For larger open rooms, ceiling mount passive infrared sensors would be appropriate. Dual technology ceiling sensors are recommended for bathrooms and other spaces with partitions.

It is recommended to replace exterior lighting with LED technology for longer life and more efficient energy use.

Renewable Energy Opportunities

Solar:

There is opportunity at this site for the utilization of solar energy for either hot water heating or electrical usage. A passive system of roof mounted solar arrays will offset gas and electrical usage and reduce CO2 emissions. The roof presently does have numerous pieces of mechanical equipment, so location and footprint of the solar system equipment is limited to the available open roof area.

Potential Energy Cost Savings

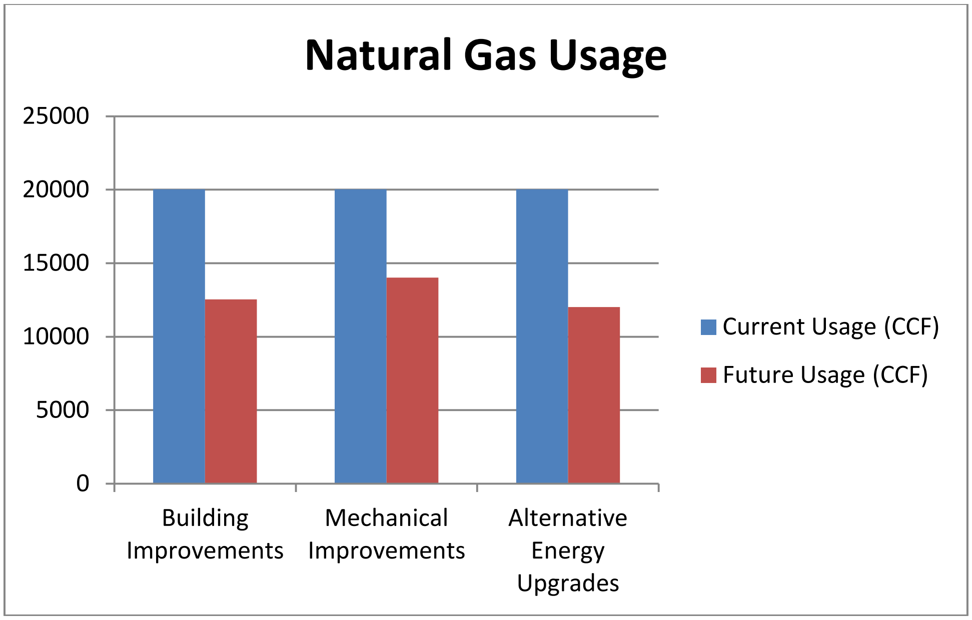
Natural Gas

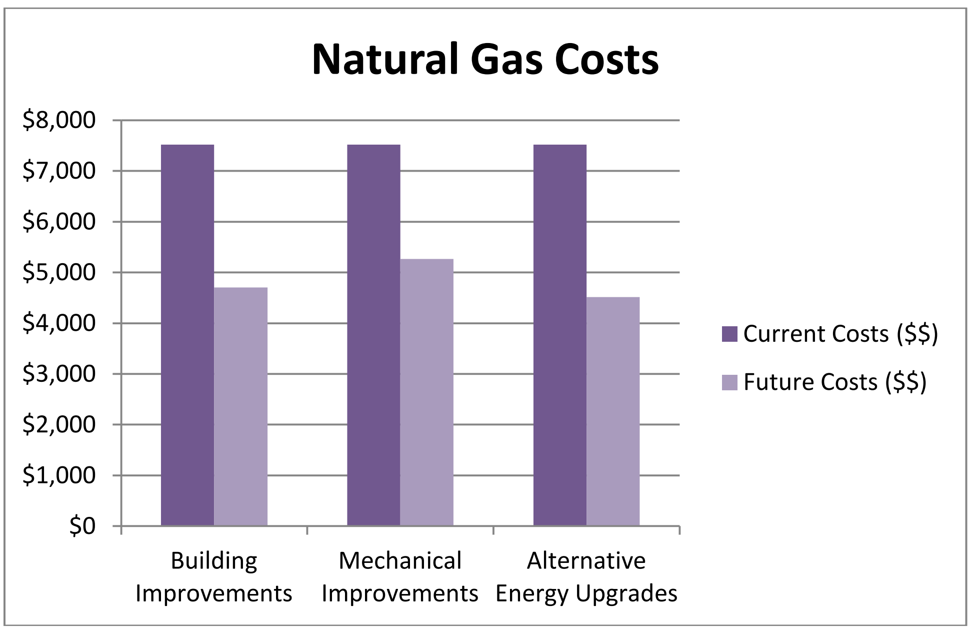
The following natural gas energy usage and cost savings is an estimate based on the following improvements (Improvements are independent of each other):

- Building Improvements:
  - Replacement of windows.
  - Addition of insulation in the walls and roof systems.

- Mechanical Improvement:
  - Replacement of the existing boilers, pumps and accessories.
  - Installation of an enhanced temperature control system.
  - Installation of a hot water recirculation system.

- Alternative Energy Upgrades
  - The installation of a solar system for heating hot water.



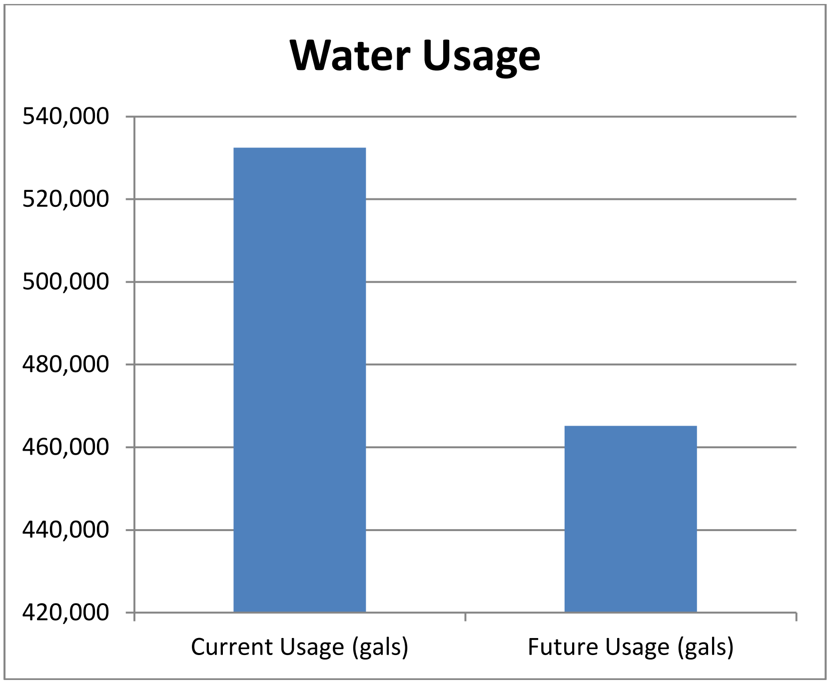


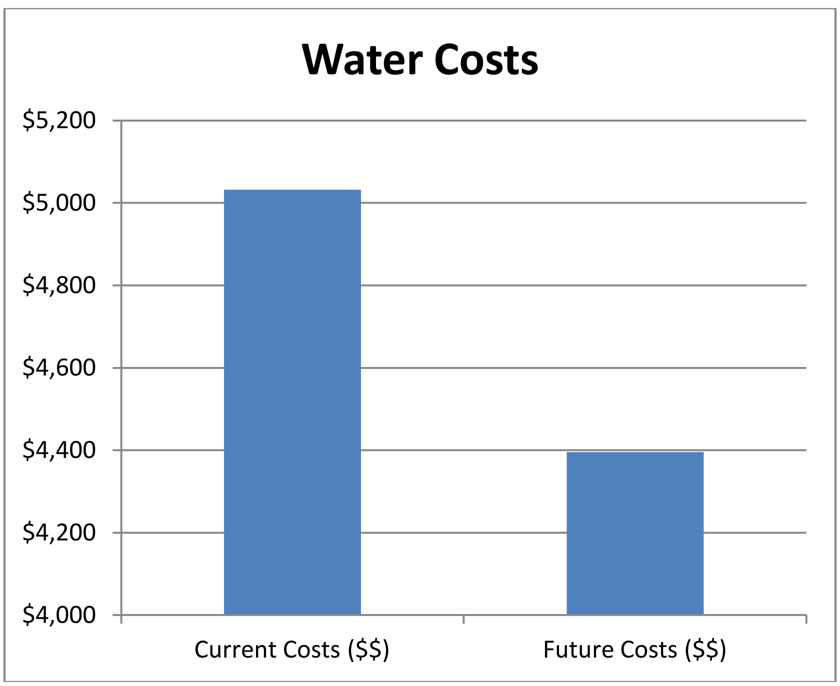
Energy Improvement Opportunity	ECI (per sq ft/yr)	ECU (BTU/sq ft)
Building Improvements	$0.14	36,350
Mechanical Improvements	$0.15	40,651
Alternative Energy Upgrades	$0.13	34,843

Water

The following water usage and cost savings is an estimate based on the following improvements:

- Replacement of water closet and urinal flush valves with low flow flush valves.
- Installation of low flow aerators on sinks and lavatories.





Electrical Systems:

The installation of motion sensors to control interior lighting could result in approximately $3000 per year of electrical savings. Additionally, upgrading exterior light fixtures to LED type could save another $800 per year.

The installation of approximately 30kW of rooftop solar (PV) electric panels & associated equipment (inverters, charge controllers, etc.) is estimated to reduce the building's annual electric bill by approximately $6,000.

Thermal Imaging Data

Infrared photos were not taken during initial site investigation, as the ambient exterior temperature was too warm to show and temperature differences. Photos were taken on a later visit when the weather had turned colder.

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. This building had slightly more than normal excess heat loss detected. There are some areas that may warrant further investigation, especially some of the exterior doors and windows. The most significant or surprising "find" by using the thermal imaging camera was heat loss detected through some of the exterior masonry. It appears that there may be little or no insulation behind some of the masonry, particularly the masonry close to the ground around exterior of the "portable" classrooms located on east side of the site and also in the lower exterior classroom walls in the oldest portion of the original building.

References

Existing wall U-value (Main Bldg): 0.225 Btu/hr/sq ft/deg F
Existing wall U-value (Modular Bldg): 0.342 Btu/hr/sq ft/deg F
Existing roof U-value (Main Bldg): 0.121 Btu/hr/sq ft/deg F
Existing roof U-value (Modular Bldg): 0.741 Btu/hr/sq ft/deg F
Existing window U-value (Main Bldg): 0.588 Btu/hr/sq ft/deg F
Existing window U-value (Modular Bldg): 0.70 Btu/hr/sq ft/deg F
Existing ACH (Main Bldg): 0.75
Existing ACH (Modular Bldg): 1.00

Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Software
HAP 4.06: Hourly Analysis Program, Carrier, Inc.
REVIT 2011: Computer Aided Design Software
AutoCAD MEP 2011: Computer Aided Design Software
FLIR Tools, Version 2.2: FLIR E40 Infrared Camera analysis software

Air System Sizing Summary for Main Building

Project Name: Untitled 12/20/2012
Prepared by: UPEA 02:39PM

Air System Information

Air System Name	Main Building		Number of zones	1	
Equipment Class	UNDEF		Floor Area	34500.0	ft²
Air System Type	SZCAV		Location	Sault Ste Marie, Michigan	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Sum of space airflow rates	Calculation Months	Jan to Dec
Space CFM	Individual peak space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	80.8	Tons	Load occurs at	Jul 1500	
Total coil load	969.1	MBH	OA DB / WB	83.0 / 69.0	°F
Sensible coil load	825.5	MBH	Entering DB / WB	77.3 / 65.1	°F
Coil CFM at Jul 1500	41843	CFM	Leaving DB / WB	58.5 / 57.4	°F
Max block CFM	41843	CFM	Coil ADP	56.4	°F
Sum of peak zone CFM	41843	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.852		Resulting RH	53	%
ft²/Ton	427.2		Design supply temp.	58.0	°F
BTU/(hr-ft²)	28.1		Zone T-stat Check	1 of 1	OK
Water flow @ 10.0 °F rise	193.92	gpm	Max zone temperature deviation	0.0	°F

Central Heating Coil Sizing Data

Max coil load	1580.4	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	41843	CFM	BTU/(hr-ft²)	45.8	
Max coil CFM	41843	CFM	Ent. DB / Lvg DB	55.7 / 91.6	°F
Water flow @ 20.0 °F drop	158.12	gpm			

Supply Fan Sizing Data

Actual max CFM	41843	CFM	Fan motor BHP	22.92	BHP
Standard CFM	40758	CFM	Fan motor kW	18.18	kW
Actual max CFM/ft²	1.21	CFM/ft²	Fan static	2.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	6640	CFM	CFM/person	26.56	CFM/person
CFM/ft²	0.19	CFM/ft²			

Air System Sizing Summary for Modular Building

Project Name: Untitled
Prepared by: UPEA

12/20/2012
02:40PM

Air System Information

Air System Name	**Modular Building**	Number of zones	1	
Equipment Class	**UNDEF**	Floor Area	9360.0	ft^2
Air System Type	**SZCAV**	Location	**Sault Ste Marie, Michigan**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Sum of space airflow rates**	Calculation Months	**Jan to Dec**
Space CFM	**Individual peak space loads**	Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**54.8**	Tons	Load occurs at	**Jul 1400**	
Total coil load	**658.0**	MBH	OA DB / WB	**82.3 / 68.8**	°F
Sensible coil load	**614.7**	MBH	Entering DB / WB	**77.0 / 64.5**	°F
Coil CFM at Jul 1400	**32201**	CFM	Leaving DB / WB	**58.9 / 57.7**	°F
Max block CFM	**32201**	CFM	Coil ADP	**56.9**	°F
Sum of peak zone CFM	**32201**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.934**		Resulting RH	**51**	%
ft^2/Ton	**170.7**		Design supply temp.	**58.0**	°F
BTU/(hr-ft^2)	**70.3**		Zone T-stat Check	**0 of 1**	OK
Water flow @ 10.0 °F rise	**131.67**	gpm	Max zone temperature deviation	**0.1**	°F

Central Heating Coil Sizing Data

Max coil load	**868.1**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**32201**	CFM	BTU/(hr-ft^2)	**92.7**	
Max coil CFM	**32201**	CFM	Ent. DB / Lvg DB	**62.2 / 87.9**	°F
Water flow @ 20.0 °F drop	**86.86**	gpm			

Supply Fan Sizing Data

Actual max CFM	**32201**	CFM	Fan motor BHP	**17.64**	BHP
Standard CFM	**31366**	CFM	Fan motor kW	**13.99**	kW
Actual max CFM/ft^2	**3.44**	CFM/ft^2	Fan static	**2.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**2623**	CFM	CFM/person	**17.49**	CFM/person
CFM/ft^2	**0.28**	CFM/ft^2			

UPEA ENGINEERS & ARCHITECTS

Infrared photos taken with FLIR E40 Camera
JKL Bahweting School Building
301 Marquette Street, Sault Ste. Marie, MI 49783

Measurements	°F
Sp1	41.7

Parameters	
Emissivity	0.95
Refl. temp.	68 °F

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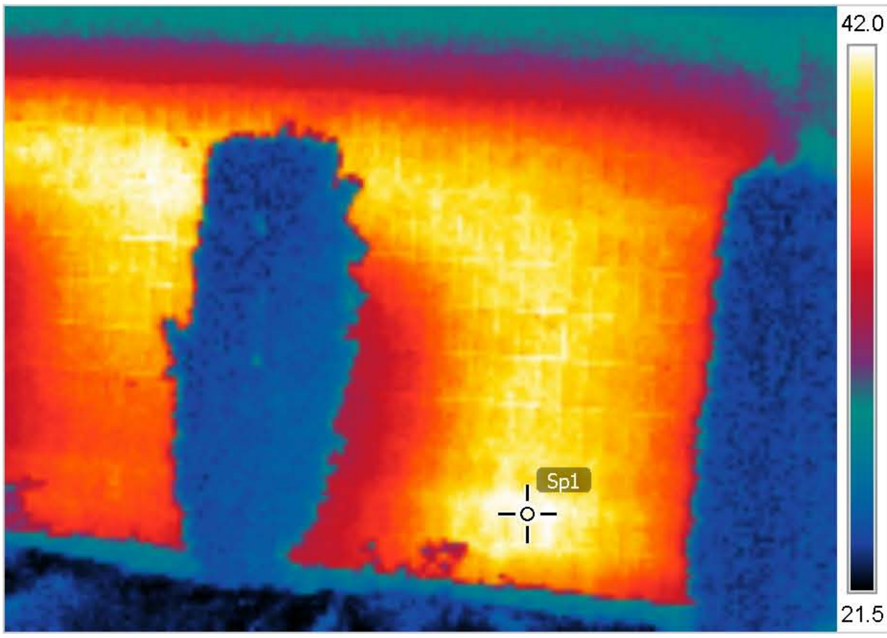

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DC_1551.jpg

UPEA ENGINEERS & ARCHITECTS

Infrared photos taken with FLIR E40 Camera
JKL Bahweting School Building
301 Marquette Street, Sault Ste. Marie, MI 49783

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Sp1	39.9

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Emissivity	0.95
Refl. temp.	68 °F

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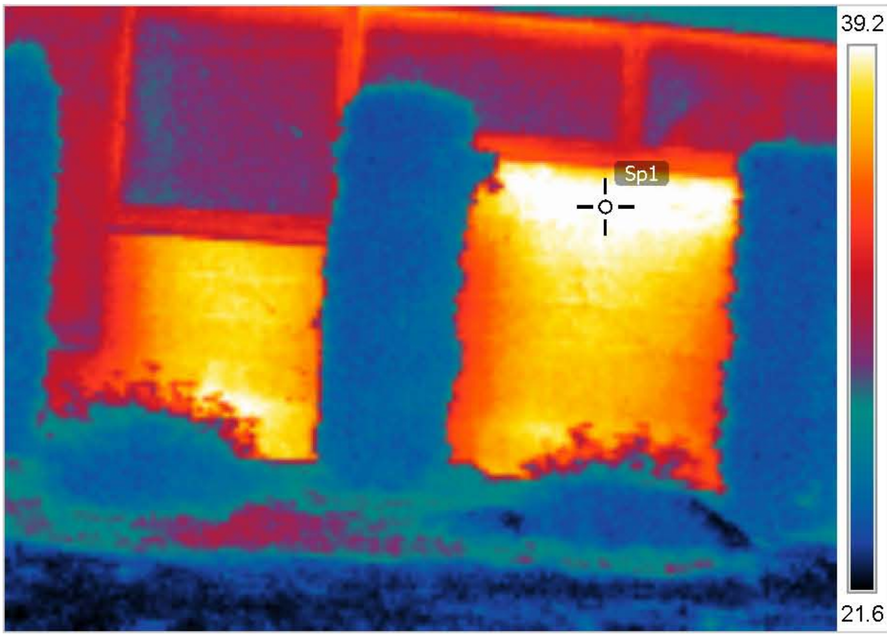

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DC_1553.jpg

Infrared photos taken with FLIR E40 Camera
JKL Bahweting School Building
301 Marquette Street, Sault Ste. Marie, MI 49783

Measurements	°F
Sp1	34.5

Parameters	
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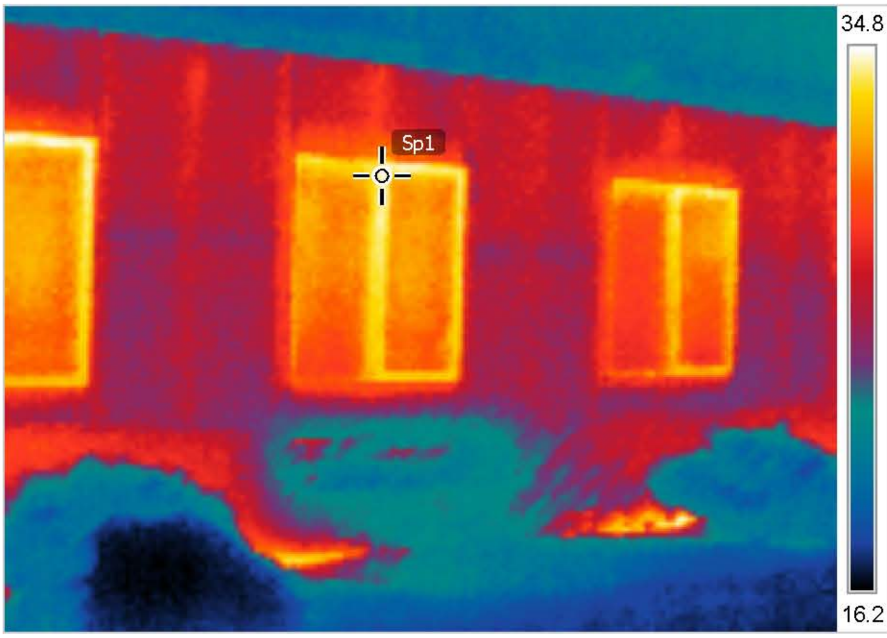

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Energy Audit
Manistique Tribal Health / Community Center
5698 W. Highway US-2
Manistique, MI 49854

December 2012

Table of Contents

Summary

The Manistique Tribal Health and Community Center was built in 2004 and consists of approximately 24,822 square ft of space all on 1 level. The space currently houses Tribal Health, Dental, Social Services and Elder Services along with Tribal Law Enforcement. The center encompasses many amenities such as a large kitchen and community, meeting space and is adjacent to the Manistique Casino.

Existing Building Envelope Profile

Wall Construction: Exterior wall is a two part system. The upper wall construction is vinyl siding, lower wall construction is brick veneer. Interior wall construction is 2x6 wood framing with cavity insulation and interior gypsum board.

Roof Construction: Roof system is pre-engineered wood trusses, gypsum board on bottom chord of trusses, 12 inch fiberglass batt insulation in roof cavity and fiberglass shingles. Ice damming is evident and heat tracing has been installed on several sections of roofing. Additional insulation was added to ceiling space in 2011.

Floor Construction: Floor system is 4 inch concrete slab on grade with 2 inch rigid perimeter insulation. Floor treatment is vinyl composition tile, vinyl sheet, carpet and concrete.

Window and Door Construction: Exterior doors are aluminum frame, front entrance doors include windows. Exterior windows are double pane aluminum clad wood windows with operable sections. Weather stripping, door sweeps and seals are in fair condition.

Ceilings: Ceilings are 2x2 acoustical tile and gypsum board.

Existing Mechanical Systems Profile

HVAC

General Description: The HVAC system consists of fan coil units with heating and cooling coils, air handling units, a heating hot water boiler system, a chilled water system, cabinet unit heaters, unit heaters, convectors and exhaust fans.

- Horizontal fan coil units located above the ceiling have supply, return and outside air directly ducted to the units. Each unit contains a hot water and chilled water coil. The ductwork that is insulated is in good condition.
- The hot water heating consists of two boilers, Weil McLain model 80, 787 MBH gas input, two base mounted main circulation pumps, 1.5 horsepower each, expansion tank, air separator and accessories. The boilers, pumps and pipe insulation are in good condition.
- The chilled water system consists of an 80 ton outdoor condensing unit, an indoor evaporator and two base mounted main chilled water circulation pumps, 3 horsepower each. The equipment and insulation are in excellent condition.
- Four indoor air handling units with heating/cooling coils, Trane Climate Changer types, provide outdoor air for the fan coil units. Duct and piping insulation for these units is in good condition.
- Hot water cabinet unit heaters, convectors and ceiling hung unit heaters provide space heating for vestibules, mechanical/electrical rooms and entryways.
- Roof mounted exhaust fans provide exhaust for bathrooms, storage rooms, labs, janitor’s closets and utility rooms. Operation of the fans is continuous.

- A split system air conditioning unit serves the IT room.

Plumbing

General Description: The water system is served from a well with two pressure tanks. The sewer system is septic with drain field. There are compressed air and vacuum systems serving the medical offices. The septic system requires maintenance for replacement of filters.

- Fixtures:
  - Water closets are tank type, floor mounted.
  - Urinals are flush valve type, wall mounted
  - Sinks and lavatories have two handle faucets.
  - Service sinks are floor mounted with two handle faucets.

- Domestic hot water is provided by a single gas fired hot water storage tank type water heater, AO Smith, model 300A970, 130 gallon capacity, 360 GPH recovery rate. There is a hot water recirculation system for both the low temp system and the kitchen hot water system. The average hot water delivery test at the farthest fixtures was 120 seconds.

Temperature Controls

General description: The temperature control system is direct digital control system, Delta controls. Each zone has a Delta wall mounted thermostat with direct space temperature adjustment. The building is controlled by an occupied/unoccupied control scheme. The general exhaust fan operates continuously.

Special Systems

- The building has a full fire protection sprinkler system including a wet system for the occupied areas and a dry system for the attic area.

- The building has a commercial kitchen including commercial kitchen hood and make-up air unit. Hood exhaust and make-up air unit are in excellent condition.

Existing Electrical Systems Profile

Lighting Systems

The majority of interior lights are 4' linear fluorescent. Fixtures have recently been upgraded to T8 lamps and electronic ballasts throughout. Lamps are 32-watt, with color temperature of 4100K. Electronic Ballasts are instant start, GE UltraMax. Exterior lighting consists of several different types of metal halide fixtures located at the main entrance, ground mounted flood lights, a few wall-pack lights and several pole mounted fixtures for the parking lot area.

Power Systems

The building is served from an exterior pad-mount transformer owned by Cloverland Electric (formerly Edison Sault). The main switchboard is 1600-amp, 208/120-volt, 3-phase, 4-wire and is located in main electrical room. Many of the electrical branch panels are also located in the main electrical room, with additional panels located throughout the building.

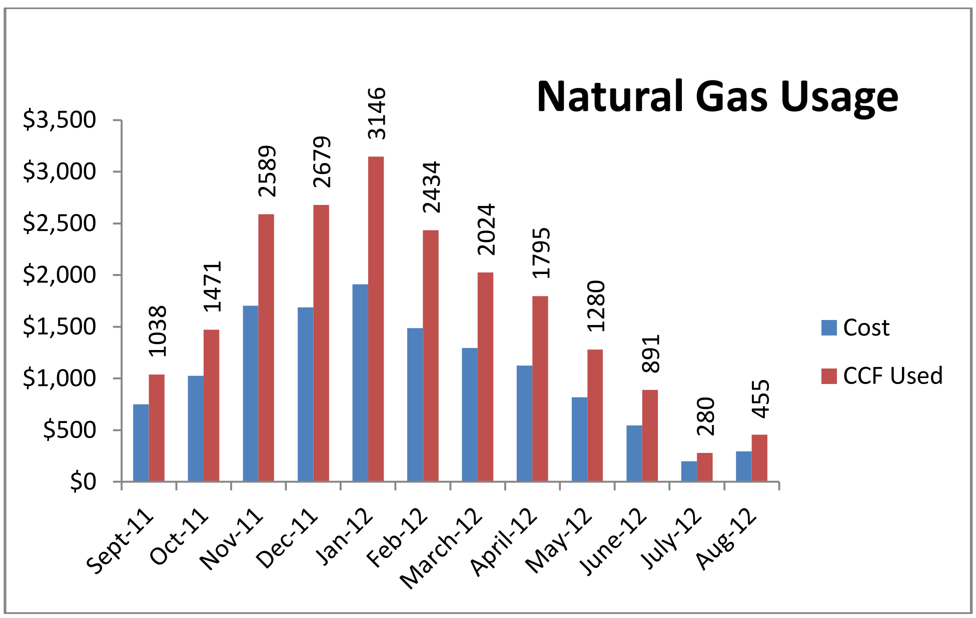
Existing Energy Consumption and Energy Cost Analysis

Natural Gas Usage

The following graphical data represents the monthly natural gas usage and costs for the September 2011 through August 2012 billing period.

Month	Cost	CCF
Sept-11	$749	1,038
Oct-11	$1,025	1,471
Nov-11	$1,704	2,589
Dec-11	$1,687	2,679
Jan-12	$1,911	3,146
Feb-12	$1,488	2,434
March-12	$1,295	2,024
April-12	$1,126	1,795
May-12	$819	1,280
June-12	$547	891
July-12	$200	280
Aug-12	$296	455
Totals	$12,847	20,082

Natural Gas ECI:	$0.52	per sq ft/yr
Natural Gas ECU:	80,904	BTU/sq ft
Average Cost per CCF:	$0.64	$/CCF

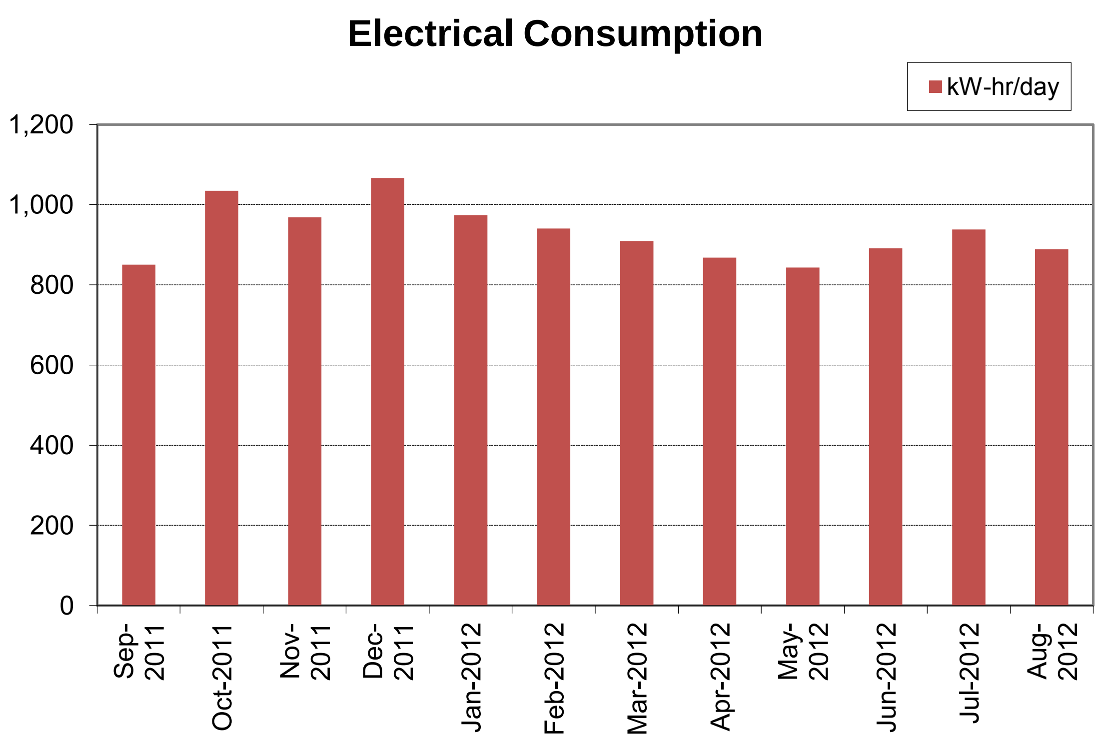


Electrical Usage: The following is electrical energy use for the past year:

Electrical Consumption

		Period	Cost	Usage	
# days	kW-hr/day	Month	Cost	kWh	cost/day
30	851	Sep-2011	$2,774	25,520	$92
31	1,035	Oct-2011	$3,484	32,080	$112
29	968	Nov-2011	$3,051	28,080	$105
21	1,067	Dec-2011	$2,436	22,400	$116
41	974	Jan-2012	$4,407	39,920	$107
25	941	Feb-2012	$2,601	23,520	$104
33	909	Mar-2012	$3,315	30,000	$100
27	868	Apr-2012	$2,592	23,440	$96
35	843	May-2012	$3,262	29,520	$93
29	891	Jun-2012	$2,857	25,840	$99
33	938	Jul-2012	$3,384	30,960	$103
29	888	Aug-2012	$2,818	25,760	$97
average:	931	Totals	$36,980	337,040	$102 average

Electrical ECI:	$1.49	per sq ft/yr
Electrical ECU:	46,682	BTU/sq ft
Average Cost per kWh:	$0.11	$/kWh



Energy Improvement Recommendations

Building

- Doors: Exterior doors should be examined. Weather stripping, seals and sweeps should be examined and repaired on a regular schedule. This will reduce infiltration and heat loss through the components.

- Windows: Exterior windows should be examined. Weather stripping and seals should be examined and repaired on a regular schedule. This will reduce infiltration and heat loss through the components.

- Roof:
    - Additional continuous insulation should be considered above the ceiling.
    - The ice damming is a result of poor ventilation in the attic space and excessive heat being introduced into the attic space. Ventilation and insulation in the attic space should be inspected to prevent future ice buildup issues.

Mechanical

- General: Preventative maintenance schedules should be implemented for the boilers, condensing units, evaporator, pumps, fans and fan coil units. This will increase life usage of the equipment and reduce future maintenance issues.

- Hot water heating system:
    - Hot water boilers should be replaced with high efficiency type condensing boilers to reduce natural gas usage and costs.
    - Variable frequency drives should be installed on the main circulation pumps by varying pump speeds to match building heating loads. This will result in a reduction in electrical energy usage.
    - A system wide test and balance should be done, including inspection and replacement of the flow control components.

- Air handling units:
    - Filters and components should be inspected and maintained in accordance with a preventative maintenance schedule determined by the equipment manufacturer.
    - Installation of variable frequency drives should be considered for the fan motors. This will operate the fan motors at slower speeds as necessary to maintain the minimum ventilation requirements. An occupied/unoccupied type schedule is an example where the fan could run at slower speed during unoccupied mode.

- Fan coil units: The fan coil units should be inspected and maintained on a regular basis.

Temperature Controls

- Replacement of the existing direct digital control system with an enhanced temperature control system to include greater space temperature, hot and chilled water system and lighting controls should be considered.

Plumbing

- The hot water recirculation system be examined and additional piping added to reduce the water usage required to provide hot water to fixtures.

- A preventative maintenance schedule should be implemented for the septic and water systems to include filter changes, pump service and pressure tank service.

- Fixtures:
    - Water closet flush valves should be replaced with low flow type flush valves.
    - Urinals flush valves should be replaced with sensor operated low flow type flush valves.
    - Lavatories and sinks should have low flow aerators installed on the faucets.
    - Manually operated faucets should be replaced with sensor operated type faucets.

Electrical Systems:

Many spaces in the building could benefit from motion sensors to turn off lights during un-occupied times of the day. For smaller offices, storage rooms, and similar smaller spaces a passive infrared wall box motion sensor would be recommended. For larger open rooms, ceiling mount passive infrared sensors would be appropriate. Dual technology ceiling sensors are recommended for bathrooms and other spaces with partitions.

It is recommended to replace exterior lighting with LED technology for longer life and more efficient energy use

Renewable Energy Opportunities

- Solar: There is opportunity at this site for the utilization of solar energy for either hot water heating or electrical usage. A passive system of roof-top or ground mounted solar arrays will offset gas and electrical usage and reduce CO2 emissions.

- Geothermal
    - There is opportunity for a ground source open or closed looped geothermal heating and cooling system. The system would require ground wells and accessories to be installed and would provide heating and cooling to replace the existing systems. Additional testing would be required to determine the feasibility of a geothermal system.
    - Additional tax incentives may be realized with the installation of a geothermal system.

- Wind: There is opportunity for the implementation of a turbine system to assist in electricity production and reduce electrical costs.

Potential Energy Cost Savings

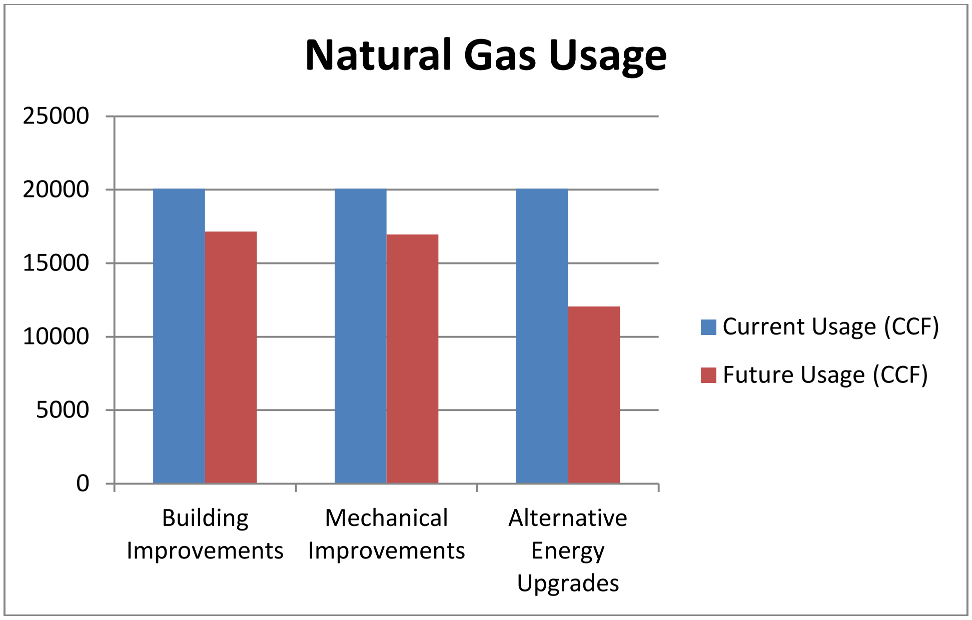
Natural Gas

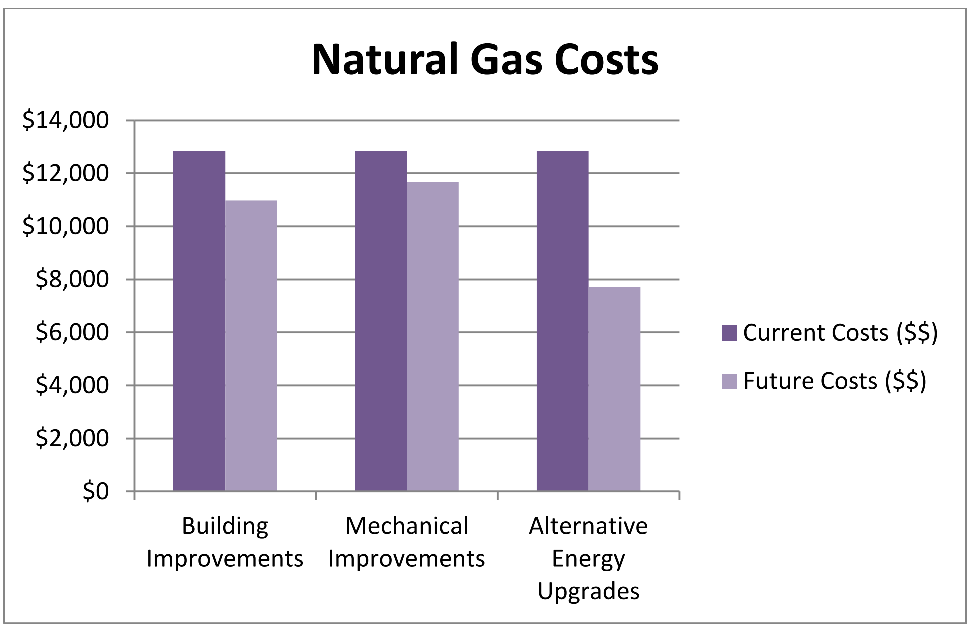
The following natural gas energy usage and cost savings is an estimate based on the following improvements (Improvements are independent of each other):

- Building Improvements:
    - Addition of insulation above ceilings.
    - Repair of weather stripping on windows and doors.

- Mechanical Improvement:
    - Replacement of existing boilers.
    - Enhanced temperature control system.
    - Installation of additional domestic hot water recirculation piping.

- Alternative Energy Upgrades
    - Installation of a geothermal system for hot water heating.





Energy Improvement Opportunity	ECI (per sq ft/yr)	ECU (BTU/sq ft)
Building Improvements	$0.44	69,136
Mechanical Improvements	$0.47	68,286
Alternative Energy Upgrades	$0.31	48,542

Water/Sewer

Water and sewer usage can be reduced by the following:

- Replacement of flush valves with low flow flush valves.
- Installation of low flow aerators on lavatories and sinks.

This will also result in a reduction in electrical energy usage by limiting the operation of the well pumps.

Electrical Systems:

The installation of motion sensors to control interior lighting could result in approximately $2000 per year of electrical savings. Additionally, upgrading exterior light fixtures to LED type could save another $800 per year.

The installation of approximately 20kW of rooftop solar (PV) electric panels & associated equipment (inverters, charge controllers, etc.) is estimated to reduce the building's annual electric bill by approximately $4,000.

Thermal Imaging Data

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. This building had very little unexpected heat loss detected. There were a few small areas at the "ceremonial" room roof/ceiling that may be lacking insulation or has gaps in the insulation.

Exterior windows and doors have typical heat loss, particularly areas with double doors. Weather stripping and door sweeps should be examined periodically and replaced when excessive wear and/or damage is found.

References

Existing wall U-value: 0.045 Btu/hr/sq ft/deg F
Existing roof U-value: 0.24 Btu/hr/sq ft/deg F
Existing window U-value: 0.58 Btu/hr/sq ft/deg F
Existing ACH: 0.75

Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Software

HAP 4.06: Hourly Analysis Program, Carrier, Inc.
REVIT 2011: Computer Aided Design Software
AutoCAD MEP 2011: Computer Aided Design Software
FLIR Tools, Version 2.2: FLIR E40 Infrared Camera analysis software

Air System Sizing Summary for Manistique Tribal Health

Project Name: TRIBAL COMMUNITY CENTER - manistique — 12/19/2012
Prepared by: UPEA — 04:16PM

Air System Information

Air System Name	Manistique Tribal Health		Number of zones	1	
Equipment Class	UNDEF		Floor Area	25026.0	ft²
Air System Type	SZCAV		Location	Sault Ste Marie, Michigan	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Sum of space airflow rates		Calculation Months	Jan to Dec	
Space CFM	Individual peak space loads		Sizing Data	Calculated	

Central Heating Coil Sizing Data

Max coil load	604.5	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	19534	CFM	BTU/(hr-ft²)	24.2	
Max coil CFM	19534	CFM	Ent. DB / Lvg DB	64.2 / 93.6	°F
Water flow @ 20.0 °F drop	60.48	gpm			

Supply Fan Sizing Data

Actual max CFM at Des Htg	19534	CFM	Fan motor BHP	0.00	BHP
Standard CFM	19027	CFM	Fan motor kW	0.00	kW
Actual max CFM/ft²	0.78	CFM/ft²	Fan static	0.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	1091	CFM	CFM/person	36.37	CFM/person
CFM/ft²	0.04	CFM/ft²			

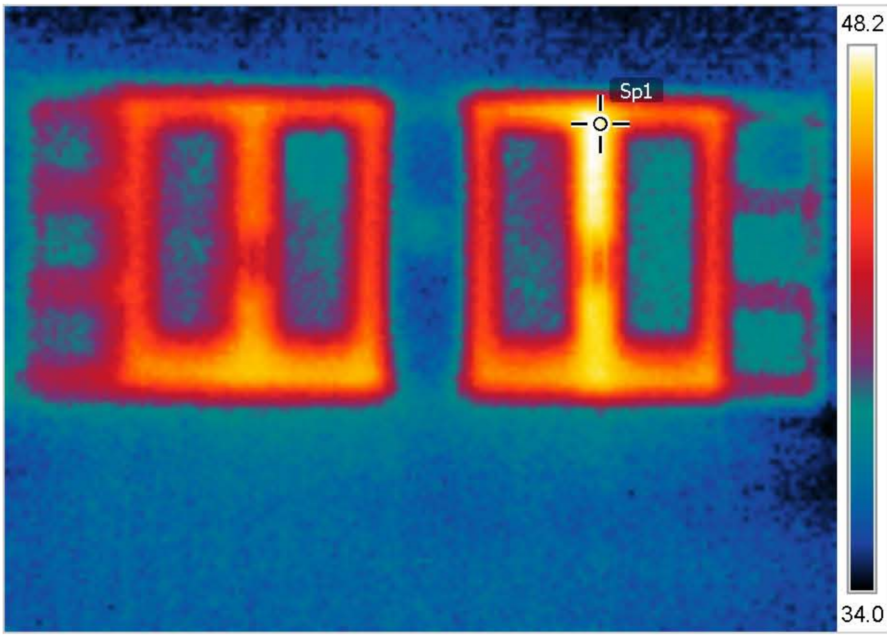
UPEA ENGINEERS & ARCHITECTS

Manistique Tribal Health Center [Building #6]
Infrared photos taken with FLIR E40 Camera
October 30, 2012

Measurements	°F
Sp1	47.8

Parameters	
Emissivity	0.95
Refl. temp.	68 °F

10/30/2012 10:47:04 AM



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DC_0425.jpg

Manistique Tribal Health Center [Building #6]
Infrared photos taken with FLIR E40 Camera
October 30, 2012

Measurements	°F
Sp1	39.3

Parameters	
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Refl. temp.	68 °F

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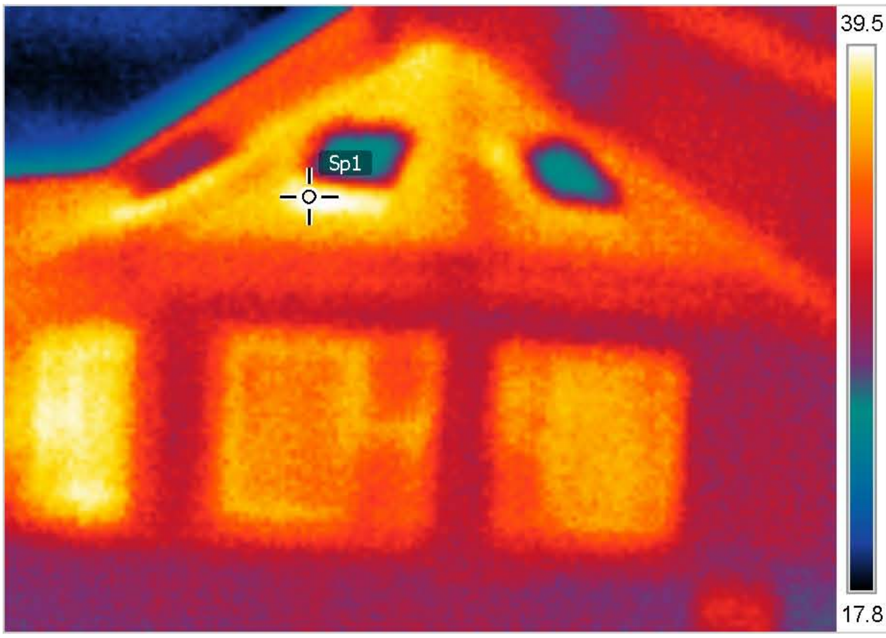

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DC_0429.jpg

Energy Audit
Munising Tribal Health / Community Center
622 W. Superior Street
Munising, MI 49862

December 2012

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Attachments:

Summary

The Munising Tribal Health / Community Center (former Lincoln School) was built in 1915 and completely renovated by the Tribe in 2006. The building consists of 3 floors with approximately 21,000 square feet. This facility is located in Munising with frontage on both Superior Street and M-28 (West Munising Ave). Community space is located on the lower level with entry off M-28. Health is located on the main floor with entry from the Superior Street side of the building. The third floor was designed for possible use for a fitness area with a walking path. Entrance to the 3rd floor can be obtained by utilizing the stairs and/or elevator from both the lower level and main floors.

Existing Building Envelope Profile

Wall Construction: The original exterior wall construction was 22” thick stone masonry walls. During the 2006 renovation, 2” of rigid insulation was added to the inside surface of the stone walls.

Roof Construction: A new Duro-Last membrane was installed, along with rigid insulation during the 2006 renovation project. The roof is in excellent condition.

Floor Construction: The building is slab on grade construction. The floors have a combination of tile and vinyl covering.

Window and Door Construction: The windows and doors are wood frame construction. Window glazing is double pane with shading available on the first floor windows. The windows, doors, weather stripping and sweeps are in excellent condition.

Existing Mechanical Systems Profile

HVAC

General Description: The HVAC system consists of fan coil units with heating and cooling coils, a make-up air unit, a heating hot water boiler system, a chilled water system, cabinet and unit heaters and exhaust fans.

- Horizontal fan coil units located above the ceiling have supply, return and outside air directly ducted to the units. Each unit contains a hot water and chilled water coil. The ductwork that is insulated is in excellent condition.
- The hot water heating consists of two high efficiency boilers, Fulton model PHW300, two base mounted main circulation pumps, 1.5 horsepower each, expansion tank, air separator and accessories. The boilers, pumps and pipe insulation are in excellent condition.
- The chilled water system consists of an outdoor condensing unit, a two pass indoor evaporator and two main chilled water circulation pumps, 5 horsepower each. The equipment and insulation is in excellent condition.
- Outdoor air requirements are met by an indoor floor mounted make-up air handling unit located in Mechanical Room 109. The unit is a York, model XT1-039X with hot and chilled water coils. The equipment and insulation are in excellent condition.
- Cabinet unit heaters with hot water coils are located in vestibules, stairways and bathrooms. These units are in excellent condition.
- Ceiling mounted hot water unit heaters are located in mechanical and electrical rooms and in excellent condition.

- A central downblast roof mounted exhaust fan, Greenheck model GB-180, 2 horsepower provide exhaust for bathrooms and general areas. Fan operation is controlled by the temperature control system. There is a ceiling mounted exhaust fan dedicated for room 203. The fans and ductwork are in excellent condition.

- There are two split system air conditioning units serving the first and third floor IT rooms. These units are in excellent condition.

Plumbing

- Domestic hot water is provided by a single storage tank, gas fired hot water heater, Ruud, model HE119, 120 gal storage capacity, 184 gph. There is a hot water recirculation system. The average hot water delivery test at the farthest fixtures was 12 seconds. The system is operating correctly and in excellent condition.

- Water closets are floor mounted flush valve type. Urinals are wall mounted flush valve type. Lavatory faucets are manual single handle type. Exam room sink faucets are gooseneck type with dual hot/cold water wrist blade controls.

- Domestic water and sewer are city provided.

Temperature Controls

General description: The temperature control system is direct digital control system, Delta controls. Each zone has a Delta wall mounted thermostat with direct space temperature adjustment. The building is controlled by an occupied/unoccupied control scheme. The general exhaust fan operates on a time clock schedule.

Special Systems

- The building has a full fire protection sprinkler system.

- Switching gear is installed for a future emergency generator.

- Exterior doors are accessible by a Kery key system.

- The building has a commercial kitchen including commercial kitchen hood and make-up air unit. Hood exhaust and make-up air unit are in excellent condition.

Existing Electrical Systems Profile

Lighting Systems: All building lighting was installed new during the 2006 renovation project. Interior lighting is all fluorescent, with the majority being 4' linear T8 lamps and several areas with compact fluorescent downlights (cans). The exterior lighting building and parking area lights are metal halide. Most of the 4' linear fluorescent interior lighting had lamps and ballasts replaced in 2011. Lamps are by TCP and ballasts are GE Ultramax instant start.

Lighting controls are a mixture of motion sensors and wall switches, with most spaces covered by motion sensors. The instant start ballasts are not a good fit with the motion sensors and are causing premature end blackening and burn-outs of fluorescent lamps.

Power Systems: The electrical power for the building is provided by a dedicated 150kVA pad-mount transformer owned by UPPCO. The building main panel is 800-amp, 208Y/120-volt, 3-phase, 4-wire. All electrical panels are General Electric.

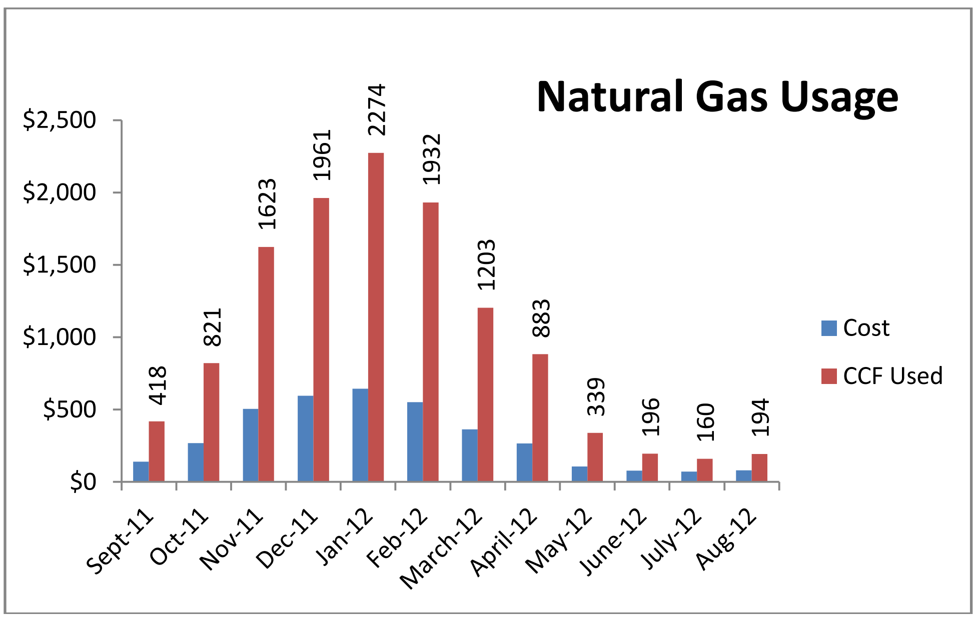
Existing Energy Consumption and Energy Cost Analysis

Natural Gas Usage

The following graphical data represents the monthly natural gas usage and costs for the September 2011 through August 2012 billing period.

Month	Cost	CCF
Sept-11	$141	418
Oct-11	$268	821
Nov-11	$505	1,623
Dec-11	$595	1,961
Jan-12	$645	2,274
Feb-12	$551	1,932
March-12	$363	1,203
April-12	$266	883
May-12	$108	339
June-12	$78	196
July-12	$71	160
Aug-12	$81	194
Totals	$3,672	12,004

Natural Gas ECI:	$0.17	per sq ft/yr
Natural Gas ECU:	57,162	BTU/sq ft
Average Cost per CCF:	$0.31	$/CCF

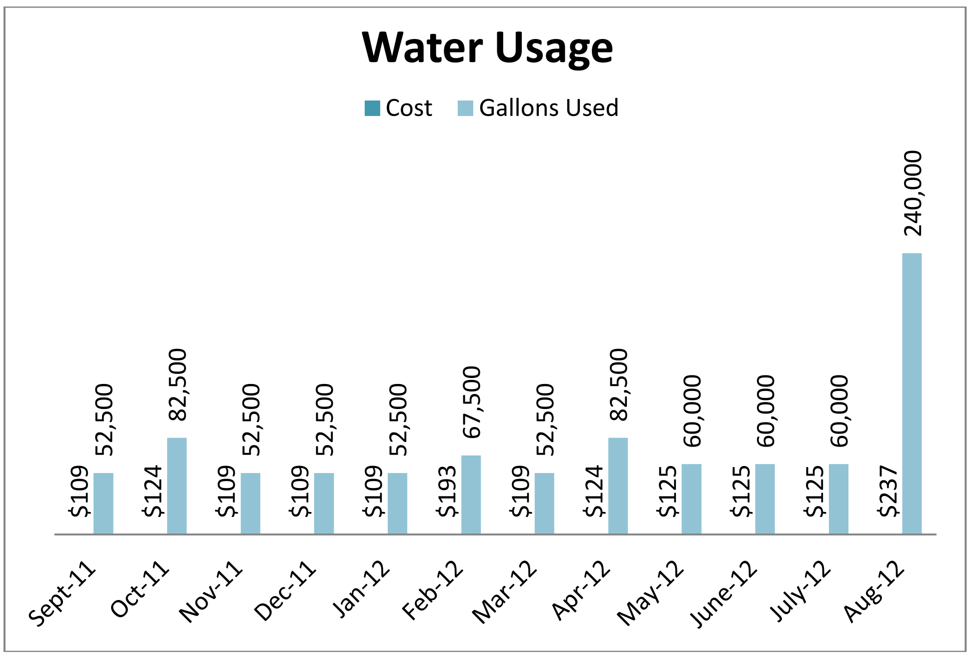


Water Usage

The following graphical data represents the monthly water usage and costs for the September 2011 through August 2012 billing period.

Month	Cost	Gallons
Sept-11	$109	52,500
Oct-11	$124	82,500
Nov-11	$109	52,500
Dec-11	$109	52,500
Jan-12	$109	52,500
Feb-12	$193	67,500
Mar-12	$109	52,500
Apr-12	$124	82,500
May-12	$125	60,000
June-12	$125	60,000
July-12	$125	60,000
Aug-12	$237	240,000
Totals	$1,598	915,000

Cost per sq ft:	$0.08	per sq ft/yr
Average Usage per Fixture:	18,673	gallons/fix
Average Usage Cost per Fixture:	$0.00	$/gallon

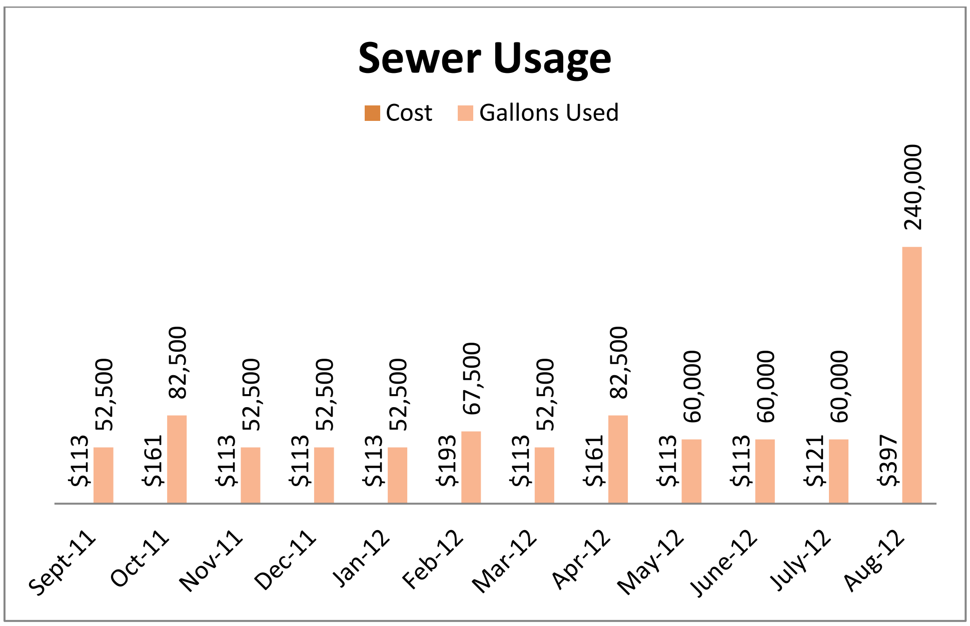


Sewer Usage

The following data is a graphical representation of monthly and annual sewer usage and costs for the September 2011 to August 2012 billing period.

Month	Cost	Gallons
Sept-11	$113	52,500
Oct-11	$161	82,500
Nov-11	$113	52,500
Dec-11	$113	52,500
Jan-12	$113	52,500
Feb-12	$193	67,500
Mar-12	$113	52,500
Apr-12	$161	82,500
May-12	$113	60,000
June-12	$113	60,000
July-12	$121	60,000
Aug-12	$397	240,000
Totals	$1,824	915,000

Cost per sq ft:	$0.09	per sq ft/yr
Average Usage per Fixture:	18,673	gallons/fix
Average Usage Cost per Fixture:	$0.00	$/gallon

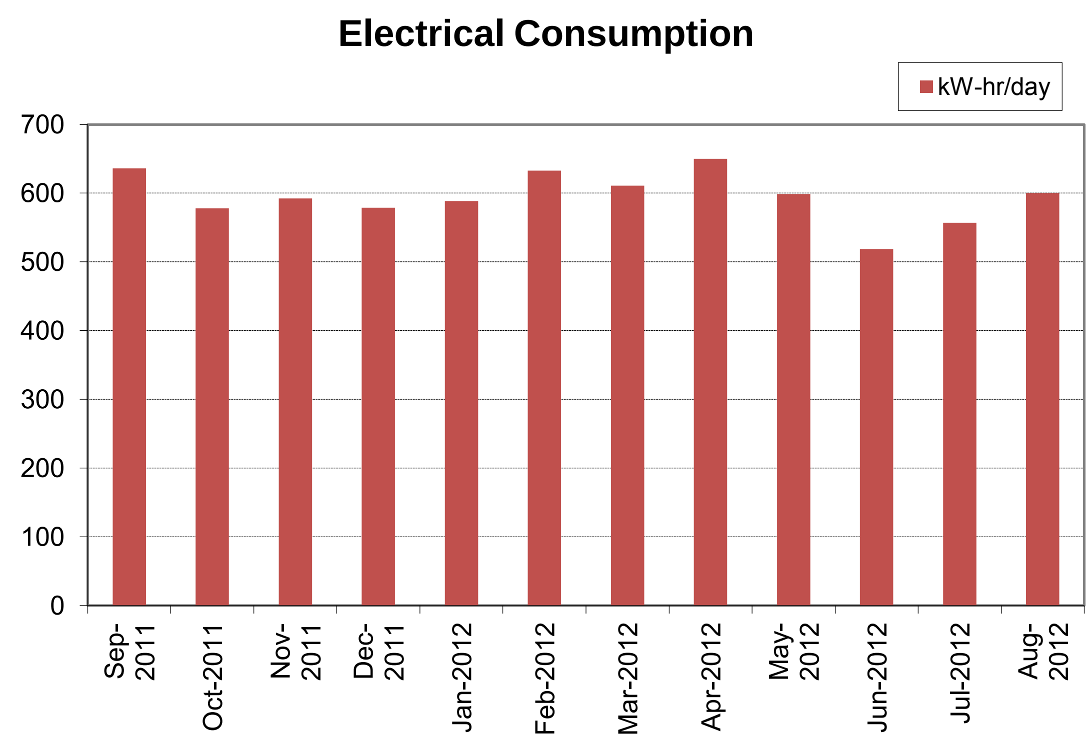


Electrical Usage: The following is a summary of electric use for the past year:

Electrical Consumption

		Period	Cost	Usage		
# days	kW-hr/day	Month	Cost	kWh	cost/day	
30	636	Sep-2011	$2,660	19,080	$89	
29	578	Oct-2011	$2,327	16,760	$80	
32	593	Nov-2011	$2,552	18,960	$80	
30	579	Dec-2011	$2,272	17,360	$76	
35	589	Jan-2012	$2,828	20,600	$81	
28	633	Feb-2012	$2,556	17,720	$91	
33	611	Mar-2012	$2,800	20,160	$85	
28	650	Apr-2012	$2,726	18,200	$97	
30	599	May-2012	$2,484	17,960	$83	
30	519	Jun-2012	$2,254	15,560	$75	
28	557	Jul-2012	$2,370	15,600	$85	
34	600	Aug-2012	$2,988	20,400	$88	
average:	595	Totals	$30,818	218,360	$84	average

Electrical ECI:	$1.47	per sq ft/yr
Electrical ECU:	35,749	BTU/sq ft
Average Cost per kWh:	$0.14	$/kWh



Energy Improvement Recommendations

Building:

- Ceilings: Additional insulation could be installed above the ceilings. This will reduce heat loss above the ceiling in the plenum space.

- Windows and doors: Weather stripping, caulking and door sweeps should be inspected annually and repaired as necessary.

Mechanical

- General: Preventative maintenance schedules should be implemented for the boilers, condensing units, evaporator, pumps, fans and fan coil units. This will increase life usage of the equipment and reduce future maintenance issues.

- Hot water heating system:
    - Variable frequency drives should be installed on the main circulation pumps by varying pump speeds to match building heating loads. This will result in a reduction in electrical energy usage.

- Cooling system:
    - Variable frequency drives should be installed on the main circulation pumps by varying pump speeds to match building cooling loads. This will result in a reduction in electrical energy usage.

Temperature Controls

- Replacement of the existing direct digital control system with an enhanced temperature control system to include greater space temperature, hot and chilled water system and lighting controls should be considered.

Plumbing

- Fixtures:
    - Water closet flush valves should be replaced with low flow type flush valves.
    - Urinals flush valves should be replaced with sensor operated low flow type flush valves.
    - Lavatories and sinks should have low flow aerators installed on the faucets.
    - Manually operated faucets should be replaced with sensor operated type faucets.

Electrical Systems:

Install low ballast factor program start ballasts and 28-watt premium T8 linear fluorescent lamps.

Replace exterior lighting with LED.

Replace compact fluorescent recessed “can” interior fixtures with LED.

Renewable Energy Opportunities

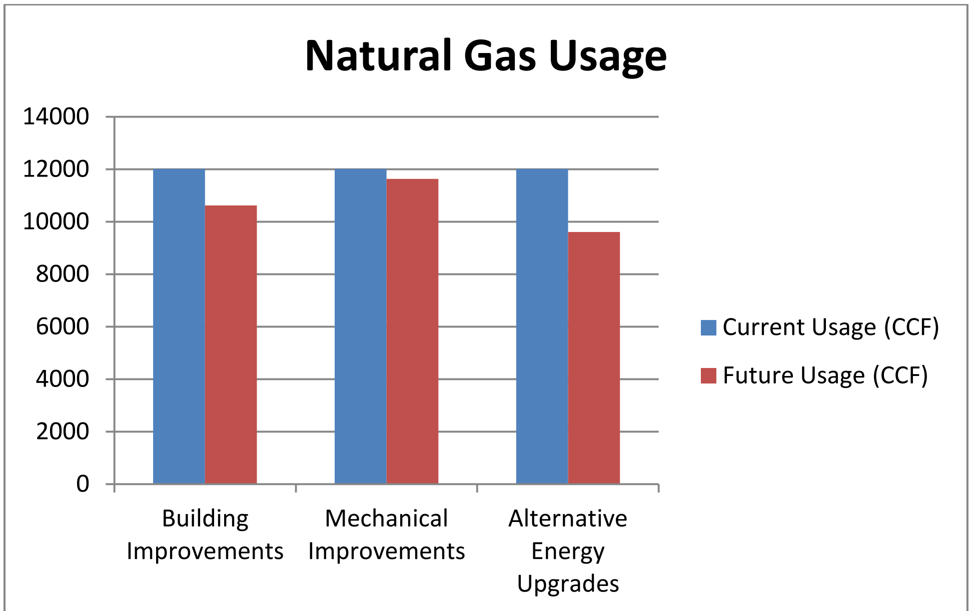
- Solar: There is opportunity at this site for the utilization of solar energy for either hot water heating or electrical usage. A passive system of roof mounted solar arrays will offset gas and electrical usage and reduce CO_2 emissions. The roof presently has very few pieces of mechanical equipment, so location and footprint of the solar system equipment is only limited to the available open roof area.

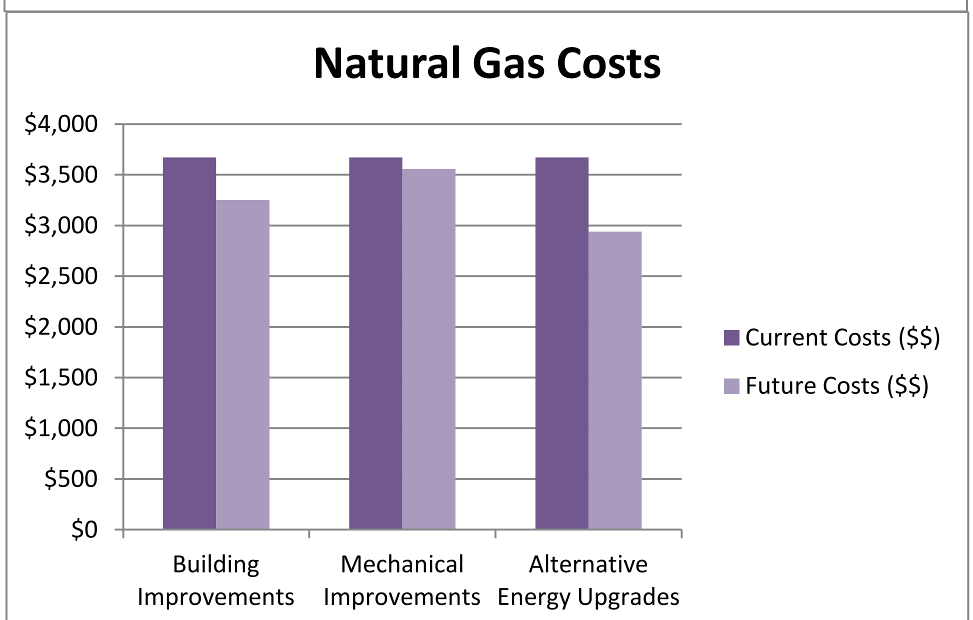
Potential Energy Cost Savings

Natural Gas

The following natural gas energy usage and cost savings is an estimate based on the following improvements (Improvements are independent of each other):

- Building Improvements:
  - Additional insulation above ceilings.
- Mechanical Improvements:
  - Enhanced temperature control system.
- Alternative Energy Upgrades
  - The installation of a solar system for heating hot water.



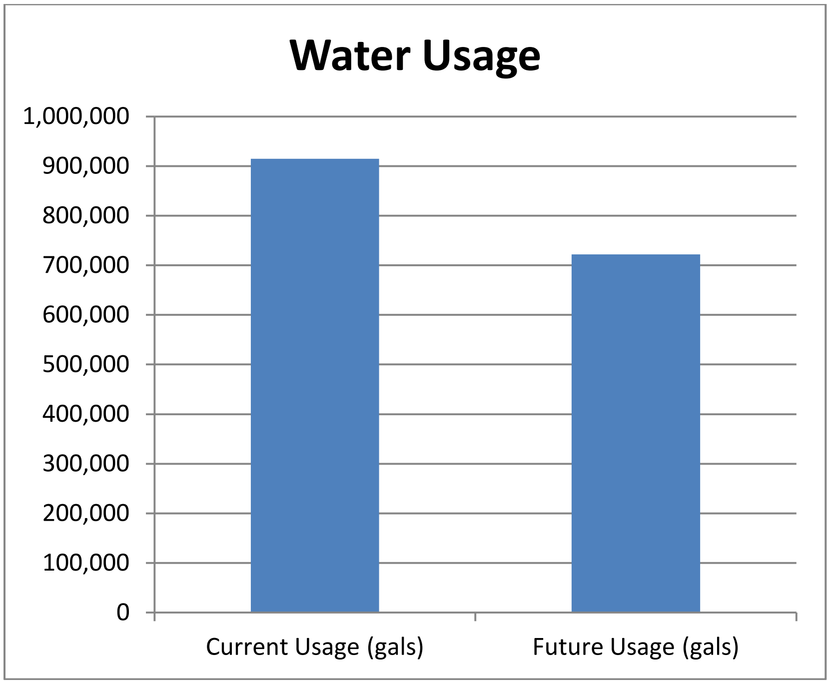


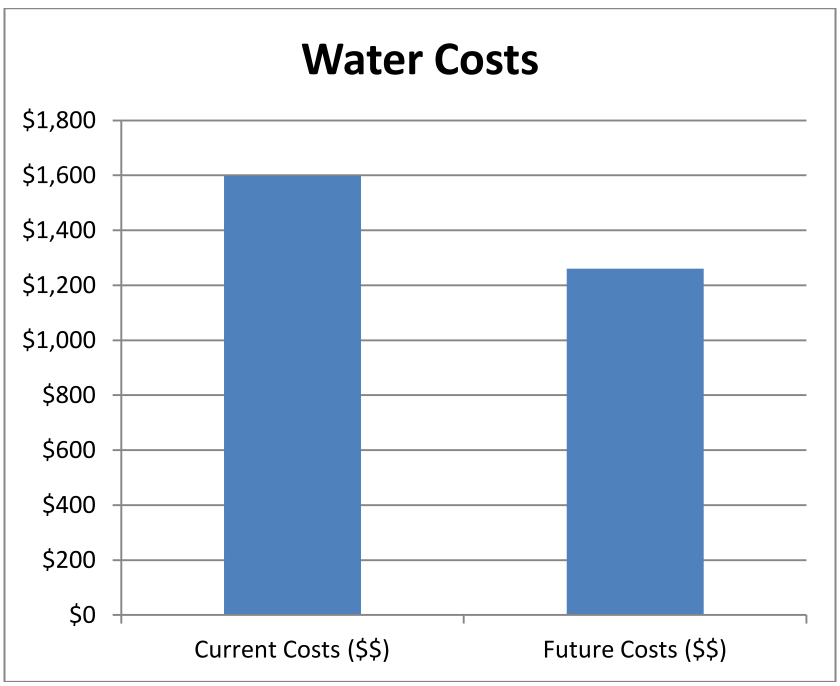
Energy Improvement Opportunity	ECI (per sq ft/yr)	ECU (BTU/sq ft)
Building Improvements	$0.15	50,587
Mechanical Improvements	$0.17	55,357
Alternative Energy Upgrades	$0.14	45,730

Water

The following water usage and cost savings is an estimate based on the following improvements:

- Replacement of water closet flush valves with low flow flush valves (1.3<).
- Replacement of flush valve urinals with waterless urinals.
- Installation of low aerators on lavs and sinks.





Electrical Systems:

Low ballast factor program start electronic ballasts and 28-watt premium T8 linear fluorescent lamps, along with LED fixtures for recessed interior and all exterior lights will provide significant energy savings for the facility. In addition, the very long life of premium T8 lamps and LED's will provide a significant savings in maintenance costs. Lighting improvements are estimated to provide approximately savings of $800 per year.

The installation of approximately 20kW of rooftop solar (PV) electric panels & associated equipment (inverters, charge controllers, etc.) is estimated to reduce the building's annual electric bill by approximately $4,000.

Thermal Imaging Data

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. This building had very little unexpected heat loss detected.

Exterior windows and doors have typical heat loss, particularly areas with double doors. Weather stripping and door sweeps should be examined periodically and replaced when excessive wear and/or damage is found.

References

Existing wall U-value: 0.109 Btu/hr/sq ft/deg F
Existing roof U-value: 0.43 Btu/hr/sq ft/deg F
Existing window U-value: 0.59 Btu/hr/sq ft/deg F
Existing ACH: 0.5

Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Software

HAP 4.06: Hourly Analysis Program, Carrier, Inc.
REVIT 2011: Computer Aided Design Software
AutoCAD MEP 2011: Computer Aided Design Software
FLIR Tools, Version 2.2: FLIR E40 Infrared Camera analysis software

Air System Sizing Summary for Manistique Tribal Health

Project Name: TRIBAL COMMUNITY CENTER - manistique 12/19/2012
Prepared by: UPEA 04:20PM

Air System Information

Air System Name	Manistique Tribal Health		Number of zones	1	
Equipment Class	UNDEF		Floor Area	25026.0	ft²
Air System Type	SZCAV		Location	Sault Ste Marie, Michigan	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Sum of space airflow rates		Calculation Months	Jan to Dec	
Space CFM	Individual peak space loads		Sizing Data	Calculated	

Central Heating Coil Sizing Data

Max coil load	604.5	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	19534	CFM	BTU/(hr-ft²)	24.2	
Max coil CFM	19534	CFM	Ent. DB / Lvg DB	64.2 / 93.6	°F
Water flow @ 20.0 °F drop	60.48	gpm			

Supply Fan Sizing Data

Actual max CFM at Des Htg	19534	CFM	Fan motor BHP	0.00	BHP
Standard CFM	19027	CFM	Fan motor kW	0.00	kW
Actual max CFM/ft²	0.78	CFM/ft²	Fan static	0.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	1091	CFM	CFM/person	36.37	CFM/person
CFM/ft²	0.04	CFM/ft²			

Munising Tribal Health Center [Building # 7]
Infrared Camera photos taken with FLIR E40 Camera
October 29, 2012

Measurements	°F
Sp1	46.9

Parameters	
Emissivity	0.95
Refl. temp.	68 °F

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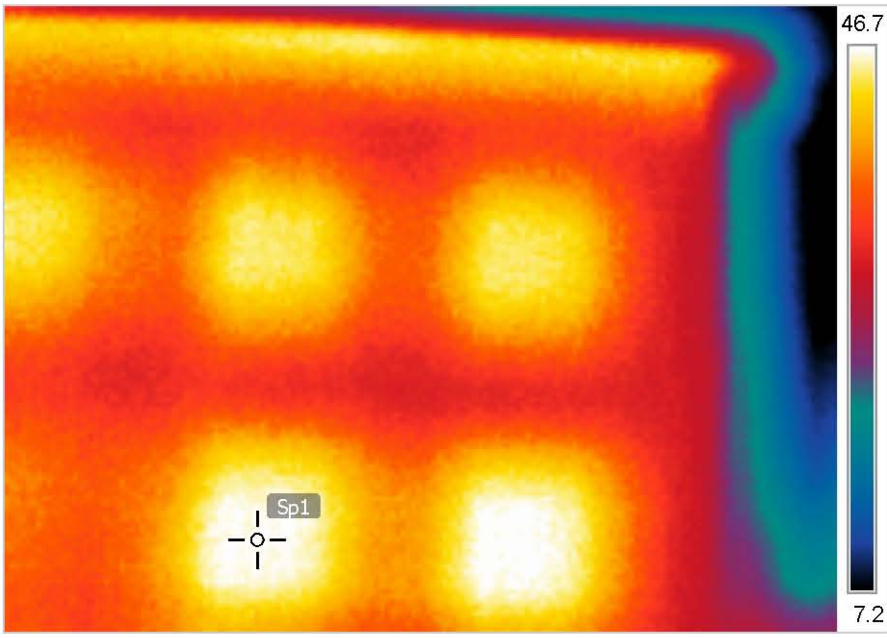

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UPEA ENGINEERS & ARCHITECTS

Munising Tribal Health Center [Building # 7]
Infrared Camera photos taken with FLIR E40 Camera
October 29, 2012

Measurements °F

Sp1	53.4

Parameters

Emissivity	0.95
Refl. temp.	68 °F

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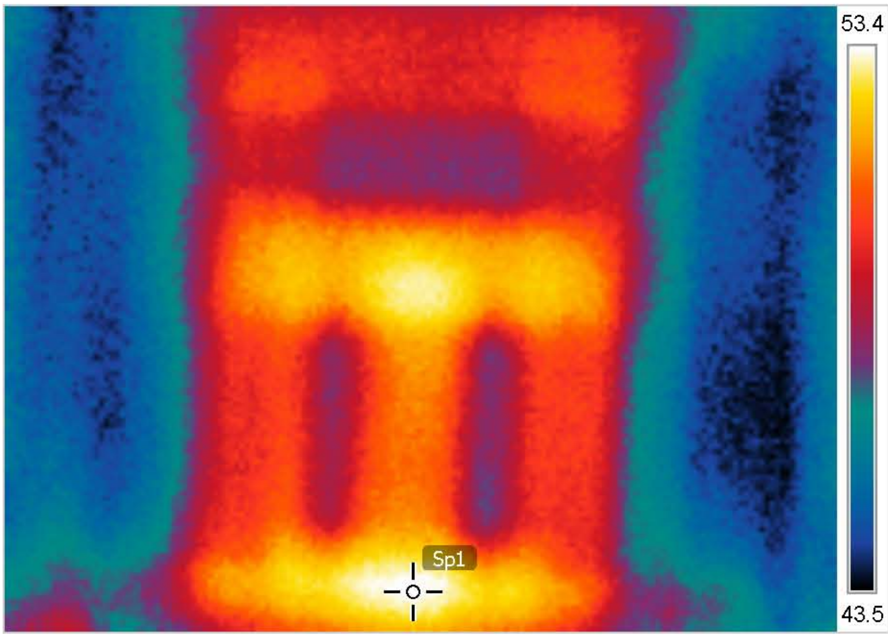

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DC_0347.jpg

Energy Analysis Report
Proposed Motor Pool Building
3 Mile Road
Sault Sainte Marie, MI

May 2013

Table of Contents

Summary

The Proposed Motor Pool Fleet Building located on 3 Mile Road is a 8,000 square foot metal building. The building was purchased for use as office/garage facility for Motor Pool and Inland Fish and Wild Life Department, a division of the Sault Tribes Department of Natural Resources. The building was constructed by Nomad Construction and is a metal building package from the Gulf States.

Existing Building Envelope Profile

Wall Construction: Exterior walls are metal with insulated liner panel and vertical metal exterior siding.

Roof Construction: Roof is metal roofing.

Floor Construction: Floor is a concrete slab on grade.

Window and Door Construction: There are several existing overhead doors into garage areas, 2 existing personnel doors and 3 aluminum frame windows located in the office area only.

Existing Mechanical Systems Profile

HVAC

The building has one (1) existing Reznor unit heater suspended from the ceiling. It is recommended to install natural gas furnace(s) with outdoor a/c condensing units to provide HVAC to office spaces. It is recommended to use overhead infrared “tube” heaters for heating in the garage spaces and to provide in-line exhaust fans with side-wall vents and louvers for garage space ventilation. Water or air source heat pumps may be an option instead of furnaces for office spaces and should be evaluated.

Plumbing

There are no plumbing fixtures at this facility. Some rough-ins were originally placed in the floor slab. It is unknown where the rough-ins are routed. The facility will need to have either a septic tank and drain field installed or connection made to City Sewer (availability uncertain). The site does have a water well of unknown condition – needs to be tested prior to use.

Temperature Control Systems

The building does not have a Temperature Control System. It is recommended to install a control system for new HVAC equipment and systems, including thermostats to be wall mounted programmable type. Garage spaces will be required to have CO/NO2 sensors to control ventilation equipment.

Existing Electrical Systems Profile

Lighting Systems: Existing Interior lights are 8’ T12 high-output fluorescent and should be upgraded/replaced with energy efficient T8 lamps and electronic ballasts.

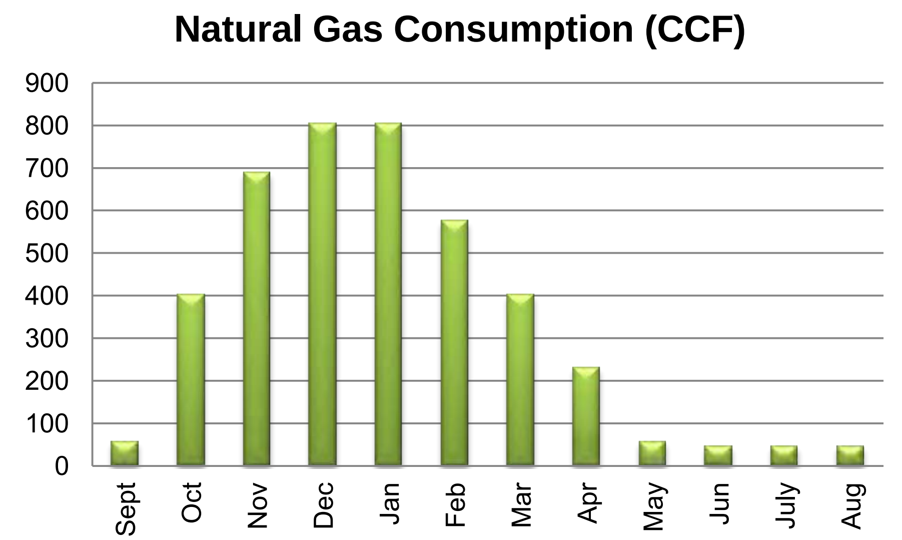
Power Systems: Electrical service is from Cloverland Electric and is 200-amp, single-phase, 240/120-volt. Three phase power is available nearby. It is recommended to install a 400-amp, three-phase 208Y/120-volt main service panel for the proposed building use.

Expected Energy Consumption and Energy Cost Analysis

The following is a prediction of energy use based on expected building use as motor pool shop/office. No existing utility were provided and even if they were provided would not have accurately reflected future use.

Natural Gas Use Prediction:

Month	Cost	CCF
Sept	$50	57
Oct	$350	402
Nov	$600	690
Dec	$700	805
Jan	$700	805
Feb	$500	575
Mar	$350	402
Apr	$200	230
May	$50	57
Jun	$40	46
July	$40	46
Aug	$40	46
Totals	$3,620	4,161



Square Footage 8000

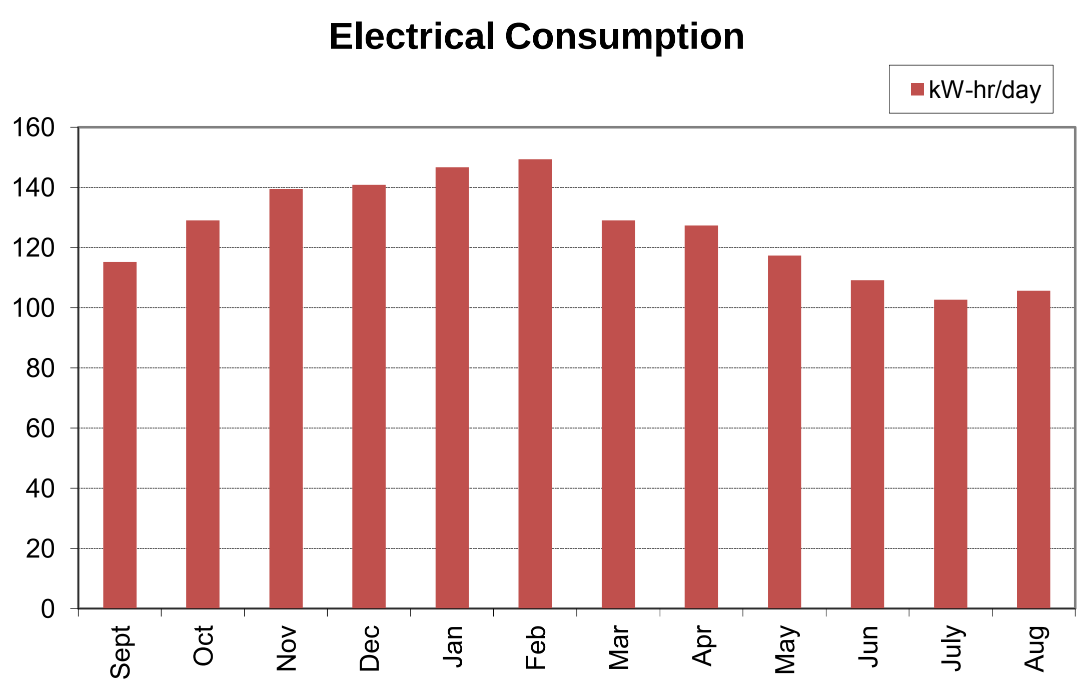
cost per ccf $0.87

Natural Gas ECI:	$0.45	per sq ft/yr
Natural Gas ECU:	52,011	BTU/sq ft
Average Cost per CCF:	$0.87	$/CCF

Electrical Usage: The following is a prediction of electric use for a typical year:

# days	kW-hr/day	Period Month	Cost Cost	Usage kWh	cost/day	
30	115	Sept	$380	3,455	$13	
31	129	Oct	$440	4,000	$14	
30	139	Nov	$460	4,182	$15	
31	141	Dec	$480	4,364	$15	
31	147	Jan	$500	4,545	$16	
28	149	Feb	$460	4,182	$16	
31	129	Mar	$440	4,000	$14	
30	127	Apr	$420	3,818	$14	
31	117	May	$400	3,636	$13	
30	109	Jun	$360	3,273	$12	
31	103	July	$350	3,182	$11	
31	106	Aug	$360	3,273	$12	
average:	126	Totals	$5,050	45,909	$14	average
		Square Footage		8000		
		kW-hr per sq ft per year =		5.7		

Electrical ECI:	$0.63	per sq ft/yr
Electrical ECU:	19,729	BTU/sq ft
Average Cost per kWh:	$0.11	$/kWh



Total Energy Use Summary

The following is a total projected Energy use summary for electricity and natural gas:

Summary		
Total Gross Area of Building:	8,000	sq ft
Annual Energy Costs	$8,670	dollars
Total Energy Cost Index (ECI):	$1.08	per sq ft/yr
Total Energy Utilization Index (EUI):	71,741	BTU/sq ft
Percentage of Annual Energy Costs for Electricity	58.25%	percentage
Percentage of Annual Energy Costs for Gas	41.75%	percentage

Water and sewer cost have not been projected; analysis was done assuming on site sewer and water source.

Energy Improvement Recommendations

Building

ECM #	Energy Conservation Measure	Benefit
B1	Replace windows and doors with high efficiency type, insulated door and windows.	Reduce infiltration, reduce electrical energy usage.
B2	Replace garage doors with insulated doors.	Reduce infiltration, reduce gas usage.
B3	Add insulation to exterior walls.	Reduce gas usage and costs.

Mechanical

ECM #	Energy Conservation Measure	Benefit
M1	Implement a comprehensive maintenance program for the mechanical equipment to include filter changes and general maintenance.	Extend life of equipment, improve efficiency of equipment.

Temperature Controls

ECM #	Energy Conservation Measure	Benefit
T1	Install programmable thermostats.	Reduce energy usage during unoccupied hours.

Electrical Systems

ECM #	Energy Conservation Measure	Benefit
E1	Upgrade/replace lighting with T8	Reduce electrical energy costs.

Renewable Energy Opportunities

ECM #	Energy Conservation Measure	Benefit
R1	Install passive solar energy system for electrical	Reduce carbon footprint, reduce gas and utility

	usage.	costs.

Potential Energy Cost Savings

There are several areas that should be addressed to provide energy savings when the building is renovated for future use/needs:

Building Envelope

It is recommended to replace all existing aluminum window with newer commercial grade windows to reduce heat loss and infiltration.

It is also recommended to replace existing personnel doors with high-insulation commercial doors.

These upgrades will also save on future heating/cooling energy use.

Mechanical/Plumbing

It is recommended to install high-efficiency furnaces and air conditioning condensers or use a geo-thermal heat pump system for office space HVAC.

Low flow faucets and toilets are recommended to conserve water use.

High efficiency water heater(s) should be installed.

These improvements will reduce future natural gas energy use.

Electrical Systems

It is recommended to provide new interior lighting with premium 28-watt T8 lamps and program start electronic ballast and to utilize motion sensors to control lighting. Exterior lights should be replaced with LED type. These improvements will reduce future electrical use.

Thermal Imaging Data

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. Since there was no heat producing equipment active in the building, the thermal images do not accurately reflect actual conditions that would occur when the building is occupied and heated. It is recommended to re-evaluate heat loss with a thermal imaging camera in the future.

References
Existing wall U-value: 0.046 Btu/hr/sq ft/deg F
Existing roof U-value: 0.036 Btu/hr/sq ft/deg F
Existing window U-value: 0.99 Btu/hr/sq ft/deg F
Existing ACH: 0.8

Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Software
REVIT 2011: Computer Aided Design Software
AutoCAD MEP 2011: Computer Aided Design Software

FLIR Tools, Version 2.2: FLIR E40 Infrared Camera analysis software

Infrared photos taken with FLIR E40 Camera
Sault Sainte Marie, Michigan

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Sp1	30.5

Parameters	
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Refl. temp.	68 °F

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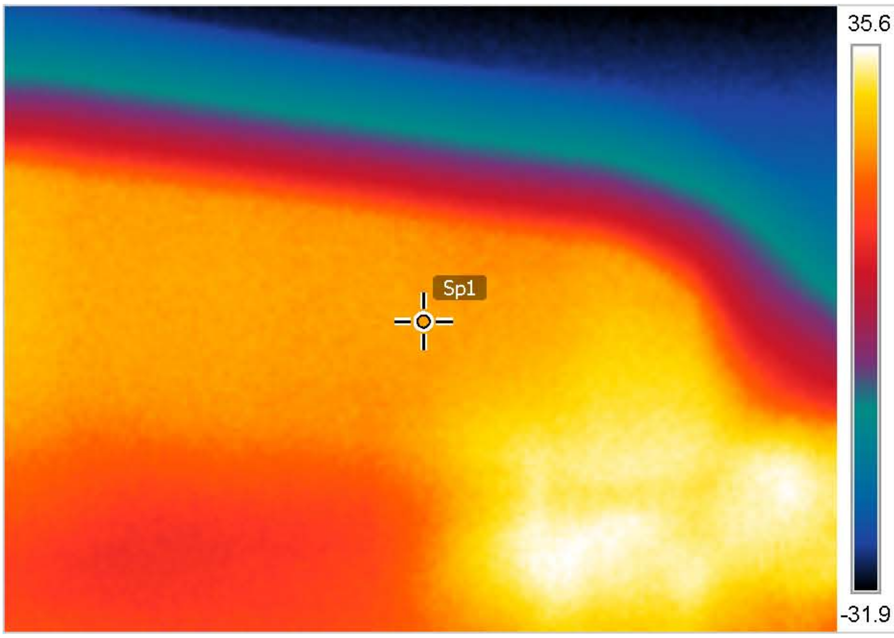

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Energy Audit
Advocacy Resource Center for Sault Tribe
2769 Ashmun Street
Sault Sainte Marie, MI

May 2013

Table of Contents

Summary

The Advocacy Resource Center Building located at 2769 Ashmun is a 5,216 square foot office and living facility with construction similar to a large ranch style house built on a crawlspace. The building had a significant interior renovation completed mainly for the north half last year, with major upgrades to room finishes, new bathrooms and laundry, new furnaces, renovated kitchen, updated lighting, a complete new fire sprinkler system, and site improvements.

Existing Building Envelope Profile

Wall Construction: Exterior walls are wood frame with vertical wood panel siding. Foundation walls are concrete block (insulated on interior but not exterior). Wood frame walls are insulated.

Roof Construction: Roof is wood frame with composite shingle roofing and gutters.

Floor Construction: Floor is wood over a crawlspace, and is not insulated.

Window and Door Construction: Exterior windows and doors are residential/light commercial grade.

Existing Mechanical Systems Profile

HVAC

Heating and air conditioning for the building is served by 3 natural gas furnaces and 3 outdoor condensing units. Two of the furnaces have heat recovery ventilation units. The air distribution system is zoned.

Plumbing

The facility has 3 bathrooms, a laundry room, and 2 kitchens. Most of the plumbing fixtures are brand new from the major renovation project last year. The building has (1) 50-gallon natural gas water heater. Water service is a new 4" line from Ashmun Street.

Temperature Control Systems

Thermostats are wall mounted programmable type.

Existing Electrical Systems Profile

Lighting Systems:

Interior lighting in the north half of the building has T8 high-efficiency fluorescent lamps and electronic ballasts, which were installed during major renovation project last year. The south half of the building has 4 lamp T12 recessed "troffer" light fixtures that should be upgraded to T8. The staff bathroom has vanity light with 5 incandescent lamps that should be upgraded to a more efficient type.

Controls for interior lights are standard wall-box mounted manual switches for each space. Motion sensors would provide energy savings by automatically turning off lights during periods of time that the space is not occupied.

Exterior lighting consists of 19 wall mounted CFL fixtures and 4 pole mounted Metal Halide lights. Exterior lighting is controlled via photocells.

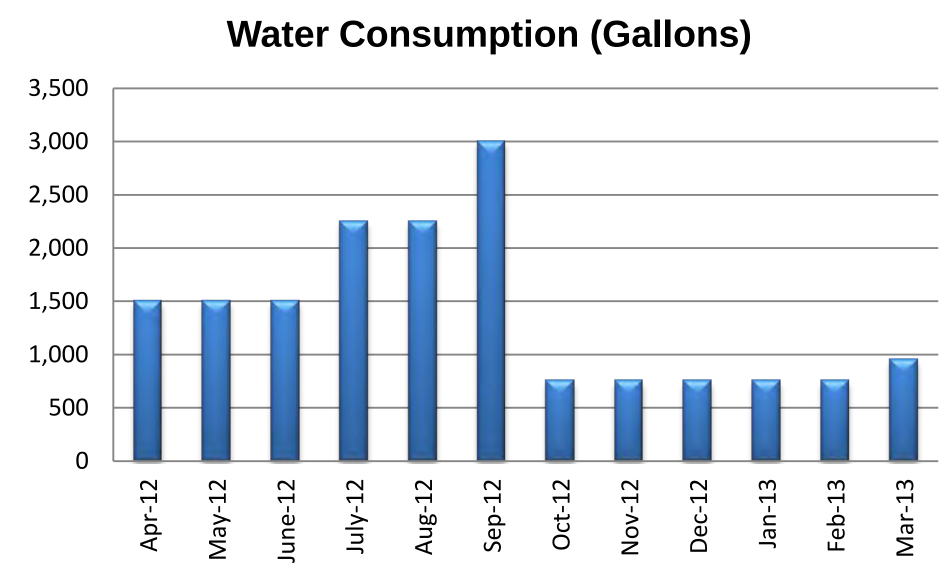
Power Systems: Electrical service is from Cloverland Electric and is single-phase, 240/120-volt. There is (2) separate 200-amp meters and (2) main 200-amp panels, along with (2) 100-amp subpanels.

Existing Energy Consumption and Energy Cost Analysis

Water Usage

The following graphical data represents the monthly water usage and costs for the April 2012 through March 2013 billing period:

Month	Cost	Gallons
Apr-12	$13	1,500
May-12	$13	1,500
June-12	$13	1,500
July-12	$19	2,250
Aug-12	$19	2,250
Sep-12	$58	3,000
Oct-12	$50	750
Nov-12	$41	750
Dec-12	$41	750
Jan-13	$41	750
Feb-13	$41	750
Mar-13	$35	953
Totals	$380	16,703



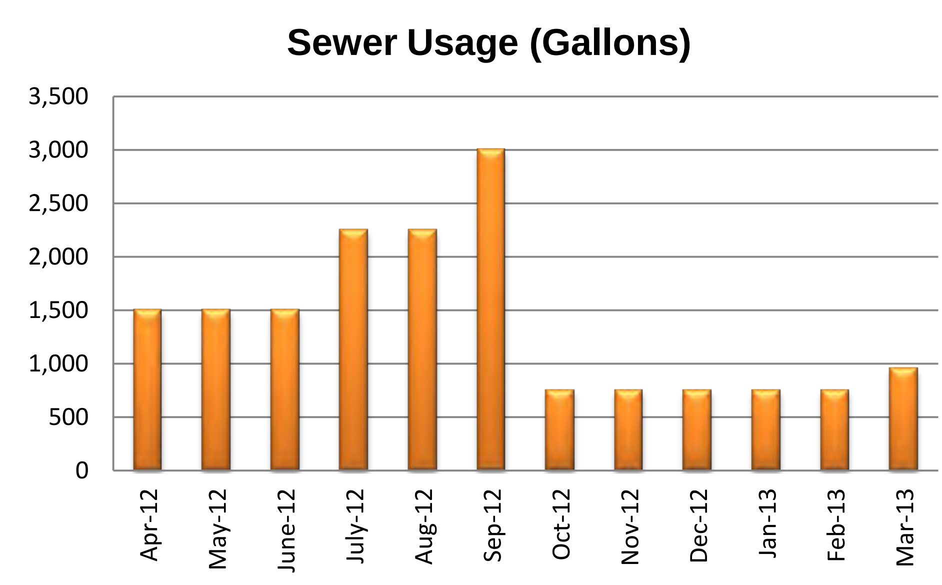
Cost per sq ft:	$0.07	per sq ft/yr
Average Usage per Fixture:	835	gallons/fix
Average Usage Cost per Fixture:	$0.023	$/gallon

Note: Water costs increased in September 2012 due to monthly fee of $33.46 for “Fire Line” service after the addition of complete fire sprinkler system during the renovation project.

Sewer Usage

The following data is a graphical representation of monthly and annual sewer usage and costs for the April 2012 to March 2013 billing period:

Month	Cost	Gallons
Apr-12	$15	1,500
May-12	$15	1,500
June-12	$15	1,500
July-12	$22	2,250
Aug-12	$22	2,250
Sep-12	$29	3,000
Oct-12	$9	750
Nov-12	$9	750
Dec-12	$9	750
Jan-13	$9	750
Feb-13	$9	750
Mar-13	$3	953
Totals	$169	16,703

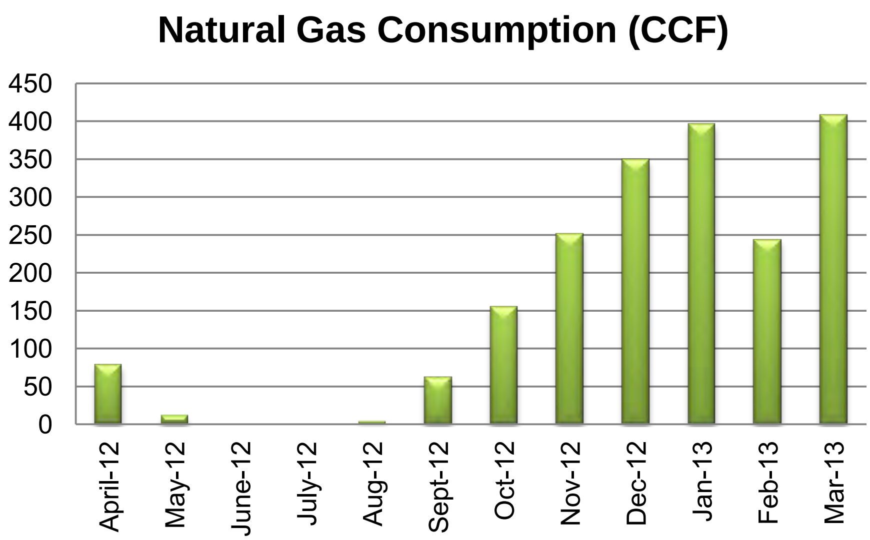


Cost per sq ft:	$0.03	per sq ft/yr
Average Usage per Fixture:	835	gallons/fix
Average Usage Cost per Fixture:	$0.010	$/gallon

Natural Gas Usage

The following graphical data represents the monthly natural gas use and cost for the April 2012 to March 2013 billing period:

Month	Cost	CCF
April-12	$92	78
May-12	$25	11
June-12	$50	0
July-12	$24	0
Aug-12	$28	3
Sept-12	$130	62
Oct-12	$156	154
Nov-12	$240	251
Dec-12	$308	349
Jan-13	$342	396
Feb-13	$220	243
Mar-13	$354	408
Totals	$1,970	1,955



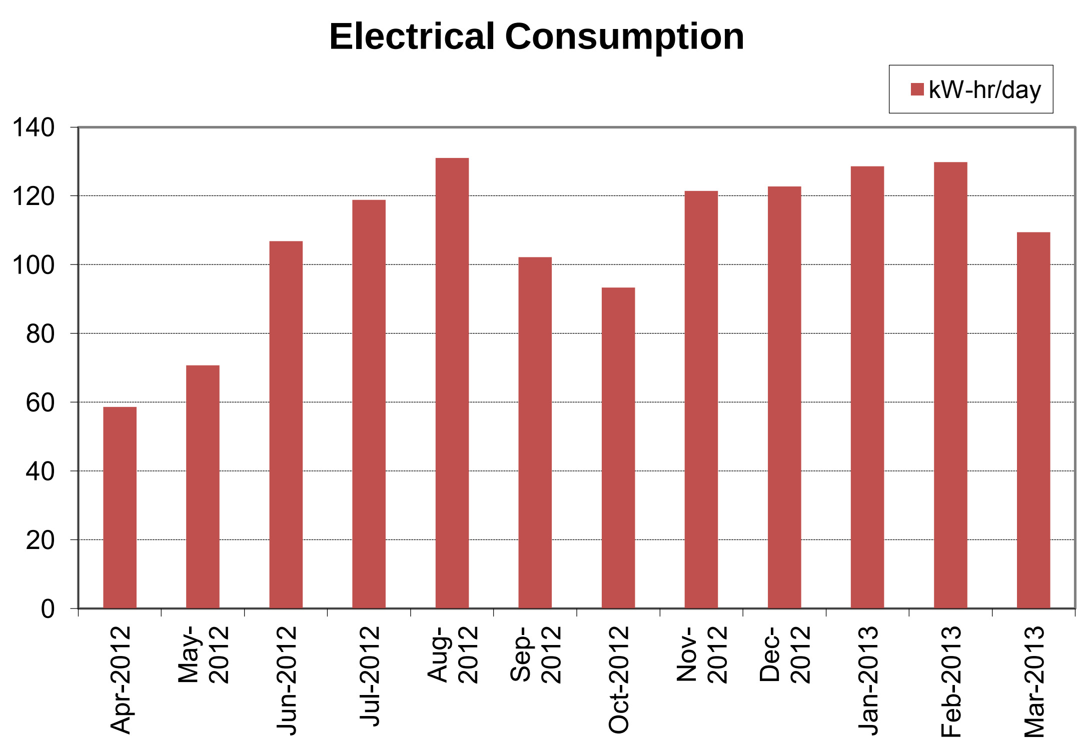
Natural Gas ECI:	$0.38	per sq ft/yr
Natural Gas ECU:	37,481	BTU/sq ft
Average cost:	$1.01	$ per CCF

Electrical Usage: The following is a summary of electric use for the past year, and is a combination of the two electric meters:

# days	kW-hr/day	Period Month	Cost Cost	Usage kWh	cost/day	
30	59	Apr-2012	$215	1,759	$7	
33	71	May-2012	$279	2,334	$8	
30	107	Jun-2012	$371	3,206	$12	
33	119	Jul-2012	$449	3,922	$14	
29	131	Aug-2012	$425	3,800	$15	
33	102	Sep-2012	$363	3,373	$11	
27	93	Oct-2012	$276	2,521	$10	
31	121	Nov-2012	$383	3,764	$12	
30	123	Dec-2012	$431	3,683	$14	
32	129	Jan-2013	$479	4,114	$15	
29	130	Feb-2013	$383	3,765	$13	
30	109	Mar-2013	$353	3,282	$12	
average:	108	Totals	$4,408	39,523	$12	average

Square Footage	5216
kW-hr per sq ft per year =	7.6

Electrical ECI:	$0.85	per sq ft/yr
Electrical ECU:	26,051	BTU/sq ft
Average Cost per kWh:	$0.11	$/kWh



Total Energy Use Summary

Summary		
Total Gross Area of Building:	5,216	sq ft
Annual Energy Costs	$6,378	dollars
Total Energy Cost Index (ECI):	$1.22	per sq ft/yr
Total Energy Utilization Index (EUI):	63,531	BTU/sq ft
Percentage of Annual Energy Costs for Electricity	69.11%	percentage
Percentage of Annual Energy Costs for Gas	30.89%	percentage

Energy Improvement Recommendations

Building

ECM #	Energy Conservation Measure	Benefit
B1	Provide rigid insulation and EIFS system on exterior of block foundation walls.	Reduce heat loss and infiltration; reduce heating and cooling energy usage.
B2	Upgrade windows to premium grade with super Low-E glass system.	Reduce drafts, infiltration, heat loss; reduce heating and cooling energy usage.
B3	Add insulation to exterior walls.	Reduce gas usage and costs.

Mechanical

ECM #	Energy Conservation Measure	Benefit
M1	Implement a comprehensive maintenance program for the mechanical equipment to include filter changes and general maintenance.	Extend life of equipment, improve efficiency of equipment.
M2	Replace 1 older furnace and condenser unit with high-efficiency furnace and SEER 14 or higher outside condenser unit.	Reduce energy use/cost.

Temperature Controls

ECM #	Energy Conservation Measure	Benefit
T1	Adjust/program thermostats.	Reduce energy usage during unoccupied hours.

Electrical Systems

ECM #	Energy Conservation Measure	Benefit
E1	Upgrade/replace south portion interior fluorescent lighting with premium T8 lamps and high-efficiency electronic ballasts.	Reduce electrical energy costs.
E2	Install motion sensors in office areas to automatically turn off lights during periods when spaces are not occupied.	Reduce hours of light used and reduce electrical energy costs.
E3	Replace exterior lights with LED type.	Reduce electrical energy costs.

Renewable Energy Opportunities

ECM #	Energy Conservation Measure	Benefit
R1	Install passive solar energy system for electrical usage.	Reduce carbon footprint, reduce gas and utility costs.

Potential Energy Cost Savings

Natural Gas

The following natural gas energy usage and cost savings is an estimate based on the building, mechanical and renewable energy conservation measures:

Approximately $300 per year would be saved by adding insulation to exterior foundation walls and upgrading/replacing windows to premium grade with super Low-E glass system.

Approximately $100 per year would be saved by replacing the older furnace and condenser unit with high-efficiency furnace and SEER 14 or higher outside condenser unit.

Electrical Systems

Upgrading the south half (office/break) area lighting to premium 28-watt T8 lamps and program start electronic ballast could provide about $300 in electrical savings per year.

The installation of motion sensors would provide an additional $100 in electric savings per year.

Upgrading/replacing exterior lighting with LED type would provide $200 - $300 per year in electric savings.

Thermal Imaging Data

Infrared and corresponding digital photos taken with FLIR E40 thermal imaging camera are attached to this report. This building had very little unexpected heat loss detected.

Exterior windows and doors have more than normal heat loss. Weather stripping and door sweeps should be examined periodically and replaced when excessive wear and/or damage is found. It is recommended that windows be upgraded/replaced in the near future.

References
Existing wall U-value: 0.046 Btu/hr/sq ft/deg F
Existing roof U-value: 0.036 Btu/hr/sq ft/deg F
Existing window U-value: 0.99 Btu/hr/sq ft/deg F
Existing ACH: 0.8

Standards

ASHRAE Std 62.1-2007: Ventilation standard used for analysis.
ASHRAE Std 90.1-2007: Energy standard used for analysis.
LEED 2009: LEED rating system used for analysis.

Software
REVIT 2011: Computer Aided Design Software
AutoCAD MEP 2011: Computer Aided Design Software
FLIR Tools, Version 2.2: FLIR E40 Infrared Camera analysis software

Infrared photos taken with FLIR E40 Camera
Advocacy Resource Center, Sault Sainte Marie, MI

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Sp1	37.7

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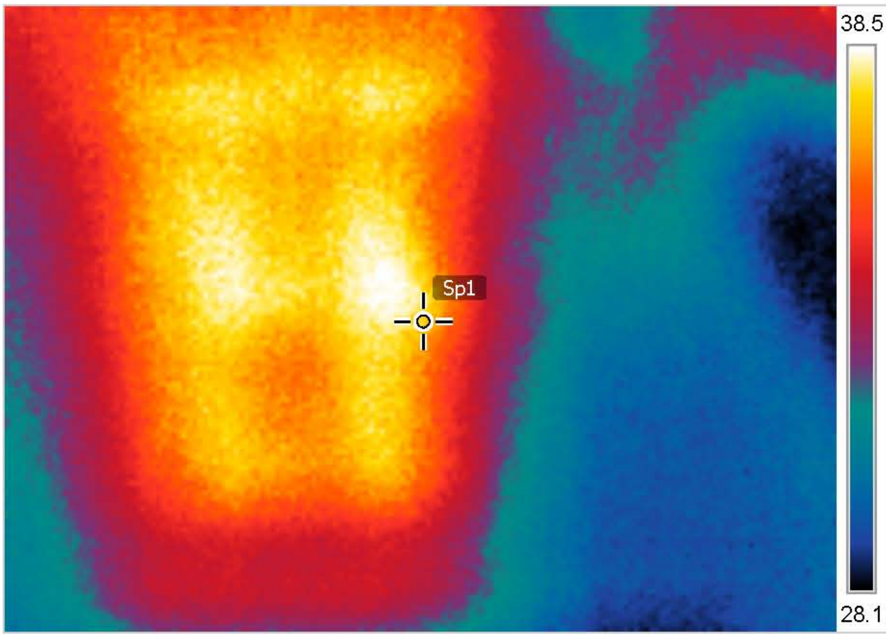

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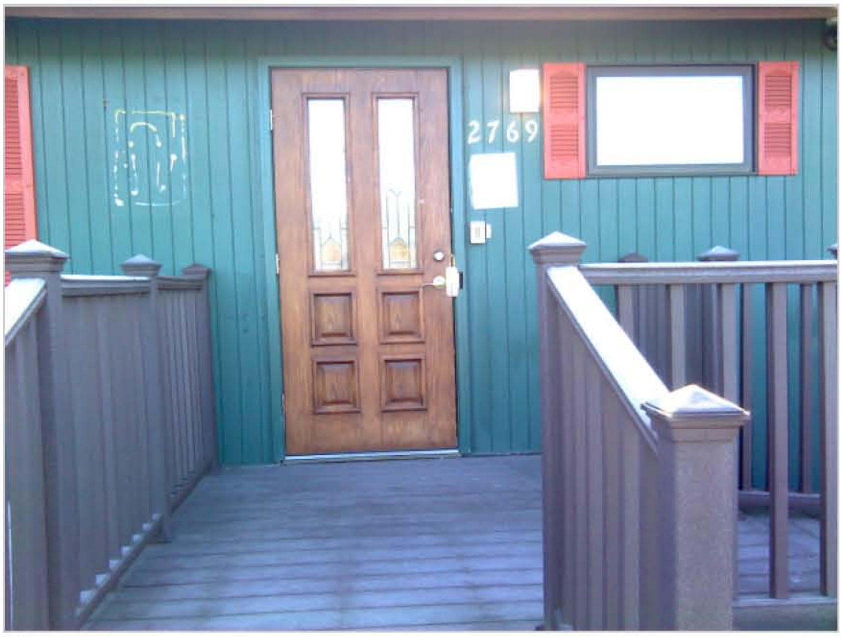

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UPEA ENGINEERS & ARCHITECTS

Infrared photos taken with FLIR E40 Camera
Advocacy Resource Center, Sault Sainte Marie, MI

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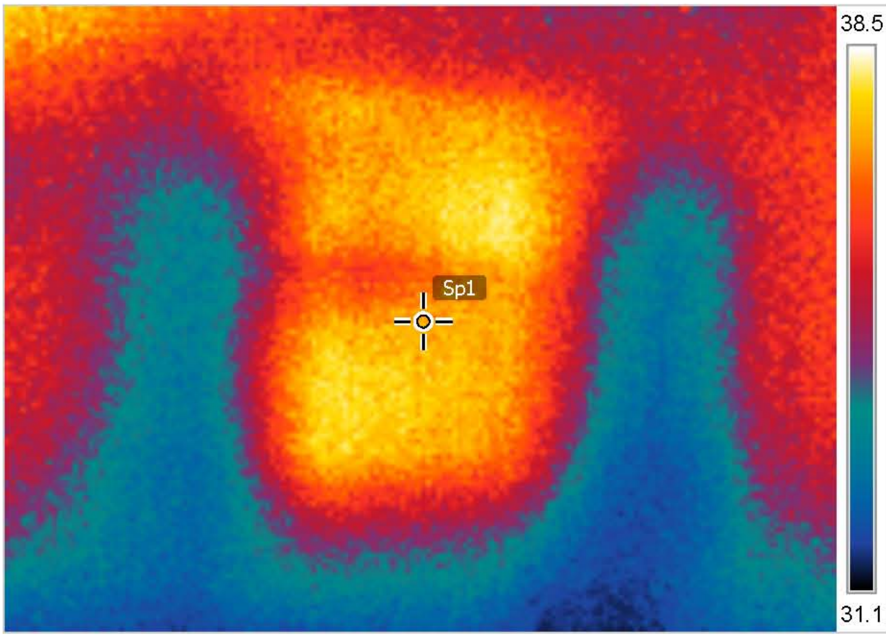

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Conclusions and Recommendations

The value of utilizing energy audit findings and recommendations to prioritize energy efficiency improvements became so evident during the implementation of this grant that, in 2011, the Tribe applied for and was awarded an additional DOE grant to conduct energy audits of the Tribe's remaining governmental buildings.

The combined findings from the two grants will provide the Tribe's Facilities Management Department with a comprehensive assessment of the governmental buildings' energy deficiencies and cost-effective strategies to improve energy efficient operations.

Planned use of the energy audit findings and recommendations include the following:

1) The project team will synopsize findings and recommendations from the 2010 energy audits grant by building, type of retrofit or renewable improvement, type of trade needed to perform retrofit or installation, and estimated energy savings into a report for prioritizing funding acquisition or implementation utilizing existing resources.

2) The report described above will also facilitate contractor procurement by trade to work at multiple locations or on multiple systems, maximizing competitive and economy of scale pricing.

3) The project team will also synopsize utility usage from the energy audits from the 2010 energy audits grant by building, type of utility and estimated energy savings into a report to serve as a benchmark for future monitoring following implementation of recommended energy improvements.

As additional energy audit reports are produced during from the 2011 grant, the findings and recommendations will be incorporated into the two reports described above to complete the comprehensive energy assessment and monitoring of the Tribe's 38 governmental buildings.

Another use of the energy audit reports will be as an integral part of potential grant applications. The energy audit reports, prepared by an independent engineering firm, will add credible technical justification to the Tribe's grant proposals requesting funding assistance for recommended energy efficiency improvements.

One of the unexpected benefits of applying for the first energy audits grant in 2009 and receiving award in 2010 was the energy efficiency and conservation awareness that evolved Tribal-wide due to presentations and communications regarding this grant with the Tribal Board of Directors, Tribal departments and programs, discussions with co-workers and at Tribal community gatherings. As a result of raised awareness, the Facilities Management Department and building operations managers began to install a variety of energy saving measures and to change how building systems were controlled to minimize energy usage. The energy audit reports funded by the DOE grant have reinforced the energy savings potential of the Tribe's continued energy conservation efforts.

Lessons Learned

Lessons learned during the course of completing this energy audit project included overcoming unexpected challenges in acquiring utility usage data and being prepared for surprising findings in the energy audit reports.

Within the rural counties of the Upper Peninsula of Michigan, some of the utility companies are still operating metering equipment that does not have the capacity to provide computerized utility usage data, are periodically estimating meter readings, have seasonal gaps in data and are therefore unable to provide computerized usage reporting. The available utility usage data with corresponding rates and costs was compiled from gathering and inputting monthly paper invoicing. The process was time consuming for assigned personnel. While the Tribe will continue to use monthly invoicing to monitor energy usage from the utility companies with limited systems, periodically the Tribe will contact the applicable utility companies to check if systems have been upgraded to enable computerized energy usage reporting.

Another lesson learned involved thermal-imaging photographs revealing unexpected findings. Energy inefficiencies due to gaps around doors and windows were anticipated. However, finding unknown window openings buried in walls causing heat loss was surprising. Heat loss from glass blocks was expected to be greater than surrounding masonry blocks. However, thermal imaging detected opposite findings, indicating heat loss was greater from the masonry blocks. While thermal imaging has been instrumental in uncovering invisible causes of energy inefficiencies, the Tribe has also found thermal-imaging photographs to be effective visual aids for presentations to feature and clarify energy deficiencies.

Perhaps the most important lesson learned and recommendation to be made is that conducting energy audits is a vital first step in developing a comprehensive facilities management energy conservation program and prioritizing strategies for moving forward with energy efficiency improvements. The Sault Ste. Marie Tribe of Chippewa Indians appreciates the funding and technical assistance from the U. S. Department of Energy, which has enabled the Tribe to achieve tangible progress launching the Tribe’s energy conservation program.