

Energy Audit Report

St. Lawrence University Canton, NY
13 University Avenue - Alpha Tau Omega

Prepared By:

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Community Energy Services, Inc.
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August 2008

Facility Name: 13 University Avenue - Alpha Tau Omega
Facility Location: St. Lawrence University

Facility Address: 13 University Avenue
Facility City: Canton
Facility State: NY
Facility Zip: 13617
Facility County: St. Lawrence

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Size of Facility: 9,686 Sq. Ft.

Total Annual Energy Costs	\$18,265.77
Electric	\$4,320.43
Natural Gas	\$13,945.34
Water and Sewer	\$7,079.09

Type of Facility (included in Abstract):
Student Residence Fraternity

13 University Ave - Alpha Tau Omega

ABSTRACT

The purpose of this study was to investigate and report on the effects of installing various energy and water conservation measures for this building. An on-site visit was conducted by experienced energy auditors from Community Energy Services, Inc. familiar with this type of facility. During a site survey conducted on June 17, 2008 data was gathered through visual inspections of the building shell and its equipment and through the use of diagnostic testing where appropriate. Data was used to produce a computer model of the facility using TREAT modeling software to predict potential energy savings from recommended improvements. Provided utility bills were reviewed to correlate the building model with actual usage. Results were compiled by L & S Energy Services, Inc. to produce this report.

SUMMARY

A summary of the recommended energy improvement measures is shown at the end of the report titled Improvement Packages. Projected savings are expressed in terms of simple payback and SIR (Savings to Investment ratio). Simple payback is calculated by dividing the estimated cost by the annual estimated savings. Simple payback is the estimated number of years it takes for energy saving to pay back your investment in the cost of improvements if interest and inflation rates are zero. SIR is a calculation that compares the return of investing capital in an interest bearing account versus in the improvements. An SIR greater than 1 means an investment in the projected measures has a better than projected return than an interest bearing account.

The estimate may include items that do not produce enough energy cost savings to justify implementation. However these measures can save significant energy in the building and/or improve the comfort and/or safety of the residence. The estimate may also include items that produce no savings but can improve the comfort and/or safety of the residence. These items have a negative impact on the payback and the SIR of the overall package.

If all the recommended energy improvement measures are implemented the total cost of the project is estimated at \$96,030. The annual cost savings is estimated to be \$6,560 . The recommended measures are projected to save 28.4% of the buildings current energy use. The energy improvement measures have a combined SIR of 1.19. Annual emissions savings are listed in Table 1.

If all the recommended water saving measures are implemented the total cost of water savings measures is estimated at \$1,800. The annual water cost savings is estimated to be \$530 . The water saving measures have a combined SIR of 5.1. The water savings measures are projected to save 52,584 gallons per year.

13 University Ave - Alpha Tau Omega

Description of Existing Building Systems

1.1 BUILDING ENVELOPE

13 University Avenue, also known as Alpha Tau Omega, is a two story building with a partial basement reportedly built around 1975. The building is used as a student fraternity residence. It consists of an older one story front section over the basement, and newer two story back section built on a slab. Occupancy is reduced in summers and on school breaks. The building contains a common commercial-style kitchen facility on the first floor and a common laundry facility in the basement. Meals are provided for residents from the commercial style kitchen.

The first floor of the building includes a large den, a large dining room, a commercial-style kitchen, bathroom, and several dorm rooms. The second floor consists of dorm rooms and another bathroom. The basement can be entered indoors from the first floor.

Exterior walls are 2 x 4 wood framed with gypsum or paneling interior and brick exterior. Walls appear to be insulated with 3.5 inches of fiberglass. Basement walls are uninsulated concrete block. The uninsulated basement is heated. Water was observed on the floor of the basement.

Windows are particularly inefficient, primarily single glazed with no storm windows. Some of the windows are broken and/or operate very poorly. The exterior doors are insulated steel. Significant air leakage was found around the windows.

The conditioned basement is used for mechanical systems, laundry, and living space. Basement walls are uninsulated concrete block. The floor of the basement is concrete slab.

The one story front section and the two story back section share one continuous attic. This attic contains approximately 9 inches of combined cellulose and fiberglass insulation. The condition of the attic insulation is generally good, with the exception of the hatch area where there is a large hole in the insulation near the hatch, and the hatch itself does not seal.

A blower door test performed on the building found substantial air leakage. Leakage was widespread, most notably the windows, a bad back door, a hole in the foyer off the kitchen, and holes around the basement entrance which moved air into the first floor from the basement. Infiltration is also severe through the unsealed attic hatch and a significant hole in the insulation near the hatch.

1.2 HEATING AND COOLING SYSTEMS

The heat for this building is supplied by a Cleaver Brooks 1,250,000 btuh natural gas boiler. The boiler is not original to the building. It is natural draft. Annual efficiency of the boiler is assumed to be 60% based on combustion efficiency tests performed on the units, manufacturer's specifications and the historical energy usage of the building. The unit appears to be significantly oversized for the heat load of the building. Powered fans provide makeup combustion air for the unit.

The heat distribution provides for no individual control, and there is reportedly overheating in some spaces. Reportedly residents frequently open windows to provide for ventilation and to counteract overheating in rooms.

A non-programmable thermostat controls the heat. Winter temperature setting at the time of the site visit was approximately 70F.

1.3 LIGHTING SYSTEMS

Lighting for the common spaces for this building is provided by compact fluorescents, T-12 linear fluorescents, circline fluorescents, and incandescent bulbs. Student personal lighting is assumed to be primarily incandescent bulbs. Exit signs are primarily LED. Two exit signs are incandescent.

1.4 WATER HEATING SYSTEMS

Domestic hot water is provided by a 331,000 Btu A.O. Smith natural draft unit hot water boiler. A separate insulated tank provides additional storage. The hot water temperature was measured at 110F. Domestic hot water piping is insulated, although it is in a conditioned basement. A circulation pump on continuous run circulates water between the tank and the hot water boiler. The boiler was short cycling at the time of the site visit. Adjustment to the boiler was completed at the time of the site visit to attempt to address the issue.

1.5 WATER USAGE

The water flow at most locations in this building was measured at 1 gallon-per-minute. Exceptions are the (commercial) kitchen sink at 3 GPM and a half-bath on the first floor with a sink at 2 GPM. Water usage of toilets was measured and found to be 3.6 gallons per flush for two, 4.3 gallons per flush for two, and 1.13 gallons per flush for one.

1.6 APPLIANCES

The kitchen contains a model 10AB 1/2 HP Jackson Faspray commercial automatic chemical dishwasher with a 70 kW wash heater and a 6.5 kW rinse heater. There is also a Victory model VR-2 double door commercial refrigerator, and a Garland commercial gas stove, range, and grill unit. In addition, there is a Kenmore chest freezer, a Kenmore upright freezer, and a Mantiowac Ice Machine. The basement contains two commercial high efficiency clothes washers and two electric dryers. The dryer vent pipes were disconnected at the time of the site visit and lint was entering the laundry space. The dorm rooms in this building were empty at the time of this summer site visit, but presumably contain a large amount of electronic equipment and perhaps dorm refrigerators when the college is in regular session.

1.7 VENTILATION

The bathrooms contain bath fans, which appear to be working and appear to vent to the exterior. Installing humidistats or automatic fan controls can help to reduce humidity and improve indoor air quality. Any attic work should include verification that the bath vents exit to the exterior and do not vent into the attic.

1.8 OTHER OBSERVATIONS

- 1) Poor heating distribution is reportedly leading to individual residents opening windows in the winter.
- 2) Water was observed on the floor of the basement, which is used as living space.

13 University Ave - Alpha Tau Omega

Description of Improvements

2.1 Increase Attic Insulation

Existing Conditions:

The one story front section and the two story back section share one continuous attic. This attic contains approximately 9 inches of combined cellulose and fiberglass insulation. The condition of the attic insulation is generally good, with the exception of the hatch area where there is a large hole in the insulation near the hatch, and the hatch itself does not seal.

Improvement Specifications:

Increase attic insulation to a minimum of 14 inches by adding blown in cellulose above the existing insulation where possible. Insulate the attic hatch to a minimum of R20. Box the hatchway to prevent cellulose from falling into the hatchway as necessary. Weatherstrip the hatch to prevent infiltration. Conduct air sealing prior to insulating. Correct any electrical wiring issues prior to insulating.

2.2 Insulate Basement Walls

Existing Conditions:

The conditioned basement is used for mechanical systems, laundry, and living space. Basement walls are uninsulated concrete block. The floor of the basement is concrete slab.

Improvement Specifications:

Insulate basement walls with 2 inches of rigid foam board applied to the interior of the basement wall. Cover the foam board with a durable fire barrier. Interior wall covering should be water resistant. Install interior covering at least 2 inches above the existing floor to prevent moisture damage.

2.3 Replace Boiler

Existing Conditions:

The heat for this building is supplied by a Cleaver Brooks 1,250,000 Btu natural gas boiler. The boiler is not original to the building. It is natural draft. Annual efficiency of the boiler is assumed to be 60% based on combustion efficiency tests performed on the units, manufacturer's specifications and the historical energy usage of the building. The unit appears to be significantly oversized for the heat load of the building. Powered fans provide makeup combustion air for the unit.

Improvement Specifications:

Replace the existing boiler with an appropriately sized high efficiency system. Savings is based on a new efficiency of 90%. Higher efficiencies may be obtained by if sufficient attention is paid to overall system design. If sufficient load is calculated installing two high efficiency boilers can offer some advantages in providing greater control and backup in case of boiler failure. A sealed combustion boiler will allow for elimination of the combustion make up air and reduce air leakage from the building. Maximizing increase in the efficiency of the system depends also on improving the overall efficiency of the distribution system. Increasing the number of zones in the building will provide greater interior temperature control and can lead to greater comfort of the residents. The ideal system would have individual room control which can be provided by individual zones to each room or thermostatic radiator valves in each room that will provide more control to the residents.

2.4 Replace Hot Water Heater with Indirect Fired off of the Existing Boiler

Existing Conditions:

Domestic hot water is provided by a 331,000 Btu A.O. Smith natural draft unit hot water boiler. A separate insulated tank provides additional storage. The hot water temperature was measured at 110F. Domestic hot water piping is insulated, although it is in a conditioned basement. A circulation pump on continuous run circulates water between the tank and the hot water boiler. The boiler was short cycling at the time of the site visit. Adjustment to the boiler was completed at the time of the site visit to attempt to address the issue

Improvement Specifications:

Install an indirect fired hot water heater off the new high efficiency boiler system. The existing storage tank may be used with the installation of a heat exchanger.

2.5 Reduce Runtime of Existing DHW Circulation Pump

Existing Conditions:

A circulation pump on continuous run circulates water between the tank and the hot water boiler.

Improvement Specifications:

Installation of an indirect fired tank off the new boiler will reduce the run time of the circulation pump. Alternatively the pump should be controlled to run only when the temperature of the water tank falls below the set point.

2.6 Reduce Infiltration

Existing Conditions:

A blower door test performed on the building found substantial air leakage. Leakage was widespread, most notably the windows, a bad back door, a hole in the foyer off the kitchen, and holes around the basement entrance which moved air into the first floor from the basement. Infiltration is also severe through the unsealed attic hatch and a significant hole in the insulation near the hatch.

Improvement Specifications:

Install weatherstripping on doors as needed. Conduct comprehensive air sealing in conjunction with a blower door to identify areas for sealing. Close off the attic hatch with an insulated removable cover. Implementation of other listed measures should contribute to overall reduction in infiltration to the building.

2.7 Replace Windows

Existing Conditions:

Windows are particularly inefficient, primarily single glazed with no storm windows. Some of the windows are broken and/or operate very poorly. The exterior doors are insulated steel. Significant air leakage was found around the windows.

Improvement Specifications:

Replace existing windows with Energy Star units with a maximum U value of 0.30. Conduct air sealing around the windows during installation with non expanding foam.

2.8 Replace Incandescent Lighting with Compact Fluorescent Lamps

Existing Conditions:

Lighting for the common spaces for this building is provided by compact fluorescents, T-12 linear fluorescents, circline fluorescents, and incandescent bulbs. Student personal lighting is assumed to be primarily incandescent bulbs.

Improvement Specifications:

Replace all incandescent lighting with compact fluorescent lamps that provide equivalent light.

2.9 Replace T12 Fluorescent linear bulbs and ballasts with T8s

Existing Conditions:

Lighting for the common spaces for this building is provided by compact fluorescents, T-12 linear fluorescents, circline fluorescents, and incandescent bulbs. Student personal lighting is assumed to be primarily incandescent bulbs.

Improvement Specifications:

Replace all T12 linear fluorescent bulbs and magnetic ballasts with T8 linear fluorescent bulbs and electronic ballasts that provide equivalent light. The existing fixture may be useable depending on condition. Light fixtures in hallways that run 24 hours per day may be replaced with Occusmart type fixtures. These fixtures automatically provide a small amount of light during unoccupied periods and immediately increase output when someone enters the corridor. Additionally the use of super T8s can further increase the efficiency of the existing fixtures while potentially increasing the light output of the fixtures. In some situations the number of fixtures can be reduced due to the high lighting output of the new fixtures.

2.10 Install LED Exit Signs

Existing Conditions:

Exit signs are primarily LED. Two exit signs are incandescent.

Improvement Specifications:

Replace incandescent exit signs with LED exit signs.

2.11 Install Natural Gas Dryers

Existing Conditions:

The basement contains two commercial high efficiency clothes washers and two electric dryers. The dryer vent pipes were disconnected at the time of the site visit and lint was entering the laundry space.

Improvement Specifications:

Install two natural gas dryers to replace the existing electric dryers. Connect the vent pipes with solid metal ductwork to allow all exhaust gases to leave the building.

2.12 Install Low Flush Toilets

Existing Conditions:

Water usage of toilets was measured and found to be 3.6 gallons per flush for two, 4.3 gallons per flush for two, and 1.13 gallons per flush for one.

Improvement Specifications:

Replace the existing high flush toilets with low flush units with a maximum flush rate of 1.6 gallons per flush. For increased potential savings dual flush toilets are now available that can reduce water usage per flush as low as 1.0 gallon per flush.

IMPROVEMENT PACKAGES

13 University ATO

For: St. Lawrence University

By: Scott Shipley

Date: 8/6/2008

Evaluated Packages:

Package Name	Cost \$	Annual Savings, MMBtu	Annual Savings, \$	Payback years	Cashflow \$/year	SIR
Improvement Package 1	96,030	378.46	6,560	14.64	-1,896	1.19

Package Description:

1. Improvement Package 1

Improvement Name	Cost (\$)	Annual Savings MMBtu	Annual Savings (\$)	Payback (years)	Cashflow (\$/year)	Improve- ment Life (Years)	SIR in Package
Increase Attic Insulation	7,600	10.31	129	59.0	-540	40	0.4
Replace Windows	33,500	103.51	1,294	25.9	-1,656	20	0.58
Insulate Basement Walls	16,500	51.76	647	25.5	-806	40	0.92
Replace Boiler	25,000	125.23	1,565	16.0	-636	20	0.94
Reduce Building Infiltration	7,500	66.02	825	9.1	165	20	1.65
Install Indirect DHW off of New Boiler	2,500	27.76	347	7.2	127	15	1.67
Upgrade T12 to T8	630	2.46	148	4.3	93	10	2.01
Reduce Runtime of Circ pump	250	5.67	95	2.6	73	10	3.24
Install Natural Gas Dryers	1,700	-27.92	678	2.5	529	15	4.79

Replace Incandescent Exits with LEDS	100	0.83	49	2.1	40	10	4.17
Replace Incandescent Lightbulbs	750	12.83	783	1.0	717	8	7.35
Total for Package	96,030	378.46	6,560	14.64	-1,896	N/A	1.19

Table 1
Annual Emissions Savings

Fuel Type	NOx (LBS)	SO2 (LBS)	CO2 (LBS)
Electricity	27	62	18,227
Natural Gas	30	0	35,369
Oil	0	0	0
Propane	0	0	0
Other: Other Fuel Type Name	0	0	0
Total	57	62	53,597

ENERGY BILLS

13 University Ave - Alpha Tau Omega

Electric Bills						
Utility:		National Grid/ Constellation Energy				
Rate Class:		SC2D				
Account Number:		Unknown				
Start Billing Date	End Billing Date	Days in Period	Usage (kWh)	Demand (kW)	Cost	Cost per kWh
06/01/06	7/3/06	32	2,627	6.9	\$181.24	\$0.07
07/03/06	8/1/06	29	2,421	5.6	\$145.23	\$0.06
08/01/06	8/31/06	30	2,739	13.6	\$226.69	\$0.08
08/31/06	9/29/06	29	8,817	26.4	\$633.65	\$0.07
09/29/06	10/31/06	32	10,738	26.0	\$653.97	\$0.06
10/31/06	12/1/06	31	9,094	26.4	\$515.40	\$0.06
12/01/06	1/2/07	32	8,598	25.8	\$597.47	\$0.07
01/02/07	1/31/07	29	5,475	27.6	\$520.74	\$0.10
01/31/07	3/1/07	29	9,798	25.1	\$494.20	\$0.05
03/01/07	4/2/07	32	8,869	25.6	\$525.74	\$0.06
04/02/07	5/1/07	29	9,303	25.3	\$636.15	\$0.07
05/01/07	6/1/07	31	6,985	24.1	\$507.70	\$0.07
Totals 2006-2007			85,464		\$5,638.18	\$0.07
06/01/07	7/2/07	31	1,838	8.7	\$171.96	\$0.09
07/02/07	8/1/07	30	1,836	10.1	\$188.25	\$0.10
08/01/07	8/30/07	29	2,817	15.0	\$246.55	\$0.09
08/30/07	9/28/07	29	8,240	22.0	\$474.59	\$0.06
09/28/07	10/30/07	32	8,874	22.5	\$472.60	\$0.05
10/30/07	11/30/07	31	7,523	21.5	\$453.42	\$0.06
11/30/07	1/2/08	33	7,211	20.9	\$326.63	\$0.05
01/02/08	1/31/08	29	5,163	22.0	\$331.38	\$0.06
01/31/08	2/29/08	29	8,088	22.5	\$381.56	\$0.05
02/29/08	3/31/08	31	7,635	25.7	\$420.57	\$0.06
03/31/08	4/29/08	29	9,041	26.0	\$441.91	\$0.05
04/29/08	5/29/08	30	6,865	23.1	\$411.01	\$0.06
Totals 2007-2008			75,131		\$4,320.43	
Average Cost Per kWh					\$0.06	

13 University is charged for electrical demand. Though this is a significant part of the cost of electricity given the resident population and the unusual usage patterns it is difficult to assess what devices are leading to the demand charges. Consequently only the price per kWh for electricity is used to calculate savings and potential demand savings is ignored.

13 University Ave - Alpha Tau Omega

Natural Gas Bills					
St. Lawrence Gas					
Account Number:			Unknown		
Start Billing Date	End Billing Date	Days in Period	Usage (Therms)	Cost	Cost per Therm
12/21/05	01/23/06	33	644	\$832.02	\$1.29
01/23/06	02/21/06	29	1252	\$1,490.85	\$1.19
02/21/06	03/22/06	29	1794	\$2,118.77	\$1.18
03/22/06	04/20/06	29	1070	\$1,125.73	\$1.05
04/20/06	05/22/06	32	1012	\$1,027.42	\$1.02
05/22/06	06/21/06	30	112	\$117.68	\$1.05
06/21/06	07/24/06	33	108	\$112.90	\$1.05
07/24/06	08/22/06	29	19	\$21.60	\$1.14
08/22/06	09/21/06	30	299	\$328.20	\$1.10
09/21/06	10/23/06	32	524	\$435.91	\$0.83
10/23/06	11/21/06	29	1141	\$1,180.68	\$1.03
Totals for 2006			7,975	\$8,791.76	
11/21/06	12/21/06	30	947	\$1,067.39	\$1.13
12/21/06	01/23/07	33	1659	\$1,938.47	\$1.17
01/23/07	02/21/07	29	1743	\$2,070.42	\$1.19
02/21/07	03/22/07	29	2664	\$3,222.62	\$1.21
03/22/07	04/20/07	29	816	\$973.31	\$1.19
04/20/07	05/22/07	32	1766	\$2,193.52	\$1.24
05/22/07	06/21/07	30	106	\$145.23	\$1.37
06/21/07	07/23/07	32	76	\$101.23	\$1.33
07/23/07	08/22/07	30	73	\$86.05	\$1.18
08/22/07	09/20/07	29	229	\$231.72	\$1.01
09/20/07	10/22/07	32	403	\$414.15	\$1.03
10/22/07	11/21/07	30	1224	\$1,501.23	\$1.23
Totals for 2007			11,706	\$13,945.34	
Average Cost Per Therm				\$1.19	

13 University Ave - Alpha Tau Omega

Water and Sewer Cost

Begin	End	Gallons	Water \$	Sewer \$	Total	\$Water/ 1000 gal	\$Sewer/ 1000 gal
Jul-08	Sep-08	71,000	\$321.94	\$404.76	\$726.70	\$4.53	\$5.70
Oct-06	Dec-06	86,000	\$393.31	\$497.41	\$890.72	\$4.57	\$5.78
Jan-07	Mar-07	192,000	\$902.11	\$1,156.73	\$2,058.84	\$4.70	\$6.02
Apr-07	Jun-07	141,000	\$683.60	\$878.65	\$1,562.25	\$4.85	\$6.23
Jul-07	Sep-08	218,000	\$1,067.83	\$1,379.92	\$2,447.75	\$4.90	\$6.33
Oct-08	Dec-08	93,000	\$444.08	\$566.17	\$1,010.25	\$4.78	\$6.09
Total		644,000	\$3,097.62	\$3,981.47	\$7,079.09	\$4.81	\$6.18