Report To:

Mr. John Smith
Smith Printing Company

ENERGY AUDIT

123 Main Street
Mississauga, Ontario

January 1, 2009

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Building Inspections

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January 1, 2009

Energy Audit Report

Property: 123 Main Street, Mississauga, Ontario

1.0 SUMMARY

This is an energy audit report (EAR) of the property at 123 Main Street, Mississauga, Ontario.

This is a single-storey, multi-unit industrial building. The subject unit covers an estimated 5,200 square feet (very rough estimate). There is an office portion at the front that covers approximately 1,000 square feet. The entire space is conditioned (approximately 477.5 m^2).

The building is presently used for printing by Smith Printing Company.

This report has been prepared by Carson Dunlop Weldon & Associates Ltd. on behalf of our client, Mr. John Smith of Smith Printing Company.

Our client is the current lessee and this report has been prepared to provide pertinent information on the energy use at the property and the potential for energy use reduction.

The site visit was carried out on December 17, 2008, in the company of Mr. John Smith of Smith Printing Company.

Lighting

The lighting fixtures for the building are of the fluorescent and incandescent types.

Heating, Air-Conditioning and Ventilation

The building heated and cooled by two, gas-fired, rooftop units.

Fresh air is supplied by air ducts in the rooftop equipment and operable windows. Exhaust is achieved by individual exhaust fans and operable windows.

Plumbing

There are four sets of 2-piece washrooms at the building. There is an electric domestic water heater.

Building Envelope

The roof is covered by a built-up asphalt and gravel membrane. The exterior walls are solid masonry. The exterior doors are aluminum-framed, single-glazed and steel units.

The windows are wood- and aluminum-framed, double-glazed units. There are steel-framed, single glazed units in the warehouse.

Insulating types noted in the building include rigid polyisocyanurate foam on the roof.

Annual Utility Costs and Consumption

The following is a summary of the most recent annual energy consumption and associated costs:

Annual Utility Usage	***Cost***	***Consumption (GJ)***	***Cost Index ($/GJ)***	***Intensity (GJ/m²)***
Electricity	$2,859	87	32.86	0.18
Natural Gas	$3,274	275	11.90	0.58
Total	$6,133	362	16.94	0.76

Comparison to Reference Building

Comparing the energy use intensity (energy use per square foot of conditioned space) of the subject building with data published by Natural Resources Canada, it was noted that the energy consumption is less than similar buildings. While this is a favourable result, there is nevertheless potential for cost effective retrofits.

Recommended Modifications

The main opportunities for energy conservation at the above property include upgrading of the aging heating and air-conditioning unit on the roof and lighting upgrades. The following lists recommended modifications in ranked order:

Report Ref	Recommendation	Initial Cost	Annual Capital Cost Savings	Annual Savings			Simple Payback
				$	Gas	Electricity	
5.2.3	Provide programmable thermostat for warehouse rooftop unit	$75		$45	1 GJ	1 GJ	1.6 years
7.2.3	Replace cracked or missing glazing sections at windows	$200		$80	4 GJ	1 GJ	2.5 years
4.2.2	Update eight foot fluorescent luminaires in warehouse with T8 lamps using electric ballasts	$3,700	$400	$275		8 GJ	5.5 years
4.2.1	Update 2- and 4-lamp fluorescent luminaires with T8 lamps using electric ballasts and mirrored reflectors.	$1,750		$230		7 GJ	7.6 years
7.2.1	Replace sealants in exteriors walls	$2,490		$175	12 GJ	1 GJ	14.2 years
5.2.2	Install economizer units on the rooftop equipment	$1,000		$65		2 GJ	15 years
7.2.2	Insulate and drywall over steel framed, single glazed windows in warehouse	$1,000		$35	3 GJ		28 years
Total		**$10,215**	**$400**	**$905**	**20 GJ**	**20 GJ**	**7.8 years**

The total proposed energy saving measures have the potential to reduce the building's energy consumption by 11%. The capital cost to implement these building system upgrades and improvements is $10,215, which can achieve a net annual savings of 40 GJ. These annual savings transform into $905 in savings per year, at current energy prices and a simple payback of 7.8 years. The total Incentives available for the recommended modifications are $15 from Enbridge and $400 from Natural Resources Canada.

2.0 INTRODUCTION

2.1 Inspection Authorization and Scope

As per the request of Mr. John Smith of Smith Printing Company and in accordance with our Proposal, an energy audit was performed to identify the present energy consumers at the building unit and identify potential modifications that cost effectively reduce energy consumption.

This assessment meets or exceeds the ASHRAE Research Project RP-669 and ASHRAE Special Project SP-56 – Procedures for Commercial Building Energy Audits and the Natural Resources Canada Federal Building Initiatives – Audit Standard Guidelines.

Historic energy use was collected and analyzed as part of this assessment.

This report provides:

- a detailed breakdown of energy end-use consumers,
- an analysis of current energy consumption by end-use,
- potential modifications that will reduce energy use and/or cost,
- a rank-ordered list of recommended modifications, including initial budget cost estimates for the modifications and the simple payback.

The report also identifies applicable incentive programs (typically offered through government and utility providers) that will assist with the capital expenses associated with the modifications.

The audit did not include testing the operation or efficiency of the equipment.

The recommendations are based on an audit sampling technique. For example, a close review of each and every lighting unit to verify the type of ballast used was not undertaken.

This report recommends modifications to reduce energy use and/or operating costs. It does not provide specifications or methods for performing the work. In some cases, a more detailed study is needed to prepare specifications for the work.

This report is intended for the exclusive use of our client. Use of the information contained within the report by any other party is not intended and, therefore, we accept no responsibility for such use.

This report is considered to be preliminary in nature. Before any major modifications are undertaken, we recommend a more detailed analysis be undertaken to develop a plan of action.

The weather at the time of the inspection was overcast, with an approximate outdoor temperature of -3°C.

2.2 Building Description

This is a single-storey, multi-unit industrial building. The subject unit covers an estimated 5,200 square feet (very rough estimate). There is an office portion at the front that covers approximately 1,000 square feet. The entire space is conditioned (approximately 477.5 m^2).

It should be understood that all building sizes noted here are rough approximations based on site observations, and are for the purposes of this report only.

The visible evidence suggests that the building was constructed approximately 40 years ago.

The building is presently used for printing by Smith Printing Company. The building is occupied Monday to Friday, from 9 am to 5:00 pm in the winter, and from 9 am to 4:30 pm in the summer.

For the purpose of this report, the front of the building is considered to be facing south.

2.3 Documents Reviewed

As part of the Energy Audit, a request was made to review available building plans, maintenance records, warranties, equipment lists and at least 12 months of utility bills.

The following was available for our review:

- Natural gas invoices – 12 months
- Hydro electric invoices – 12 months

3.0 Energy Consumption

Electrical Energy Use

There is a single meter for the unit.

The peak monthly demand in the summer is 28 kW.

The electricity is supplied to the building by Enersource Hydro. The account number is 123456-1.

Table 3.1 – Annual Electrical Consumption and Costs

Billing Period	Days in Period	Consumption (kWh)	Demand (kW)	Cost ($)
Sept 13 to Oct 17, 2007	34	1900	28	234.38
Oct 17 to Nov 13, 2007	27	1600	12	196.27
Nov 13 to Dec 13, 2007	30	2400	13	281.59
Dec 13 to Jan 15, 2008	33	2400	14	278.93
Jan 15 to Feb 14, 2008	30	2600	13	300.15
Feb 14 to Mar 13, 2008	28	2200	13	257.72
Mar 13 to Apr 11, 2008	29	2000	14	236.56
Apr 11 to May 9, 2008	28	1800	13	214.37
May 9 to Jun 11, 2008	33	1900	23	222.31
Jun 11 to Jul 15 2008	34	2000	23	232.21
Jul 15 to Aug 14, 2008	30	1700	28	202.58
Aug 14 to Sept 12, 2008	29	1700	26	202.58

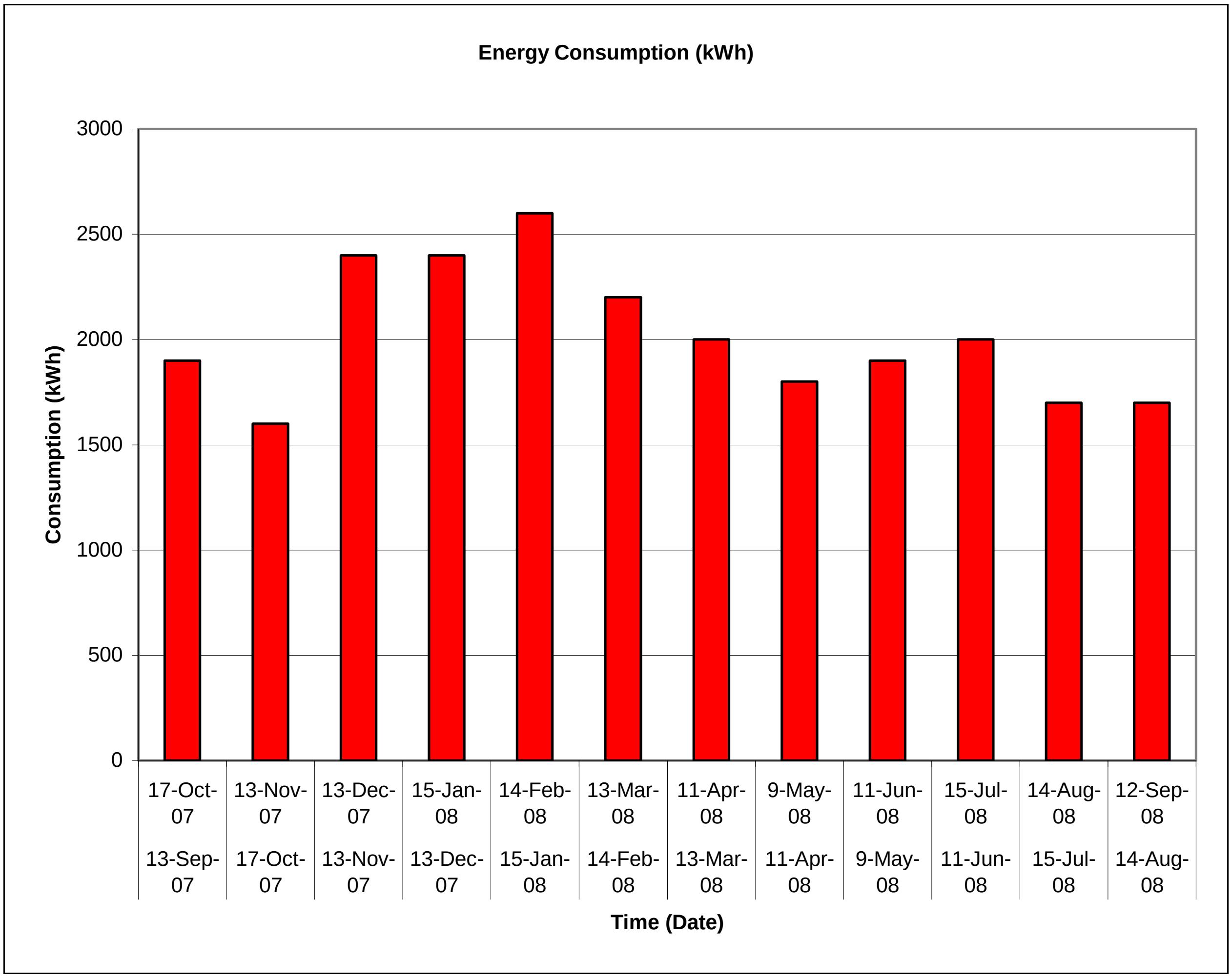

Figure 3.1 – Annual Energy Consumption

Referring to Figure 3.1, it is noted that in general, electrical consumption in the heating season is greater than in the cooling season. The maximum monthly electrical consumption of the year occurs between January and February at 2600 kWh, while the minimum monthly electrical consumption occurs between October and November at 1600 kWh.

Consumption through the summer months remains almost constant, to maintain a cool working environment. However, it is rare for the electrical consumption in a gas-fired heated building to be greater in the winter than in the summer. Therefore, the lighting, plug loads and/or process equipment are consuming a larger percentage of electricity in the winter.

This is expected as longer working hours were reported during the winter, compared to summer. As well, it was reported that there are fewer employees during the summer. Lastly, it was reported that office staff might be using portable space heaters in the winter, which consume a large amount of electricity.

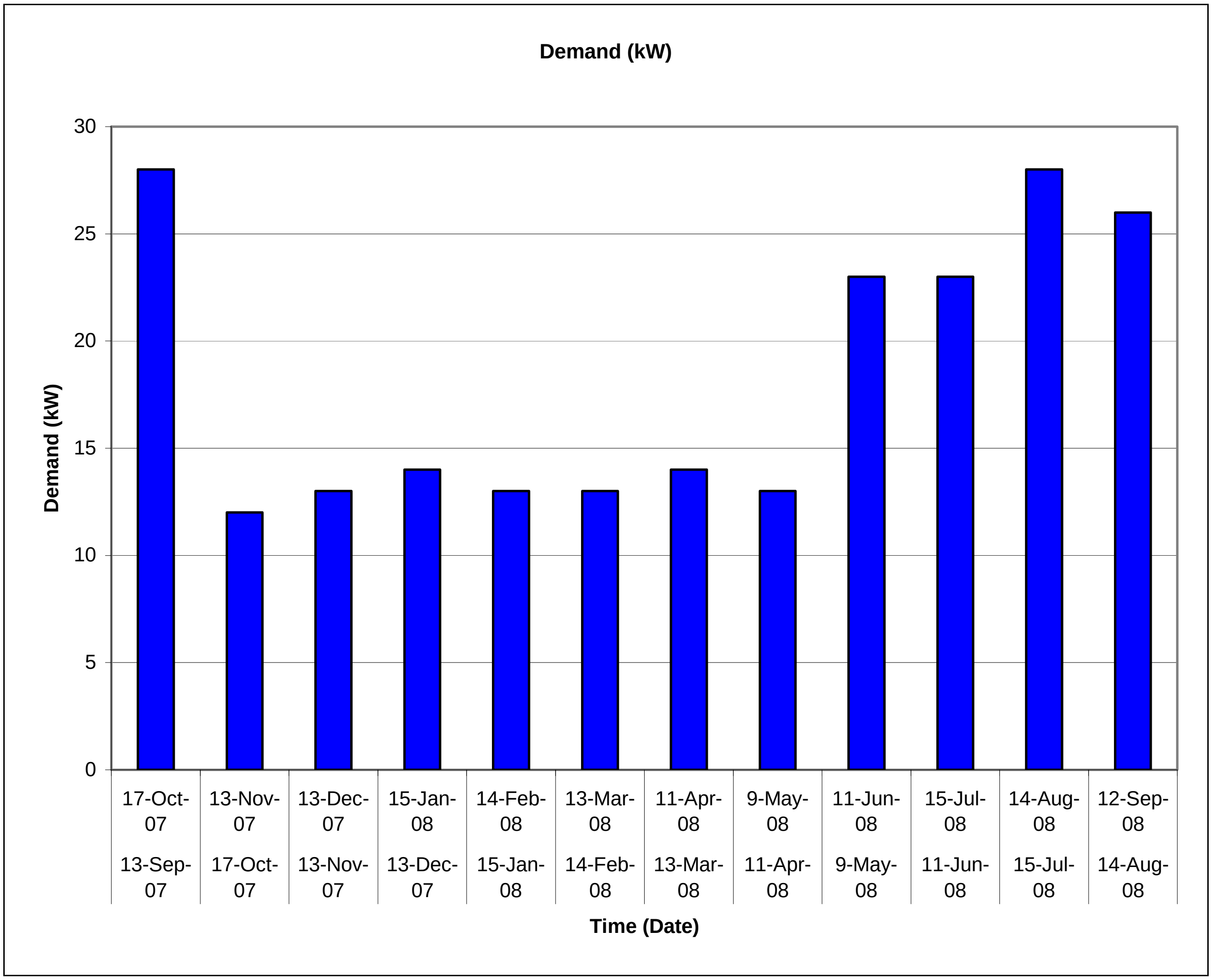

Figure 3.2 – Annual Electrical Demand

Based on the graph in Figure 3.2, the power demand has two distinct load profiles; summer and winter. The summer peak demand ranges between 23 and 28 kW, while the lower winter peak demand ranges between 12 and 14 kW. Peak demand in the late spring and early fall is quite high, when reduced air conditioning usage should significantly decrease peak loads. This represents a financial opportunity, as it should be possible to reduce peak demand charges in the spring and fall.

Natural Gas Use

There is a single gas meter for the unit located at the north exterior wall.

The peak monthly gas consumption in the winter is 1602 m^3.

The natural gas supply to the building is provided by Enbridge. The account number is 09 12 34 56789 1.

Table 3.2 – Annual Electrical Consumption and Costs

Billing Period	Days in Period	Consumption (m^3)	Cost ($)
Aug 15 to Sept 12, 2007	28	43	43.47
Sept 12 to Oct 16, 2007	34	0	94.23
Oct 16 to Nov 13, 2007	28	317	162.18
Nov 13 to Dec 13, 2008	30	1258	550.97
Dec 13 to Jan 15, 2008	33	1345	570.43
Jan 15 to Feb 14, 2008	30	1501	614.02
Feb 14 to Mar 17, 2008	32	1602	651.76
Mar 17 to Apr 15, 2008	29	882	365.83
Apr 15 to May 14, 2008	29	34	39.71
May 14 to Jun 13 2008	30	0	25.08
Jun 13 to Jul 15, 2008	32	108	93.87
Jul 15 to Aug 14, 2008	30	0	62.78

Note – Gas consumptions are taken directly from utility bills. No compensation has been made with respect to actual, estimated or adjusted readings. For the purposes of this report, all gas consumptions are assumed to be actual. Assumptions in the analyses may be made with respect to estimated gas consumptions.

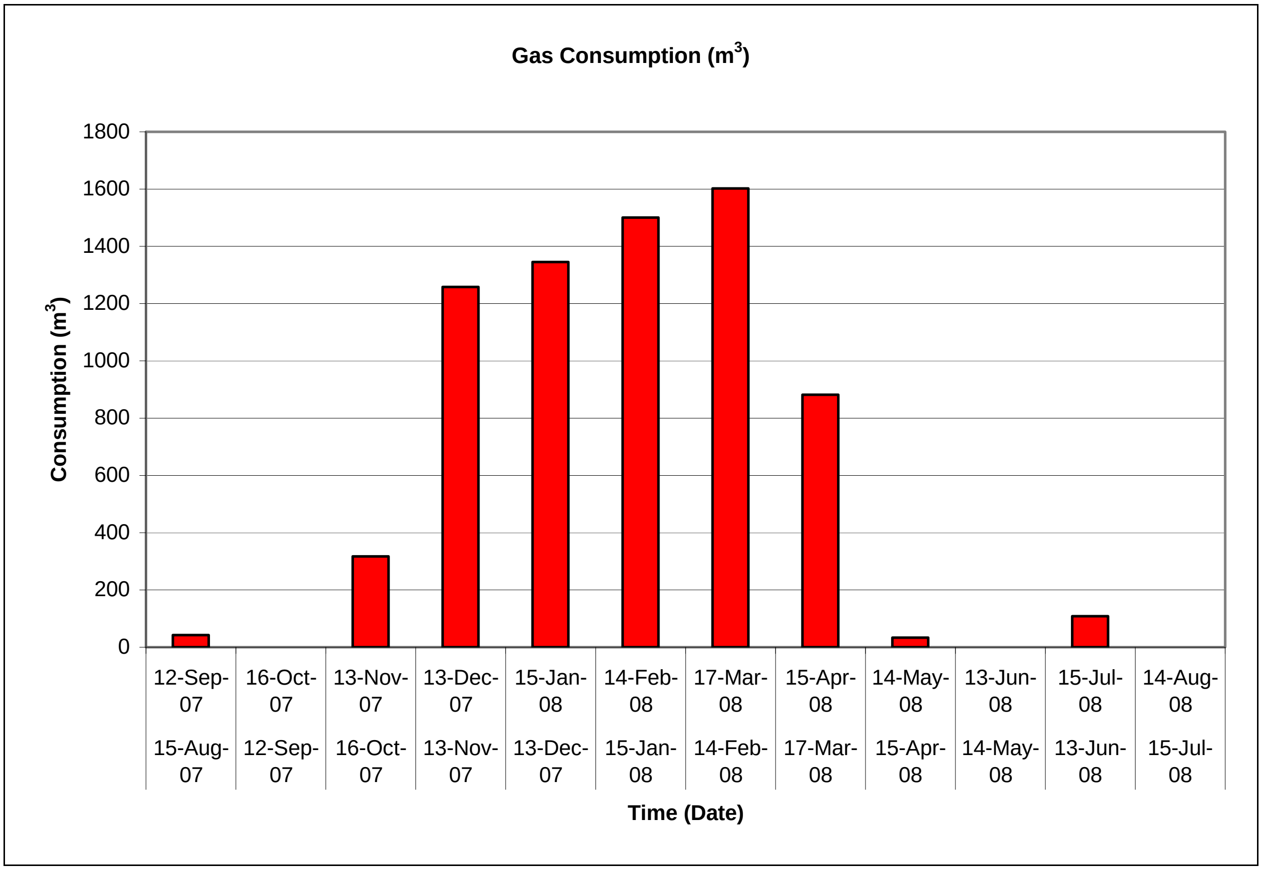

Figure 3.3 – Annual Gas Consumption

The annual gas consumption graph shows that little to no gas is consumed during the cooling season. This indicates, and the visit confirmed, that the only gas consumer for the building is the heating system. The peak natural gas consumption is noted at the end of winter.

Combined Building Energy Consumption

Based on the data collected and analysed, and the site visit, the Building Energy Breakdown is presented in the following figure. The building energy breakdown chart shows estimates of the energy consumption associated with electrical and mechanical usage.

The main building energy use is space heating, which can be expected in our climate. Following the heating system, the process and lighting systems are the next main energy consumers. This breakdown is used to assist in evaluating potential energy use reduction measures. For example, the plug load represents an opportunity to realize savings through an occupant education program, while the high lighting load represents an opportunity to replace the older fixtures and lamps with new energy efficient lights and improve the building envelope.

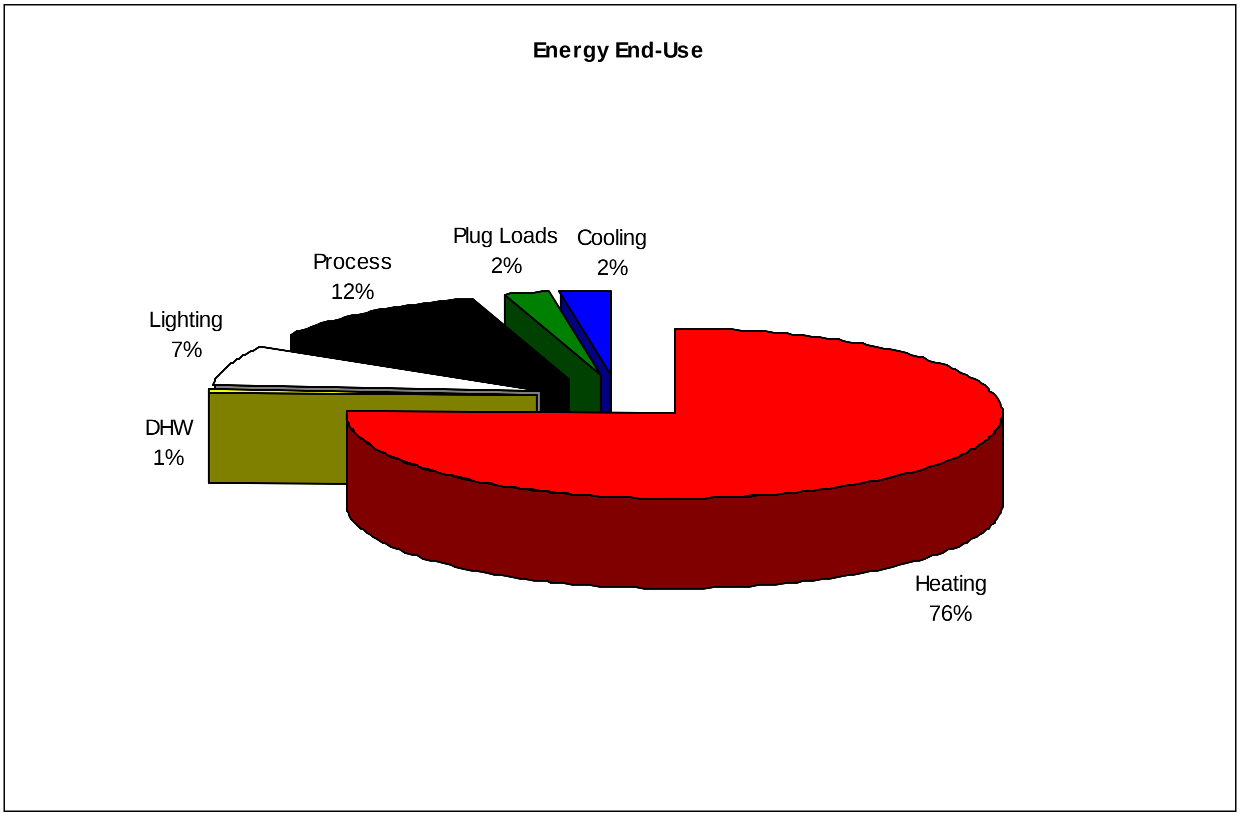

Figure 3.4 – Building Energy Break Down

3.3 Limitations

It should be understood that the building energy break down is an educated estimate, based on the utility bills, site visit and occupant interview. The energy end-use is for the purposes of this report to help quantify potential cost and energy savings.

4.0 Lighting

4.1 Description

The lighting fixtures for the offices and warehouse are of the fluorescent type. The lighting fixtures for the washrooms are of the incandescent type.

As described above, lighting accounts for approximately 7% of the unit's energy use.

The lighting systems throughout the building are a mix of T12 in the offices and warehouse, with incandescent in the washrooms. Upgrading the older T12 lighting technology represents the largest energy savings opportunity in lighting.

There is a refrigerator, microwave and kettle in the kitchen area. There are nine personal computers in use within the building. These plug loads are used by the building occupants to perform their tasks and during lunch breaks. No significant costs savings are expected here, and therefore, not included in the report.

4.2 Potential Modifications

4.2.1 Most of the lighting in the offices, and several in the warehouse are comprised of four-foot 4-lamp T12 luminaires. Several 2-lamp T12 luminaires were also noted. In many of the offices, two lamps have been removed from the 4-lamp fixtures to lower the light levels and reduce energy costs. It should be noted that the older magnetic ballasts in these fixture still draw energy, even when no lamps are connected.

While disconnecting the abandoned magnetic ballasts will reduce energy consumption, this form of lighting design is outdated, and can be upgraded in most cases by simply changing the ballasts and lamp holders inside the existing fixtures.

These 2- and 4-lamp luminaires can be retrofit with T8 lamps using electric ballasts and mirrored reflectors. There are a total of 25 ballasts and 32 lamps in approximately 16 fixtures in use, throughout the unit that can be retrofit. However, as the newer T8 technology provides more lumens/m^2, the number of fixtures to be replaced can be reduced by about 33%.

16 x 2- and 4-lamp T12 in offices and warehouse to be replaced with 10 x 2-lamp T8 fixtures.

4.2.2 The main lighting in the warehouse is comprised of eight-foot 2-lamp T12 luminaires with magnetic ballasts. Like the previously described luminaires, this form of lighting design is outdated, and can be easily upgraded. However, the number of fixtures to be replaced can be reduced by about 33%.

There are 15 of these fixtures illuminating the warehouse. These lamps can be upgraded.

15 x 2-lamp T12 in warehouse to be replaced with 10 x 2-lamp T8 fixtures.

Since the new retrofit technology has a significantly longer lamp life, less frequent lamp replacement will be necessary. This has transposed into approximately $400 in annual savings.

4.2.3 The washrooms are each provided with 2 40-watt incandescent lamps. As these lamps will no longer be available for purchase as of 2012, they can be simply upgraded with compact fluorescent bulbs without changing the fixtures.

8 x 40 watt incandescent lamps in washrooms to be replaced with 8 x 7 watt compact fluorescent lamps.

It should be noted that this measure is not included in the report, as the annual cost savings are negligible.

4.3 Energy Saving Opportunities, Costs and Paybacks

	Modification	Initial Cost	Incentive	Annual Capital Cost Savings	Annual Energy Savings			Simple Payback
					$	Gas	Electricity	
4.3.1	Update 2- and 4-lamp fluorescent luminaires with T8 lamps using electric ballasts and mirrored reflectors.	$1,750			$230		7 GJ	7.6 years
4.3.2	Update eight foot fluorescent luminaires in warehouse with T8 lamps using electric ballasts	$3,700		$400	$275		8 GJ	5.5 years

4.4 Limitations

The cost of electricity cannot be predetermined, nor can the actual occupant dependent usage of the lamps be known. The costs and savings represented above assume the present cost of electricity with estimated operating hours.

It was reported that approximately 1,000 square feet of warehouse space is not in use, and the lighting fixtures in this area are not used. As such, these light fixtures have not been included this study.

5.0 HEATING, AIR-CONDITIONING and VENTILATION

5.1 Description

The building is heated and cooled by two roof-mounted, gas-fired, heating (electric cooling) units. The total heat output of these units is 336,000 BTUs per hour. The total available cooling capacity for the building is approximately 15 tons.

As described above, the heating systems are the sole natural gas consumers in the building, while the cooling system consumes approximately 2% of the total building energy, or 10% of the building's electrical consumption.

The rooftop heating and cooling units are between one and 15 years old. The economic service lifespan of this equipment is considered to be 20 years. The rooftop heating equipment efficiencies are approximately 80%. However, due to the age of the older unit, this efficiency may have significantly dropped. This is evident as per the extremely high-energy consumption of the heating system. Furthermore, technology efficiency has in increased with regards to cooling systems. As such, simply replacing the rooftop unit with a new state-of-the art system represents an important opportunity for energy savings in this building.

The rooftop units are each controlled by wall-mount thermostats. One programmable thermostat, which controls the newer rooftop unit, is located in the front offices. The older, non-programmable, thermostat controlling the larger rooftop unit, is located in the warehouse. Replacing the non-programmable thermostat with a newer one, which can be pre-set, can allow for automatic setting of the heating and cooling system, offering energy savings.

The washrooms in the building are each ventilated by individual exhaust fans. However, exhaust fans are either missing or disconnected. Therefore, no energy conservation measures are offered here.

5.2 Potential Modifications

5.2.1 Modern rooftop package units capture the majority of the heat of combustion before the exhaust gas leaves the chimney. For the purposes of this study, we will only evaluate a two-stage rooftop unit as a potential option for the older equipment, as end of lifespan replacement of this equipment is not expected within the next two years.

As stated above, the existing units have a total heat output of 336,000 BTUs per hour and the building has a total cooling capacity of 15 tons. While heating and cooling load calculations were not performed, it is assumed that equivalent loads are required.

Replacing the older rooftop unit with a high-efficiency, two-stage rooftop unit, is expected to save up to 15% on heating and 5% on cooling energy consumptions. Conventional rooftop heaters typically operate at less than 50% of the design capacity 80% of the time. However, two-stage heaters are particularly advantageous since they offer higher part-load efficiencies. These heaters can provide a small amount of heat while handling large amounts of outdoor air. This feature will become more valuable in coming years, as the requirement for more outdoor air ventilation is expected to increase.

However, due to the long payback of this measure, and since immediate replacement of the older rooftop unit is not yet necessary, this measure is not recommended, but should be considered in the future.

5.2.2 The current rooftop units are equipped with makeup-air ducts. While these ducts allow fresh air from the exterior to mix with the return air stream, the amount of air is controlled by a manual louver. Installing economizer units on the rooftop equipment will allow the introduction of fresh air, which helps to improve indoor air quality, and provides free cooling when the outdoor conditions are ideal. This measure should provide significant electrical energy savings in the spring and fall.

5.2.3 The older rooftop unit, servicing the warehouse, is controlled by a non-programmable thermostat. New programmable thermostats allow the zone temperature to be pre-set, depending on the time of the day and the day of the week. This measure, when properly implemented, can easily prevent unnecessary conditioning of the space when unoccupied. For instance, the thermostat can be pre-set to reduce heating in the winter during the night and on weekends. The same can be done in the summer, by increasing the cooling temperature.

5.3 Energy Saving Opportunities, Costs and Paybacks

	Modification	**Initial Cost**	**Incentive**	**Annual Savings**			**Simple Payback**
				$	**Gas**	**Electricity**	
5.3.1	Replace rooftop heating and cooling unit with 2 stage heating and cooling unit	$25,000	1	$365	28 GJ	1 GJ	68 years
5.3.2	Install economizer units on the rooftop equipment	$1,000		$65		2 GJ	15 years
5.2.3	Provide programmable thermostat for warehouse rooftop unit	$75	2	$45	1 GJ	1 GJ	1.6 years

Applicable Incentives:

1. Enbridge - $450 rebate if replaced before December 31, 2008

2. Enbridge - $15 rebate if replaced before March 31, 2009

6.0 PLUMBING

6.1 Description

There is a single water meter for the building.

There is a 105-litre, electric domestic water heater in the kitchen area.

Washrooms are located at the north of the office area.

As there are few plumbing fixtures in the building, potential energy saving opportunities here are low, if any. Therefore, the plumbing systems have been excluded from this study.

7.0 EXTERIOR COMPONENTS

7.1 Description

The exterior walls are solid masonry. The main entrance door is an aluminum-framed, single-glazed unit. There are three other entrance doors, which are not in use. The rear exit doors are steel units. One of these doors is blocked off. The unit windows are a combination of aluminum- and wood-framed, double-glazed units. The operable windows are horizontal sliders. There are also steel-framed, single-glazed windows in the warehouse.

Roller shades have been installed on many of the office windows. This is ideal, as solar radiation entering the space from the west towards the end of the day can be reduced by blocking out the sun.

Rigid polyisocyanurate foam insulation, valued at an estimated R-10, was noted on the roof. No insulation was noted in the exterior walls where spot-checked, which is typical for a building of this age. While increasing the insulation in the exterior walls is a good energy saving measure, the simple payback for this improvement is long. As such, no comments are offered on providing additional insulation. This measure should be explored when renovating interior finishes or if updating the exterior wall finishes in the future.

7.2 Potential Modifications

7.2.1 There are potential cost savings by renewing the window and doorframe caulking. As the caulking is deteriorated and missing, significant air-leakage is occurring at these locations, causing increased energy losses, particularly in the peak heating and cooling seasons. Although the exact amount of leakage occurring could not be quantified, it is expected that significant energy savings will result.

Properly caulking and sealing around the abandoned doors in the offices and warehouse will also result in reduced energy costs.

Renew approximately 830 linear feet of window and doorframe caulking.

7.2.2 The steel-framed, single-glazed warehouse windows are old and allow thermal bridging. While these windows allow natural light to enter the warehouse, covering them over with insulation and drywall will provide some energy savings during the winter.

Cover over 60 square feet of steel-framed, single-glazed warehouse windows with R-12 insulation and drywall.

7.2.3 Several of the windows around the unit are cracked or missing. Significant air-leakage is occurring here. These damaged or missing glazing sections should be replaced. This will result in significant energy savings in both the heating and cooling seasons.

7.3 Energy Saving Opportunities, Costs and Paybacks

	Modification	**Initial Cost**	**Incentive**	**Annual Savings**			**Simple Payback**
				$	**Gas**	**Electricity**	
7.3.1	Replace sealants in exteriors walls	$2,490		$175	12 GJ	1 GJ	14.2 years
7.3.2	Insulate and drywall over steel framed, single glazed windows in warehouse	$1,000		$35	3 GJ		28.5 years
7.2.3	Replace cracked or missing glazing sections at windows	$200		$80	4 GJ	1 GJ	2.5 years

7.3 Limitations

The air leakage at the building was not quantified. However, the cost savings related to improving the building envelope are estimated.

8.0 SUMMARY of RECOMMENDED ENERGY CONSERVATION MEASURES

Recommendation	Initial Cost	Annual Capital Cost Savings	Annual Savings			Simple Payback
			$	Gas	Electricity	
Provide programmable thermostat for warehouse rooftop unit [1]	$75		$45	1 GJ	1 GJ	1.6 years
Replace cracked or missing glazing sections at windows	$200		$80	4 GJ	1 GJ	2.5 years
Update eight foot fluorescent luminaires in warehouse with T8 lamps using electric ballasts	$3,700	$400	$275		8 GJ	5.5 years
Update 2- and 4-lamp fluorescent luminaires with T8 lamps using electric ballasts and mirrored reflectors.	$1,750		$230		7 GJ	7.6 years
Replace sealants in exteriors walls	$2,490		$175	12 GJ	1 GJ	14.2 years
Install economizer units on the rooftop equipment	$1,000		$65		2 GJ	15 years
Insulate and drywall over steel framed, single glazed windows in warehouse	$1,000		$35	3 GJ		28 years
	$10,215	**$400**	**$905**	**20 GJ**	**20 GJ**	**7.8 years**

Applicable Incentives Total $415, as follows:

1. Enbridge - $15 rebate if replaced before March 31, 2009

2. NRCan Commercial Building Retrofit Incentive - $10/estimated GJ saved – 40 GJ X $10 = $400 rebate if modifications carried out by before March 31, 2011.

9.0 INQUIRIES

9.1 Operation Inquiries

As part of the Energy Audit, inquiries were made to our client, Mr. John Smith of Smith Printing Company, to determine the building's operating characteristics, such as hours of occupancy and total number of occupants per day. This information was used in the assumptions regarding use and, therefore, potential savings.

The following are the questions and responses obtained by the inquiry.

Days	**M**	**T**	**W**	**Th**	**F**	**Sat**	**Sun**
Office Summer Hours	7.5	7.5	7.5	7.5	7.5	0	0
Office Winter Hours	8	8	8	8	8	0	0
Hours of Processing Summer	7.5	7.5	7.5	7.5	7.5	0	0
Hours of Processing Winter	8	8	8	8	8	0	0
No.# of Occupants Summer	9	9	9	9	9	0	0
No.# of Occupants Winter	7	7	7	7	7	0	0

10.0 CLOSING COMMENTS

This report provides you with an overview of the building energy consumption and potential energy saving measures. Should you have any questions, please do not hesitate to contact us.

Appendix A contains photographs documenting components noted in our report.

A statement of qualifications is included for your reference.

Sincerely,

Richard Weldon, P.Eng.