TORONTO Atmospheric Fund

TowerWise

Case Study:

849 Broadview Avenue

Figure 1: Upper Broadview Suites

1. Executive Summary

With mechanical systems that were close to 80 years old, no attic insulation, single pane windows and steadily rising utility bills, the new owners of Upper Broadview Suites quickly realized that the entire building needed a thorough overhaul to reduce energy costs and improve tenant comfort.

The results of that overhaul were dramatic: natural gas use has been reduced by 40%, water usage has dropped by 50% and electricity required for common area lighting has been reduced by 86%. Residents are also enjoying more comfortable suites in a better maintained building, making it easier for the owners to attract and retain tenants.

But as with any retrofit, the key to success was in the planning. In this case, starting with measures to address the building's leaky envelope, including adding attic insulation and replacing single pane windows, allowed subsequent mechanical upgrades to be properly tailored to the needs of a tighter, more efficient building.

Taking a comprehensive approach, the owners also decided to address wasteful water-use in the building. Replacing all toilets, faucets and showerheads dramatically reduced the building's water consumption and costs.

The upgrades also reduced the building's greenhouse gas emissions by close to 50 tonnes per year, a key indicator of the performance improvement in all aspects of the building's operations.

Maintaining 80-year-old systems is a challenge and there were also significant maintenance cost savings as a result of all of the upgrades. The end result is a more comfortable building with smoother operations and fewer breakdowns that is significantly less costly to operate and better positioned to deal with rising energy costs.

Total Project Cost	$74,200
Annual Cost Savings	$14,000
Payback	5.7 years
Net Present Value	$45,000
Annual GHG Emission Reduction	48 Tonnes CO_2e

2. Project Description and Rationale

Constructed in the 1930s, Upper Broadview Suite is a four-storey 32 unit rental property located just north of the Danforth on the east side of the Don Valley Parkway. When Jeff and Christopher Cardona took over the property in 2002, there had been no major retrofits done on the property since it was built and, though everything in the building was functioning, it was not operating efficiently. Numerous components of the mechanical system and building envelope needed improvements including the aesthetics of the building both inside and out. Fortunately, the owners viewed this as a long term investment -- a building they planned to own for a minimum of 20 years-- and understood that by improving the building's performance, they could also add value to their investment.

High maintenance costs and regular breakdowns were also big motivators for undertaking improvements, and the new owners also saw improvements as a way to better attract and retain tenants.

The overall project strategy was to tackle the whole building at once and start reaping the benefits of reduced maintenance costs, increased rental income, and energy savings as soon as possible. Due to the age of the building, the owners were able to quickly identify a number of high-impact energy conservation measures such as:

- replacement of the original, drafty single-glazed metal-frame windows with new low-emissivity, double glazed units;
- replacement of the boiler controls and steam traps;
- installation of attic insulation (of which there was none);
- replacement of the original toilets, which were consuming about 25 litres of water per flush;
- replacement of all faucets and showerheads with low flow shower heads and low flow aerators;
- and replacement of the common area lighting with compact fluorescents.

The owners also recognized how poorly the building had been operated previously. For example, without any attic insulation, the boiler set point was maintained at a much higher temperature than typical for this type of building. Though this ensured the top floor suites remained comfortable at about 22°C, the remainder of the building could have interior temperatures closer to 27°C. This resulted in tenants opening their doors and windows to cool off while effectively dumping heated air outside. Through the measures listed above, the owners could improve thermal comfort for tenants while dramatically decreasing their energy usage.

To select specific technical solutions and suppliers for the project, the owners relied on their building management experience and information from the Federation of Rental-Housing Providers of Ontario (FRPO) as well as advice from other building owners who had undertaken energy retrofits. There are no in-suite controls or suite metering in the building, so tenant education was seen as unnecessary once the uneven heat situation was rectified.

The owners acted as their own general contractors for the project, dealing directly with companies for each major item on their to-do list. "All-inclusive" companies who had experience dealing with tenants were hired to complete the window and toilet retrofit. These companies would measure, manufacture or source products, schedule work and install onsite. A mechanical contractor was hired for the boiler control replacement and an electrician for the lighting retrofit. Each of the projects were relatively short in duration due to the size of the building, with window installation lasting just under two weeks while installation of the toilets, insulation and lighting all took less than one week each. The boiler control replacement took three weeks, but this did not present any major challenges because it did not require access to the suites and was completed during the summer when demand on the boiler was minimal.

3. Project performance

As of 2007, the retrofit measures have reduced the building's natural gas consumption by about 40% from the baseline year of 2002, as shown in Figure 2. The projected usage in Figure 2 is weather adjusted for heating degree days (HDD) from the gas usage observed in the baseline year.

Both the boiler controls and windows were replaced in the spring and summer of 2003 and insulation was added to the attic space in June 2004. As both of these projects occurred in the summer and two-thirds of a year's HDDs likely occur in the first half of the year [2], the estimated savings associated with replacement of the boiler controls and windows consists of the savings seen in 2003 and two-thirds of the 2004 savings or about 3.5 m^3/HDD each year, as shown in Figure 3.

Likewise, the savings attributed to the attic insulation occurs in the remaining one-third of 2004 savings or about 0.7m^3/HDD. The owners indicated that there have also been ongoing modifications to controls and operation of the boiler to optimize heating system performance. As no other retrofit measures have been made to the building that would affect gas use and central control of the boiler system is maintained by the owners (as opposed to unit-level control by tenants) the remaining gas savings between 2005 and 2007 have been attributed to these modifications. This has likely contributed to an understatement of the savings achieved by the attic insulation because it is unclear when

Figure 2: Weather-Normalized Annual Natural Gas Usage [1][2]

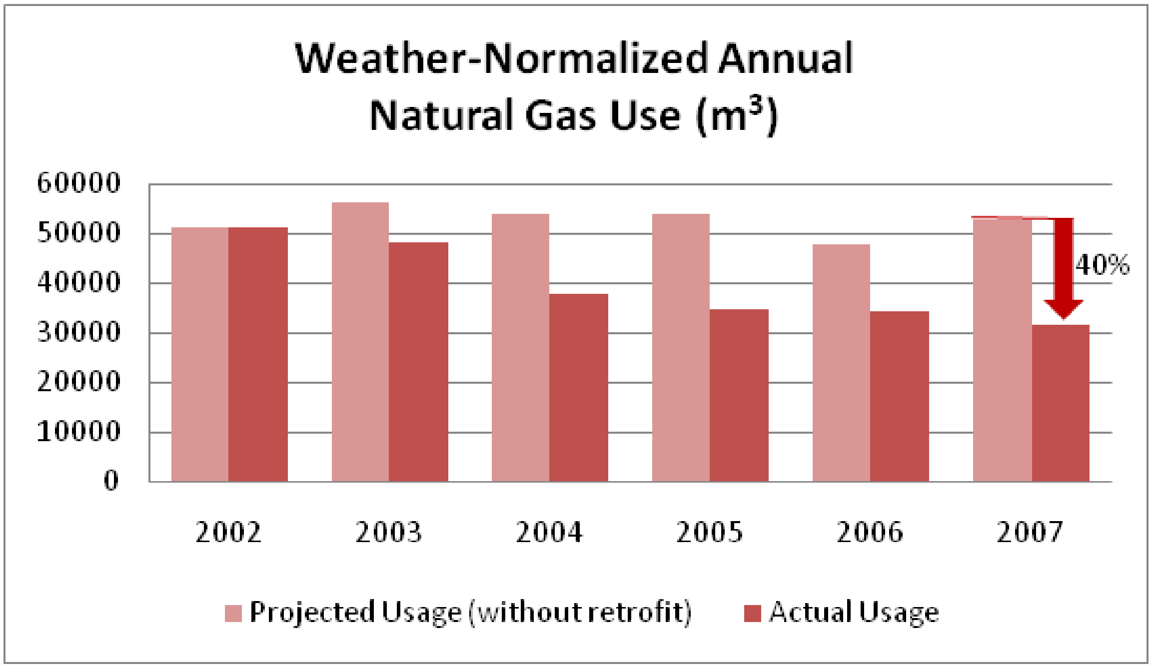
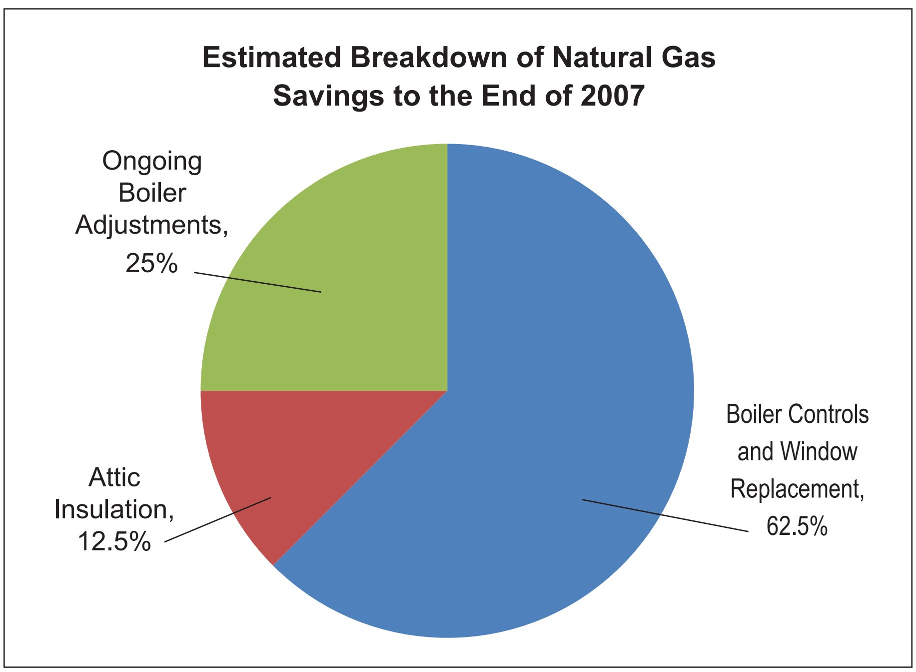


Figure 3: Breakdown of Natural Gas Savings



these changes to system operation were made. Also insulation of attic improved the thermal resistance of the building envelope so that set points could be reduced while maintaining a more comfortable temperature. Based on the above allocation, the estimated savings attributed to each retrofit measure is shown in Figure 4.

Figure 4: Low flow toilets and showerheads

Figure 5: White vinyl window frames

In addition to natural gas savings, the windows also enhance the appearance of the suites with white, vinyl frames replacing old metal ones. The new windows also contributed to quieter, more comfortable suites.

The toilets and showerheads were replaced and low flow aerators added to all faucets in November 2006, which resulted in a 50% reduction in water use the following year as shown in Figure 7. The 2005 data was excluded from the baseline average because there was a small leak underneath the building that year and a suspected problem with the water meter, which was also replaced in 2005. Both of these factors likely contributed to the anomalous usage in 2005, and savings would have been overstated had it been included.

In February 2006, the existing F40-T12 fluorescent bulbs used for common area lighting were each replaced with two 13W compact fluorescents. This retrofit of 192 existing fixtures resulted in an 86% reduction in electricity consumption associated with common area lighting, as shown in Figure 8. As the building is not sub-metered, savings were calculated by determining the electricity consumption of the pre and post-retrofit lighting fixtures, assuming that common area lighting is on 24 hours a day, seven days a week.

In addition to improved thermal comfort for tenants and more efficient building operation, saving natural gas, water and electricity also helps avoid CO_2 emissions. Annually, the natural gas savings resulted in over 40 Tonnes of CO_2e avoided [3], while water and electricity savings contributed to 0.5 [4] and 7 Tonnes [3], respectively as shown in Figure 9. The combination of all of the implemented measure is estimated to result in an annual reduction of CO_2e of approximately 48 Tonnes.

Figure 7: Annual Water Usage

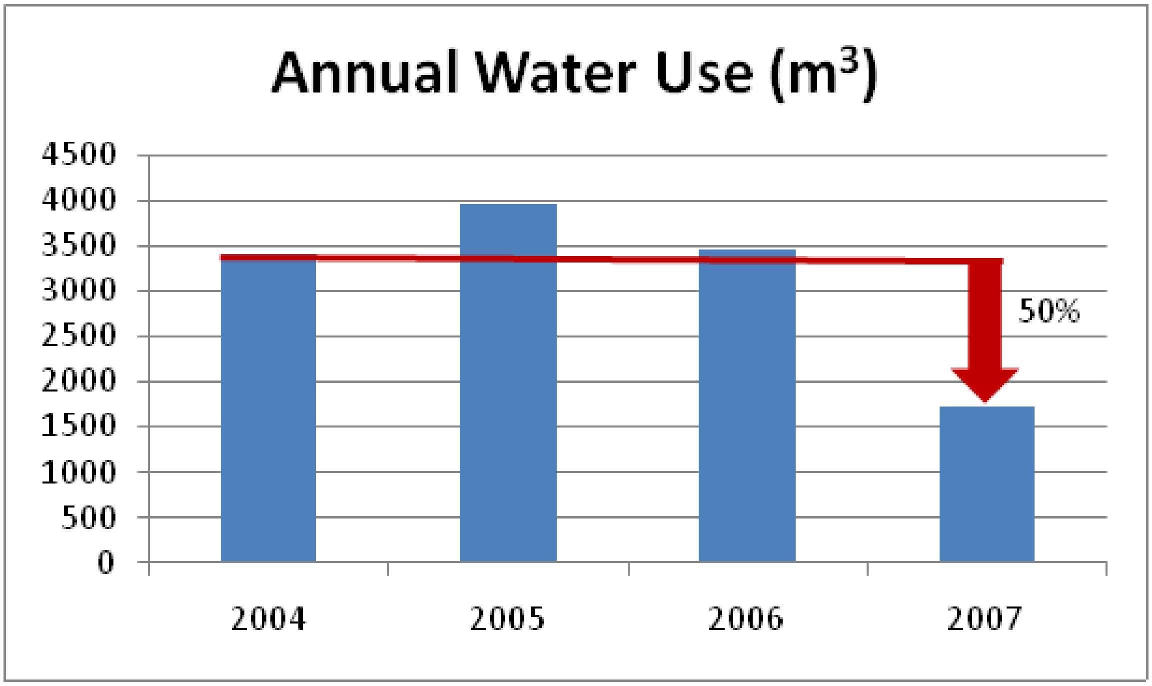


Figure 8: Annual Electricity Use for Common Area Lighting

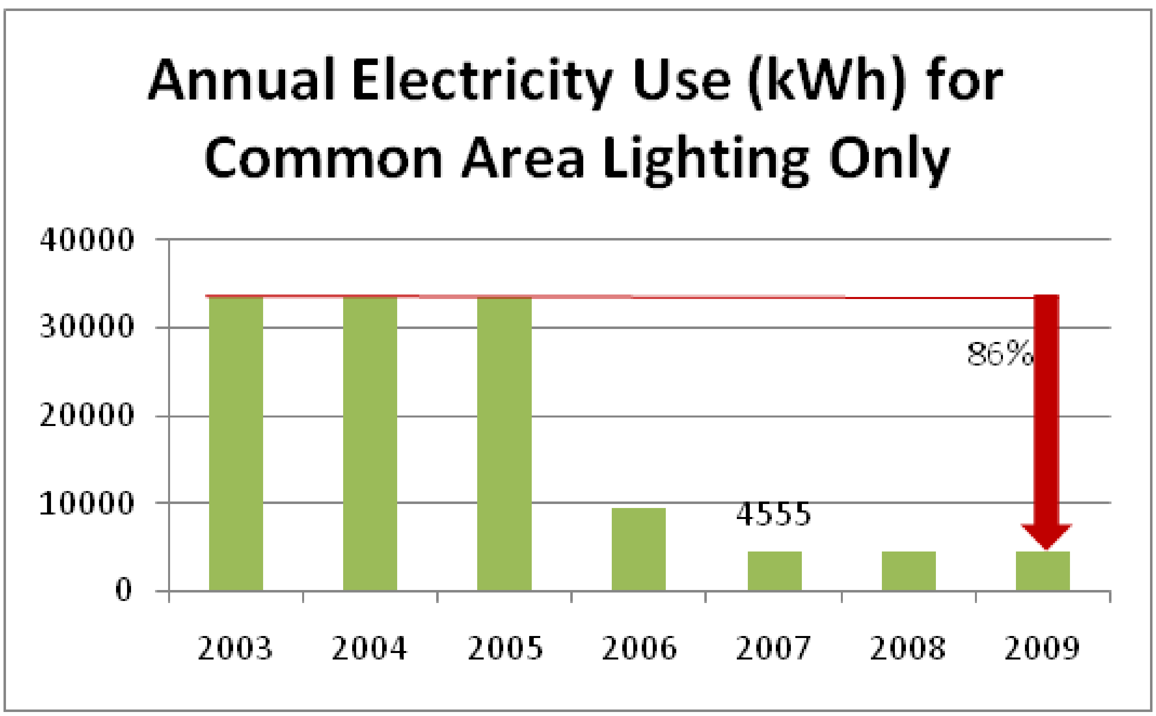
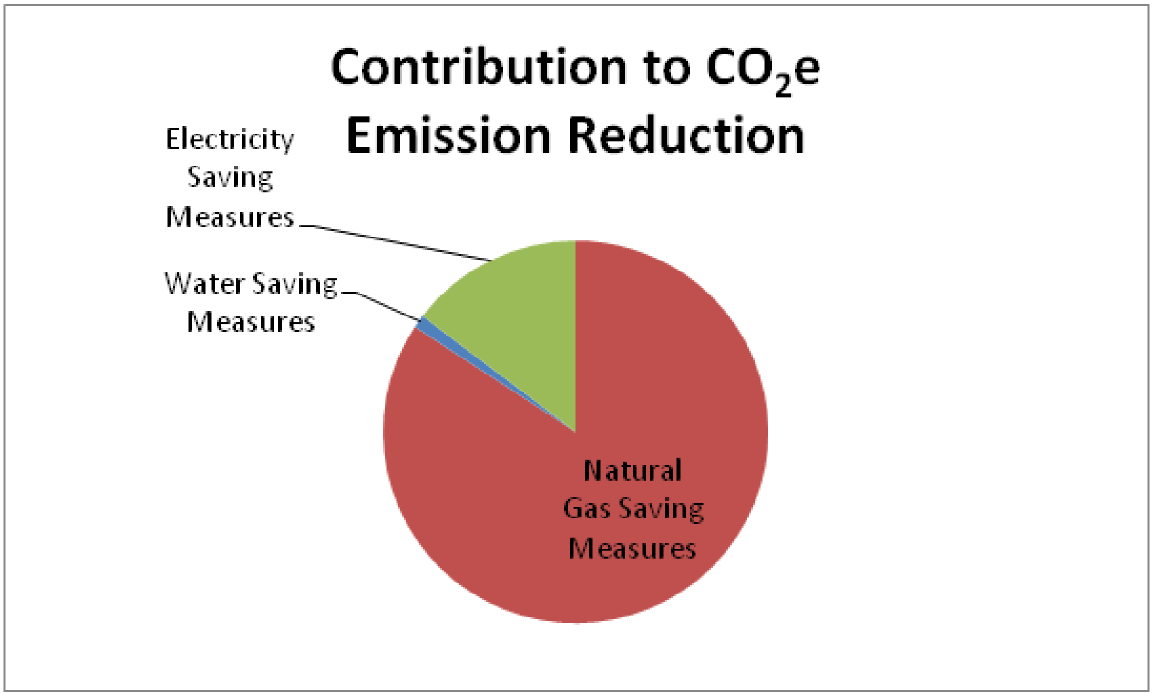


Figure 9: Impact of Resource Saving Measures on CO_2 emissions



4. Project costs

The Cardona's budget for acquiring the building included the capital needed for the building upgrades. However, they also applied for an above-guideline rent increase of 4-6% per unit to recoup costs more quickly and improve cash flow during the project. Schedule of work and budgeted and actual costs for each part of the retrofit are shown in Table 1.

Table 1: Details of Retrofit Project Costs

Retrofit Measure	Month Completed	Budgeted Cost	Actual Cost
Boiler Control Replacement	April 2003	$5,000	$7,000
Window Replacement	July 2003	$55,000	$55,000
Attic Insulation	June 2004	$3,000	$3,000
Lighting Replacement	February 2006	$2,500	$3,200
Toilet and Showerhead Replacement and Addition of Aerators	November 2006	$6,000	$6,000
Total Project		**$71,500**	**$74,200**

The only incentive program tapped into for the project was the City of Toronto's Water-Saver Program, which provided a rebate of $125 per toilet. This particular rebate was pursued because of its significance relative to installed cost of the toilet and the ease with which it was attained (the contractor completed the paperwork on the owner's behalf). Though other incentives were investigated, the owners believed that the return was not worth the time required for the application process.

They also budgeted only about 5% for contingency because of their confidence in their own cost estimates. As it turned out, the entire project came in less than 4% over budget. There were also some minor unforeseen costs associated with damage to the interior wall of some units during window installation which required dry-walling and painting.

5. Financial analysis

In order to examine the simple payback, return on investment (ROI), internal rate of return (IRR) and net present value (NPV) of the retrofits, a cash flow diagram is presented in Figure 10 with capital expenditure as negative cash flows and annual cost savings as positive cash flows.

Annual gas cost savings are generated from the difference between actual annual consumption and projected annual consumption. Projected annual consumption was derived using a pre-retrofit baseline year of 2002, and adjusting that 2002 usage according to the HDDs of the subsequent years to determine how much energy *would* have been used had there been no retrofit. Given that both of the gas conservation measures (boiler control and window replacement and attic insulation) were completed during the summer months, the savings in 2003 was accrued only in the latter half of the year. Likewise, only savings in the latter half of 2004 is affected by the attic insulation, which was added in June.

With only one year of post-retrofit water-use data (2007), this annual savings was assumed to be consistent for the remaining years in the analysis because water use is generally not affected by weather [6]. Likewise, annual post-retrofit electricity use associated with common area lighting was assumed to remain constant for the remainder of the analysis.

Table 2 shows the simple payback, return on investment (ROI) and internal rate of return (IRR) for the first ten years following the retrofit. Note that these 10-year periods are the same for the water and electricity saving measures (2007-2016) but different for the gas-saving measures (2005-2014) based on the years in which the projects were completed. The table also includes the net present value (NPV) of each investment using 2010 as the present year and assuming ten years of cost savings following completion of the retrofit.

Figure 10: Project Cash Flows [1][2]

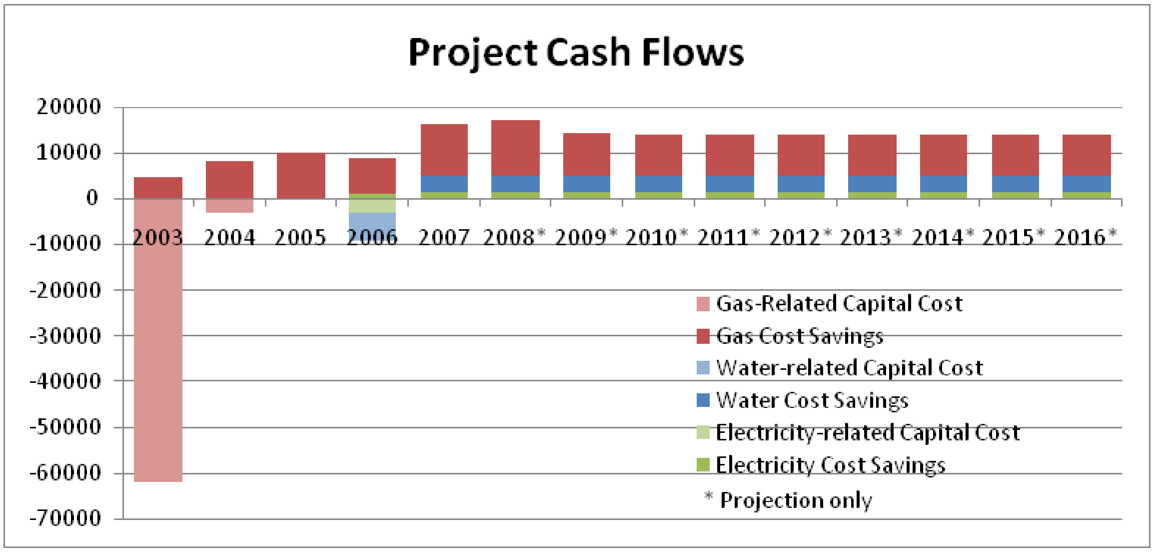


Table 2: Financial Analysis Measures

Utility Affected (Project duration)	Project	Simple Payback	10 year ROI (Est.)	IRR over 10 years (Est.)	Net Present Value in 2010
Gas (2003-2004)	Boiler Replacement Replace Windows Insulation in Attic	6.2 years (see Note 1)	74% (see Note 2) -	10%	$16,000
Water (2006)	Replace Toilets	1.7 years	483%	56%	$24,000
	Replace Showerheads				
Add Aerators					
Electricity (2006)	Common area lighting retrofit	1.3 years	673%	79%	$11,000
Total Project		5.7 years (see Note 3)	130%	14%	$45,000

NOTE 1: Though the assumptions in Section 3 estimate how the retrofit measures might have contributed to natural gas savings to date, without pre and post-retrofit air leakage data and/or sub-metered data it is not reasonable to calculate financial payback based on these proportions, so one payback period was calculated for all of the gas-saving measures combined.

NOTE 2: As the boiler and windows were replaced in the spring/summer of 2003, it is assumed that all gas savings that year occurred in the fall/winter of 2003 amounting to $4601. A linear relationship was assumed between HDD and gas usage (due to lack of detailed data) and, as 66% of the 2004 HDD occurred prior to the insulation of the attic (June 2004), 66% of the 2004 energy cost savings was attributed solely to the boiler and window replacement. The remainder of savings in 2004 must be attributed to all three measures. Once again, without more detailed data, it is not possible to separate out the savings associated with the attic insulation from the other gas-savings measure for the purposes of an ROI calculation.

NOTE 3: As the gas-saving measures were by far the largest proportion of the retrofit investment (84%) the 10-year time horizon for the gas-saving measures (2005-2014) was use to calculate the total project simple payback.

Though many building owners and operators consider payback periods beyond five years as less than desirable [7], the owners considered this building a long-term investment and saw that accepting a payback period of just over six years for the gas-saving measures meant both solving tenant comfort problems and reaping long-term operating cost savings. Though the lighting retrofit generated the greatest return on investment, the project as a whole generated returns of 130% in the first ten years of operation and will continue to accrue significant operational cost savings of almost $14,000 annually. It should be noted that this financial analysis does not include either the impact of the above-guideline rent increase or the reduction in maintenance expenditures, both of which would significantly reduce the project payback and improve the IRR and ROI.

According to the owners, the financial results to date have been better than anticipated.

6. Challenges

The owners noted that minor issues can quickly become major ones if there is poor communication between landlords and tenants. To prevent this, they recommend ensuring tenants are given plenty of notice for the work, especially those projects that require access to units. Tenants were given written notice that the work was approaching six to eight weeks in advance, what was being done and why, then another notice one week prior to the start of work.

At another property that the brothers own, they held tenant appreciation events upon completion of building works to thank tenants for their patience and cooperation. This helps build good will for when work needs to take place in the future.

7. Testimonial from Building Owner

"We are very pleased with the results of the retrofits which exceeded our expectations both financially and otherwise. In addition to the energy and maintenance savings, the work resulted in quieter, more comfortable units for our tenants. For example, one tenant said her unit was so quiet after the retrofit that she had to buy an alarm clock -- she used to be woken up by the 6:00 a.m. bus going by her window. In retrospect, we would not have done anything differently."

8. Conclusions

With a building the age of Upper Broadview, the problem can be where to start rather than whether action is needed. The new owners took a comprehensive look at the building and then drafted a retrofit plan that ensured maximum impact by properly sequencing upgrades and addressing major cost centres. They also clearly recognized the maintenance and tenant retention benefits of building upgrades and how these would contribute to increasing the value of the building.

With the retrofit completed, they are now protecting their investment by instituting a preventative maintenance program that includes adjusting heating as needed and ensuring boilers are cleaned, pumps are lubricated and everything is functioning as efficiently as possible.

Although the natural gas conservation measures generated the highest volume of utility savings and greenhouse gas reductions, the electricity and water conservation projects generated higher rates of return, helping to subsidize the other measures and reducing the overall project payback period.

Overall, the building owners have significantly increased the building's net operating income, and improved the value of their investment by reducing operating costs by about $14,000 annually.

Acknowledgements

Research and writing by Marianne Touchie. Special thanks to Jeff Cardona for his assistance with the development of this case study.

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[4] ICF International. (2007). *Greenhouse Gases and Air Pollutants in the City of Toronto: Toward a Harmonized Strategy for Reducing Emissions.* City of Toronto.

[6] P. Woodworth. (2010, October 6). *Abraxas Energy Consulting* [Online]. Available email: paul.woolworth@abraxasenergy.com Message: Question Regarding Water Normalization

[7] T. Kesik and I. Saleff. (2009). *Tower Renewal Guidelines*. University of Toronto.

Glossary

Above Guideline Increase (AGI) - An increase above the annual rent increase guideline specified by the province. Landlords can apply for this type of increase if their costs have increased due to: extraordinary increases in municipal taxes and charges or utilities; capital expenditures such as roof replacement; or operating costs related to security services. (Source: Ontario Ministry of Municipal Affairs and Housing)

Equivalent Carbon Dioxide (CO_2e) – A measure used to compare the emissions from various greenhouse gases based upon their global warming potential. For example, the global warming potential for methane over 100 years is 21. This means that emissions of one metric ton of methane are equivalent to emissions of 21 metric tons of carbon dioxide. (Source: Organisation for Economic Co-operation and Development)

Heating Degree Day (HDD) – Represents the amount of heating energy required during the heating season. It is measured by the difference between the base temperature of 18°C and the mean temperature for a particular day. (Source: Natural Resources Canada)

Internal Rate of Return (IRR) – The discount rate at which the net present value of all cash flows from a particular project is equal to zero. The IRR can be used to compare several projects under consideration. If all other factors are equal among the various projects, the project with the highest IRR would likely be selected first. (Source: Investopedia)

Net Present Value (NPV) – The difference between the present value of the cash inflows and the present value of the cash outflows which can be used to analyze the profitability of a project. (Source: Investopedia)

Return on Investment (ROI) – The benefit of an investment, or gain from investment minus cost of investment, is divided by the cost of the investment. This ratio or percentage is used to show the efficiency of the investment. (Source: Investopedia)

Simple Payback – The length of time in years required to cover the cost of a project. It is calculated by dividing the cost of the project by the annual cash inflows. (Source: Investopedia)

Sub-metering – The individual metering of utilities at the unit level in a multi-unit residential building. Each household can then be responsible for their own energy costs as opposed to splitting the energy bill for the entire building equally among all occupants. (Source: New York City Department of Housing Preservation and Development)

Weather Normalization – A mathematical process that adjusts actual energy usage so that it represents energy typically used in an average year for the same location. This accounts for weather differences from year to year that may result in abnormally high or low energy consumption. (Source: ENERGY STAR)

TORONTO Atmospheric Fund

The Toronto Atmospheric Fund (TAF) has been sparking action on climate, air pollution and energy use in Toronto for 20 years. Internationally recognized for its innovative and effective programs, TAF has helped the City save millions on energy costs and helped citizens to live greener lives in healthier communities. TAF relies exclusively on income from its own endowment and investments from program partners for its operations. For more information, visit www.toronto.ca/taf

www.TowerWise.ca

TAF's TowerWise program works with high-rise owners and managers to reduce energy use and emissions from apartment towers and condominiums. TowerWise provides unbiased advice and assistance to help high-rise owners to make their buildings more comfortable and less polluting. To get involved with the TowerWise program, contact Lyle Jones at ljones@tafund.org, 416-393-6370