Ottawa Community Housing
Logement Communautaire d'Ottawa

Building Stronger Communities Together
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FINAL REPORT

HEATING ENERGY MANAGEMENT SYSTEM PILOT PROJECT

2015

SEPTEMBER 2015

EXECUTIVE SUMMARY

In an effort to better manage the electrical heating costs in its portfolio of buildings, Ottawa Community Housing (OCH) initiated a pilot project to evaluate the impact and performance of a novel heating management system, manufactured by Demtroys Technology. This system is capable of regulating the heating energy allocated to each apartment unit based on several criteria including local outdoor temperature, floor level and orientation. The heating energy management system was installed in two OCH projects; 280 Rochester (a 20 storey, 240 unit highrise seniors building) and 1390 Lepage (a 5 storey, 157 unit mid-rise building). In principle, this system would reduce potential energy waste by preventing excessive and unnecessary heat energy from being delivered to apartments, with minimal impact on occupants' thermal comfort.

Energy consumption data (both electricity and gas) were collected for each building prior to the installation of the heating management system. Each building was then monitored for a one year period following the installation of the heating management system and the data, before and after the retrofit, was analyzed. In addition, a tenant survey was conducted at each building to gauge the occupants' perception of thermal comfort levels in response to the installation of the heating management system.

The results from the one-year monitoring pilot confirmed that the heating management system could reduce heating costs for OCH. The system reduced energy consumption by as much as 32% at 280 Rochester, resulting in a simple pay-back in just over two years. At 1390 Lepage, electrical energy consumption was reduced by approximately 30%, compared with its sister building, 1400 Lepage, providing a simple payback of five and one half years. The installation of the heating management system appeared to result in a slight overall increase in perceived occupant thermal comfort compared with thermal comfort before the pilot project.

The reduction in electrical heating demand at the two test buildings, which appears to be attributed to the installation of this heating management system, demonstrates a significant opportunity for adoption as an energy retrofit option amongst OCH's portfolio, to better manage its building operations and reduce electrical heating energy costs.

DISCLAIMER

This Project was partially funded by Canada Mortgage and Housing Corporation (CMHC) and Natural Resources Canada (NRCan) through their Program for Energy Research and Development (PERD). The content, views and editorial quality expressed in this report are those exclusively offered by the authors, Carleton University. CMHC and NRCan assume no responsibility of any kind in connection with the reader's use of the information, materials and techniques described herein.

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RÉSUMÉ

Dans le but de mieux gérer les coûts de chauffage électrique des immeubles de son portefeuille, Logement communautaire d'Ottawa (LCO) a lancé un projet pilote pour évaluer l'impact et le rendement d'un nouveau système de gestion de la capacité de chauffage, fabriqué par Technologie Demtroys. Ce système peut moduler l'énergie fournie à chaque appartement en fonction de plusieurs critères, notamment la température extérieure, l'étage sur lequel se trouve l'appartement et son orientation. Ce système de gestion d'énergie a été installé dans deux immeubles de LCO : le 280 Rochester, une tour d'habitation de 20 étages comptant 240 appartements pour personnes âgées, et le 1390 Lepage, un immeuble de moyenne hauteur de 5 étages et 157 appartements. En principe, le système devrait réduire le gaspillage d'énergie en évitant le chauffage excessif des appartements, et ce, sans créer d'incidences au niveau du confort thermique pour les occupants.

Les données sur la consommation d'énergie (électricité et gaz) ont été recueillies pour chacun des immeubles avant l'installation du système de gestion du chauffage. Chaque immeuble a ensuite fait l'objet d'un suivi pendant un an après l'installation du système. Les données d'avant et d'après les installations ont ensuite été analysées. En outre, un sondage a été fait auprès des locataires de chaque immeuble pour connaître la perception des occupants quant au confort thermique après l'installation du système de gestion du chauffage.

Les résultats du projet pilote d'un an confirment que ce système de gestion peut réduire les coûts de chauffage pour LCO. Le système a permis une diminution de la consommation d'énergie de 32 % au 280 Rochester, de sorte que la période de récupération des coûts liés à l'installation du système est d'un peu plus de deux ans. Au 1390 Lepage, la consommation d'électricité a été réduite d'environ 30 % par rapport à l'immeuble adjacent, le 1400 Lepage, et ce, pour une période de récupération de cinq ans et demi. L'installation du système de gestion du chauffage semble avoir entraîné une légère amélioration du confort thermique perçu par l'ensemble des occupants.

La diminution de la demande d'électricité pour le chauffage dans les deux immeubles du projet pilote, qui semble attribuable à l'installation du système, fait en sorte que LCO se voit offrir une excellente occasion de mieux gérer ses immeubles et de réduire les coûts d'énergie liés au chauffage électrique dans l'ensemble de son portefeuille.

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BACKGROUND

In residential buildings where the property owner pays the heating bill, tenants tend to set their thermostat temperature considerably higher (often 2-3 °C) and consume more heating energy than in buildings where the tenant is responsible for the heating utility (Gunay, O'Brien and Beausoleil-Morrison). This often leads to excessive use of heating energy and corresponding cost; especially in apartments where electric baseboards are used as the primary heating source. By limiting the amount of electricity available to each unit while at the same time maintaining the indoor thermal comfort, significant amount of wasted energy and cost could be saved. However apartments on different building elevations often require different amounts of heat due to the orientation of the sun, wind exposure and air buoyancy (or stack) effect where heated air from lower floors rises to the higher floors.

INTRODUCTION

In 2013, Ottawa Community Housing (OCH) launched a pilot project to implement a novel heating energy management system, developed by Demtroys Technology, in two of its electrically heated apartment buildings. The first is a 20 storey high-rise building located at 280 Rochester Street. The second is a 5 storey mid-rise building located at1390 Lepage; the building located at 1400 Lepage is identical to that at 1390 Lepage and is used as a reference building. The heating management system moderates the electrical power delivered to the heating system based on several parameters including exterior temperature, floor level and orientation, with time-of-use functions to enable setbacks. The building is separated into different zones, allowing each zone to be calibrated separately through a central control unit. The systems were installed in December 2013 and January 2014 (at 280 Rochester and 1390 Lepage, respectively) and each building was monitored for at least one calendar year.

An analysis of the heating energy consumption was performed and a tenant survey was also conducted for all three buildings.

The objective of this project is to determine the extent to which this heating management system is able to reduce overall heating loads and costs by eliminating energy waste in overheated units while maintaining a comfortable indoor temperature for units throughout the building.

This report summarizes how effectively the new system has been meeting the above-mentioned goal in the pilot buildings. Major methodology used includes a tenant survey and heating energy consumption analysis. The purpose of this report is to provide background information on the heating management system and pilot buildings, to present the results of tenant survey and heating energy consumption analysis, and to give an overall evaluation of the new heating management system. The manufacturer claims this heating management system has the potential of reducing heating energy cost by 10 to 30%. If so, this heating management system promises significant potential to OCH to reducing heating costs if implemented properly in all of the OCH properties.

HEATING MANAGEMENT SYSTEM INFORMATION

The new heating management system was supplied by Demtroys Technology Inc., located in Sherbrook, Quebec. In principle, individual heating profiles are developed for each unit in the building based on orientation and location in the building. These heating profiles are controlled by the outdoor air temperature and are created based on the geometry of the unit, the location and size of the heating appliances, orientation and location of the unit in the building. A central CPU gathers weather data and communicates that information to the relays that have been installed in the heating circuits of each unit and contain the heating profile for that unit. Every minute, the central CPU updates each relay with up to date outdoor temperature and the unit relay controls the amount of heat available to that unit based on the heating profile. For example, early in the morning when it's -20°C outside, all units will be receiving 100% of their heat but at noon when the outdoor temperature rises to -10°C, the ground floor units might have access to 80% while the top floors might only have access to 60%. The heating profiles are designed to maintain a comfortable indoor ambient temperature as long as the tenant does not engage in wasteful behavior (for example, leaving windows open). The profiles can also be altered for aggressive conservation or toned down for more casual conservation. The system was commissioned and confirmed to be operational during the analysis period through monitoring.

BUILDING INFORMATION

The following is a brief description of each building and its respective energy management system configuration. Three buildings are included in the tenant survey and heating energy consumption analysis; 280 Rochester, 1390 and 1400 Lepage. The new system is installed in 280 Rochester and 1390 Lepage, while 1400 Lepage was kept as a control building (for 1390 Lepage) in the study. Detailed building information is reported below

ENERGY MANAGEMENT SYSTEM CONFIGURATION: 280 ROCHESTER

The building is a categorized as a high-rise, with 240 units (see Table 1 for more details). Originally built in 1972, it has undergone a series of major renovations; the latest one was carried out from 2010 to 2014, which included new windows, doors and a new roof. The heating system for the residential units is electrical baseboard, while the common area heating and ventilation system uses natural gas as the heating energy source. The new heating management system was installed in December 2013.

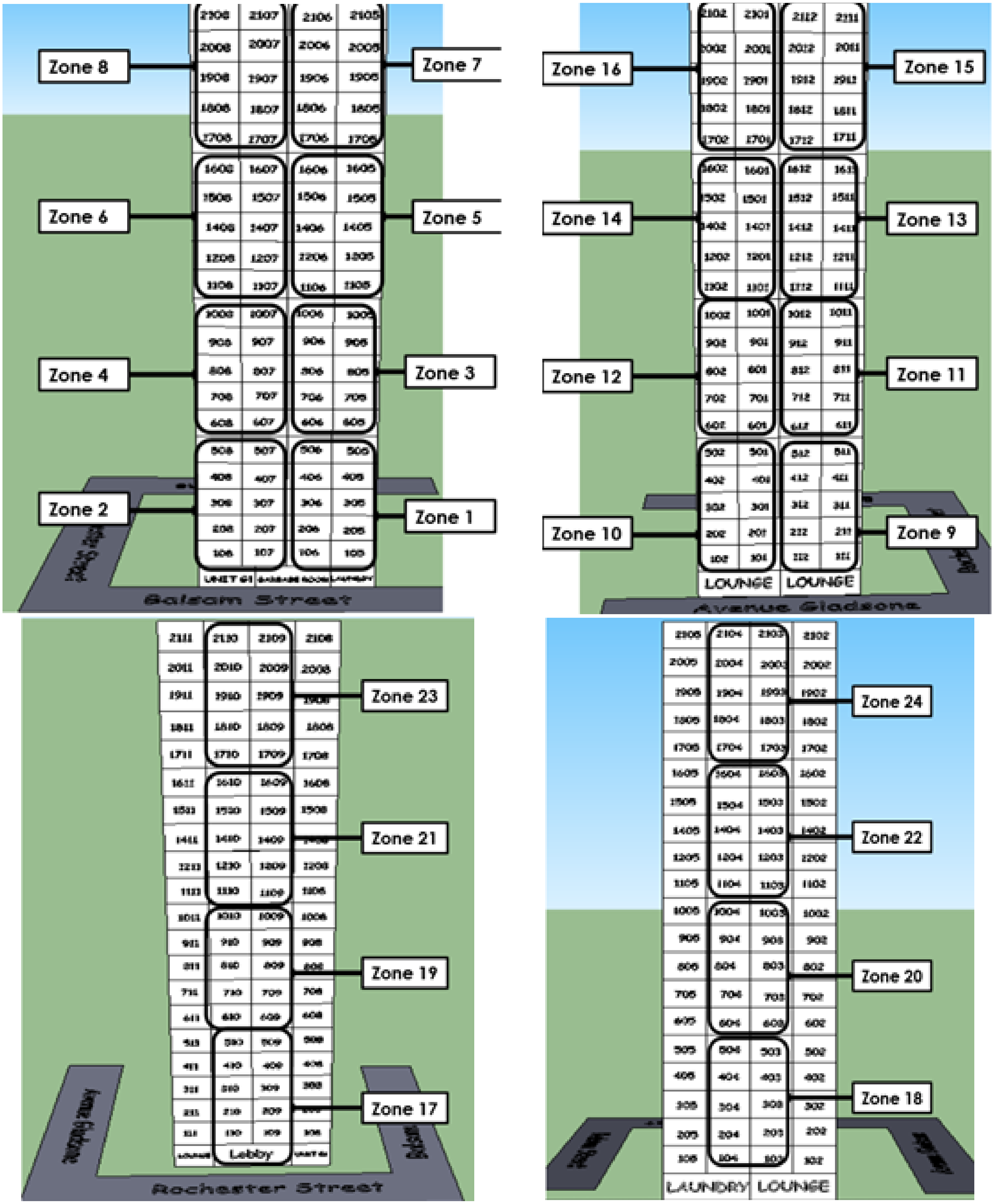
The building at 280 Rochester Street is divided into 24 separate control zones (as shown in Figure1); the energy management system for each zone is optimized for outdoor temperature, building orientation and floor elevation.

Table 1: 280 Rochester Building Information

Built	1972
System Installed	December 2013
Heated Floor Area	17,848 m^2
Stories	20
Units	240
Tenure Type	Senior
Occupancy	100%
Construction Info	Recently renovated*
Heating System	Electric Baseboard
Domestic Hot Water System	Central, Gas
Ventilation System	Forced Air in Common Areas
Appliances	Fridge, Stove
Parking	Limited, 10
Average Annual Total Energy Usage (2006-2014) see Appendix A	Electricity 2,643,521 kWh Gas 238,558 m^3
Average Energy Intensity (2006-2014)	Electricity 148 kWh/m^2/year Gas 13.4 m^3/m^2/year

***280 Rochester went through a major retrofit from July 2010 to Dec 2014. Work included new double glazed windows replacing old single pane windows and foam core doors replacing balcony solid wood doors. The roof was replaced during the summer in 2014.**

Figure 1: 24 Zones Delineated by Orientations and Floors (Top Left: South, Top Right: North, Bottom Left: East, Bottom Right: West)



BUILDING INFORMATION

1390 AND 1400 LEPAGE AVENUE

The buildings at 1390 and 1400 Lepage buildings are a pair of twin 5 storey buildings with identical floor plans containing a total of 314 residential units; 157 units in each building. Originally built in 1974, 1400 Lepage had a roof retrofit in 2014. Both buildings have electric baseboard heating in the residential units and heating and ventilation systems use natural gas for common areas. All equipments, constructions, operation schedules and tenancy are almost identical in both buildings. The new heating management system was installed in 1390 Lepage in January 2014.

Table 1: 280 Rochester Building Information

	1390 Lepage	1400 Lepage
Built	1974	1974
System Installed	January 2014	NA
Heated Floor Area	8,881m^2	8,881m^2
Stories	5	5
Units	157	157
Tenure Type	Mixed	Mixed
Occupancy	100%	100%
Construction Info		Recent minor retrofit in 1400 Lepage*
Heating System	Electric Baseboard	Electric Baseboard
Domestic Hot Water System	Central, Gas	Central, Gas
Ventilation System	Corridor forced air	Corridor forced air
Appliances	Fridge, Stove	Fridge, Stove
Parking	Limited, 35	Limited, 35
Average Annual Total Energy Usage (2006-2014)	Electricity: 2,364,553 kWh AND Gas: 223,905 m^3	
Average Total Energy Usage Index (2006-2014)	Electricity: 133.1 kWh/m^2/year AND Gas: 12.6 m^3/m^2/year	

***1400 Lepage had a recent minor retrofit replacing the roof with modified bitumen. Other constructions are typical of 1970s buildings, with single pane windows and minimal levels of wall insulation.**

Figure 2: Plan View of 1390 Lepage

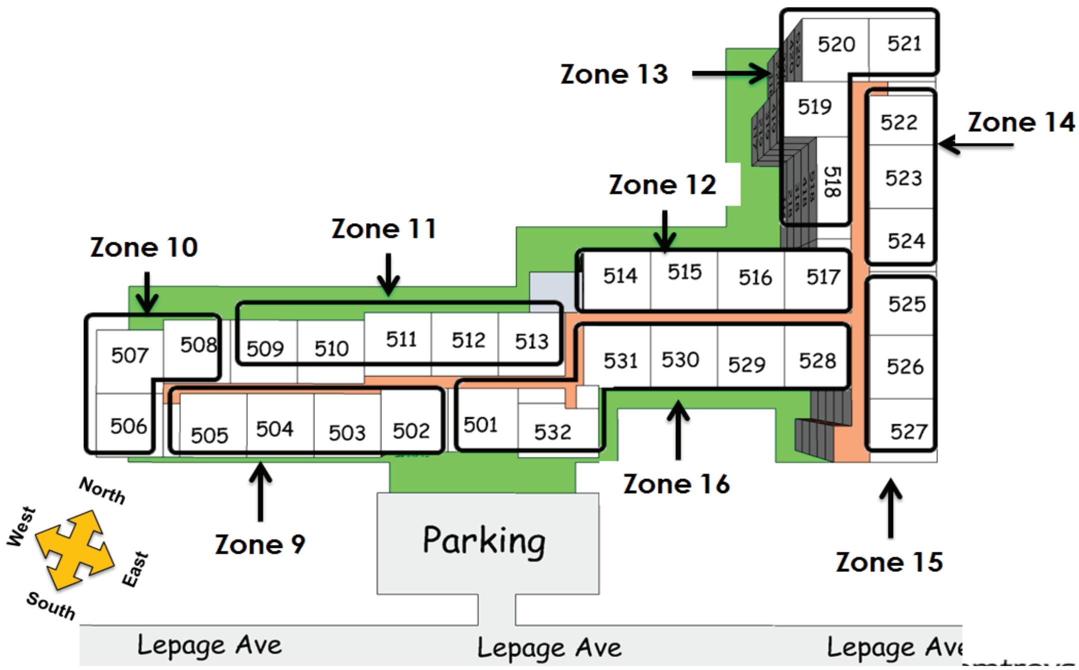


Figure 3 Building Elevations of 1390 Lepage showing the 16 monitoring zones

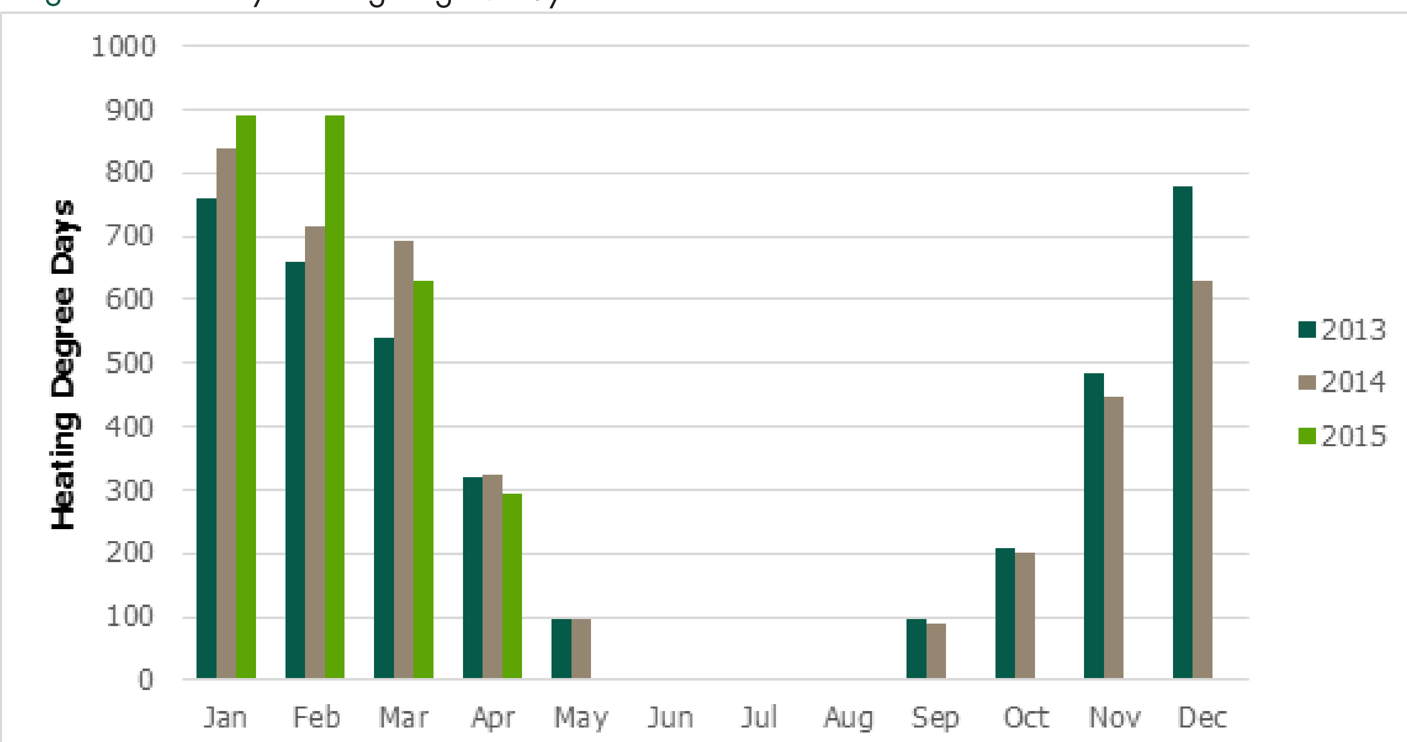
HEATING ENERGY CONSUMPTION ANALYSIS

This new heating management system has the potential of reduce heating energy cost by 10% to 30%. To investigate the actual saving, a heating energy consumption analysis was carried out following a one year monitoring period after the installation. Energy consumption data for all buildings was also weather normalized to filter the energy consumption variations caused by climate.

HEATING DEGREE DAY DATA

The degree-day (DD) data used for this analysis was obtained from Weather Underground. Degree-day measures the amount of energy and duration required to heat or cool a space, it is calculated by the difference between outdoor temperature and base temperature integrated over time. The weather data was measured at the Ottawa International Airport, with 0.05% data loss. The heating degree days (HDD) and cooling degree days (CDD) were calculated using an 18°C base temperature, and the heating seasons are set to be from late September to early May based on past operations, and cooling seasons are set to be from June to August. In all three buildings tenants install their own window-mounted air conditioning unit as there are no central cooling systems.

Figure 4 Monthly Heating Degree Day



Monthly heating degree-day variations from January 2013 to April 2015 (as shown in Figure 4) were examined. Some discrepancies were observed from year to year, but they were not too significant. Unfortunately the monthly degree-day was not appropriate to be used directly due to the variations of billing periods for different buildings, so a cumulative heating-degree-days for each building's billing period was generated. The start date and end date for each billing period vary each month.

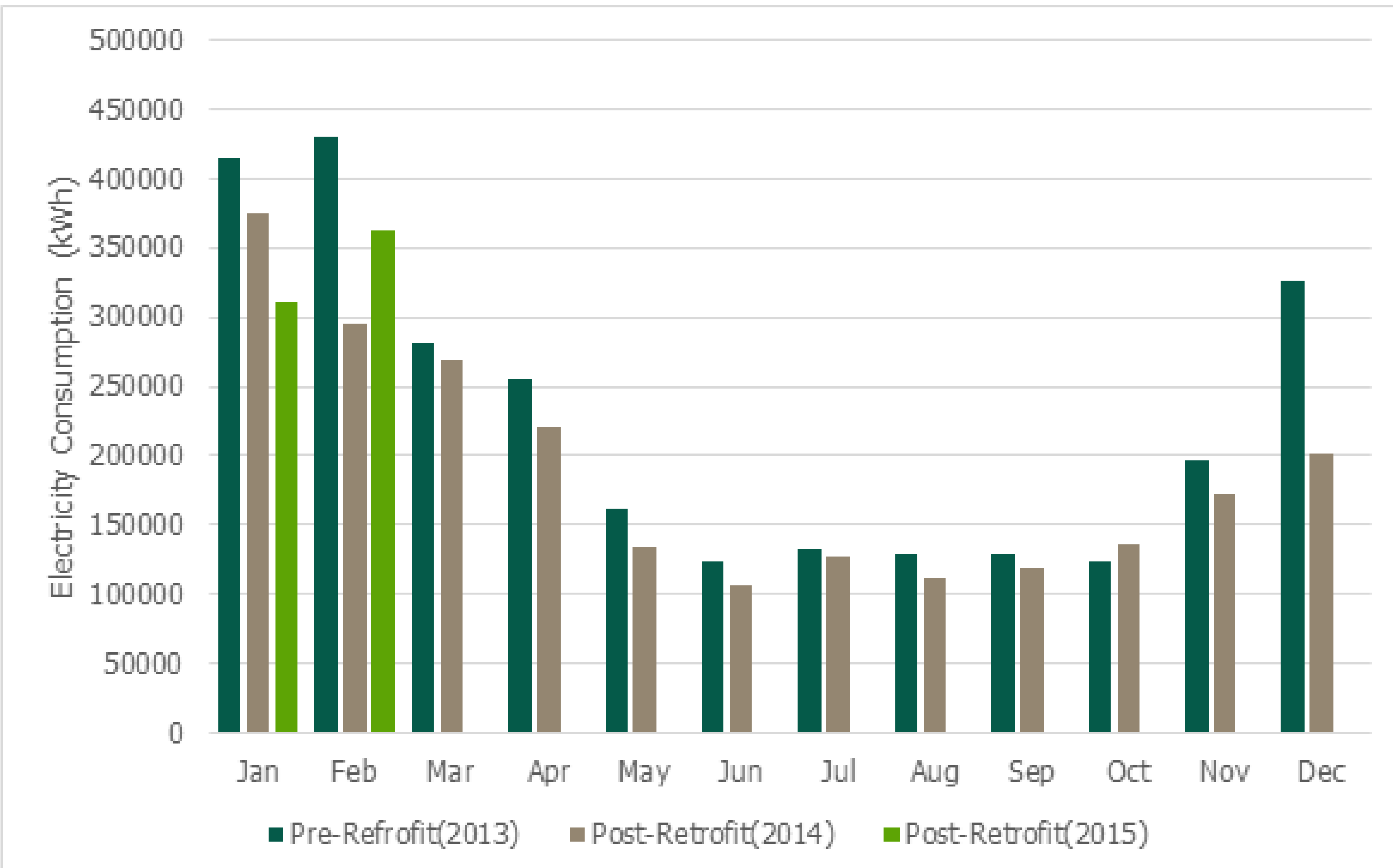
The heating degree-day data for each buildings billing periods were very different from the natural monthly data and to each other; using natural monthly data instead of the billing periods data might lead to inaccurate results. Thus in the following analysis HDD data corresponding to the billing periods were used instead. Similar procedures for the cooling degree day were also performed.

HEATING ENERGY MANAGEMENT SYSTEM PILOT PROJECT

PRE-RETROFIT AND POST-RETROFIT ENERGY CONSUMPTION

Figure 5 shows that the electricity consumption at 280 Rochester has been significantly reduced during the heating season following the building being retrofitted with the heating management system, even though during the post-retrofit period the ambient winter outdoor temperatures were colder; the raw utility data for 280 Rochester is shown in Figure 7 below.

Figure 5 280 Rochester Electricity Consumption Comparison



The buildings at 1390 and 1400 Lepage share one meter preventing us from using billing data for this analysis. Therefore, sub meters were installed on each building's heating circuits after the heating management system installation to directly compare each buildings' performance, since these two buildings are identical (Layout, construction, location, tenancy). Raw sub-meter data is shown in Figure 6 and no sub-meter data is available before the installation. As shown in Figure 8, 1390 Lepage has consistently lower heating electricity consumption than 1400 Lepage.

PRE-RETROFIT AND POST-RETROFIT ENERGY CONSUMPTION

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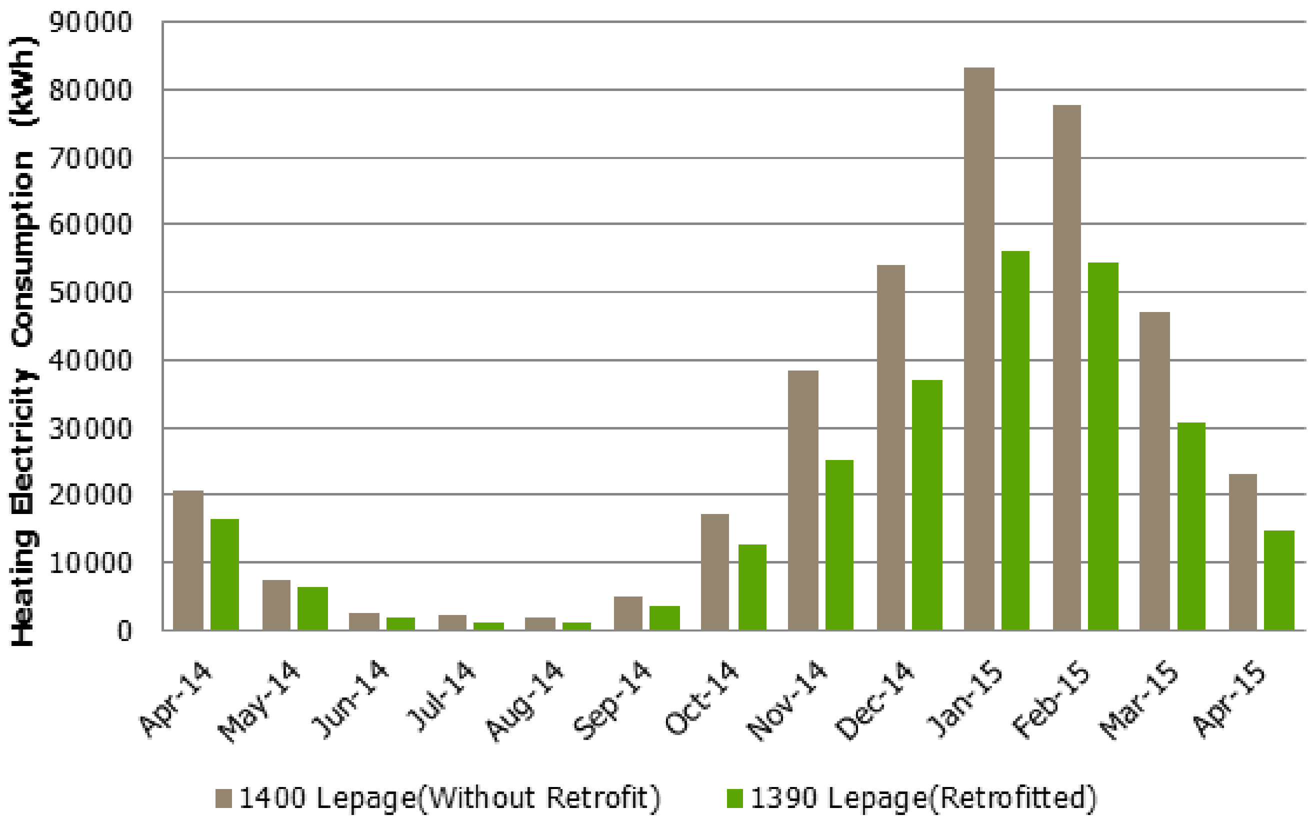
Figure 6 : 1390 & 1400 Lepage sub metered Heating Electricity Consumption/



HEATING ENERGY DEGREE DAY DEMAND ANALYSIS

The raw utility data from the previous section does not account for annual weather variations which can cause bias in the comparison. A heating degree day (HDD) sensitivity analysis was carried out to normalize the effect of climate variations and calculate the savings.

Heating energy consumption needed to be filtered from the total electricity consumption first. The heating energy consumption could be estimated by subtracting the average base load during the heating seasons.

Figure 7 shows the calculation for the 280 Rochester building based on monthly heating and cooling degree day data. The consumption data used here was after the major renovation during 2010 to 2011, in order to eliminate energy consumption bias caused by this project. Negative degree day values indicate cooling requirements and positive degree day values represent heating requirements. The average of the y intercepts of both trend lines represented an average monthly base electricity load for the building, and the base load was assumed to be constant before and after the heating management system installation and for each month. The average base load was calculated to be 110,000 kWh per billing month for 280 Rochester.

Figure 8 shows the heating electricity consumption vs. heating degree days for the building at 280 Rochester before and after the heating management system installation. The heating electricity consumption was obtained by subtracting the monthly base load from the total electricity usage. The slopes of the trend lines indicate the electricity consumption rate (in kWh/HDD) to satisfy the heating demands. A higher slope indicates that the building requires more energy to satisfy the tenant's heating requirements under colder conditions. Figure 8 clearly shows that after the energy management system installation, it requires less electricity to meet the heating requirements, with almost all the consumption points lower than the points before the installation. The difference between the two slopes gives the reduction in heating consumption rate which is 31.8%.

Besides electrical heating in the tenant units, the common area is also heated by gas. Gas consumption vs. heating degree days was also investigated to see if the reduction in electrical heating consumption was made up by extra gas consumption. Figure 9 shows that there is no significant difference between pre- and post- natural gas consumption. This suggests that gas consumption was not affected by the heating management system retrofit and the savings from the electrical heating system is not compensated for by extra gas consumption to heat make-up air supplied to the building common areas, including the corridors.

To better visualize the change in heating electricity consumption due to the installation of the heating management system, a cumulative sum (cusum) chart of the difference between actual and predicted electricity consumption was created (Figure 11). The predicted electricity consumption was calculated using the heating line equation created in Figure 6. A change in the trend of the cusum means a change in the consumption behavior, and it was clear that after the heating management system installation a change point was created – actual heating electricity consumption was consistently lower than the predicted electricity consumption. This result could also be examined in Figure 10, a direct comparison between the actual and predicted heating electricity consumption. This verified that the new heating management system was very likely to have caused the reduced heating electricity consumption.

Figure 7 : 280 Rochester Base Load Calculation metered

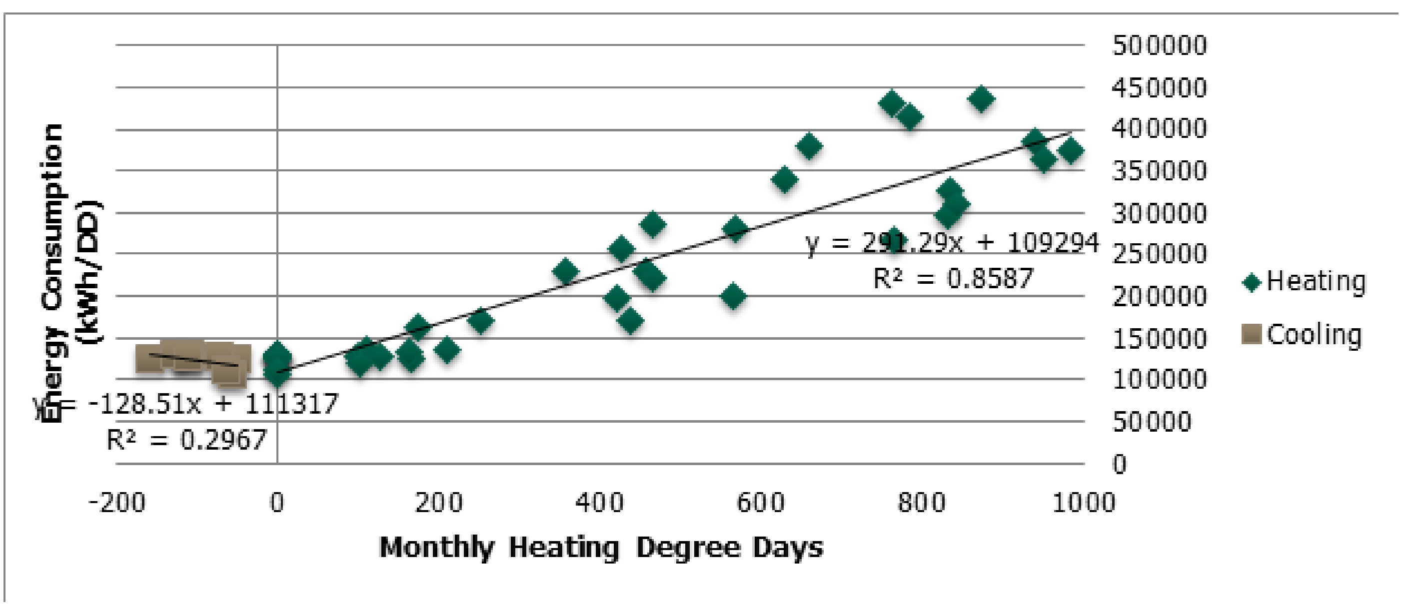


Figure 8 280 Rochester Heating Electricity Consumption

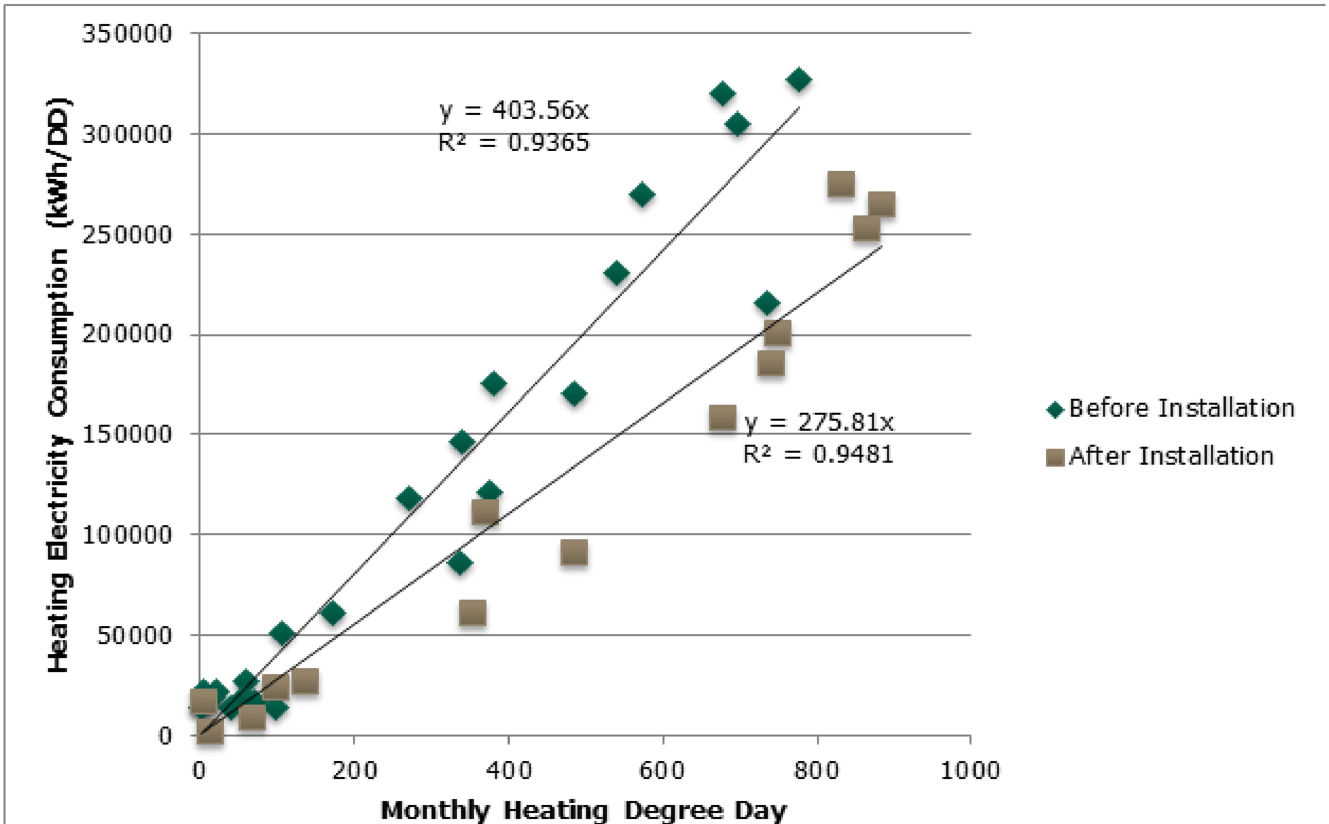


Figure 9 : 280 Rochester Gas Consumption

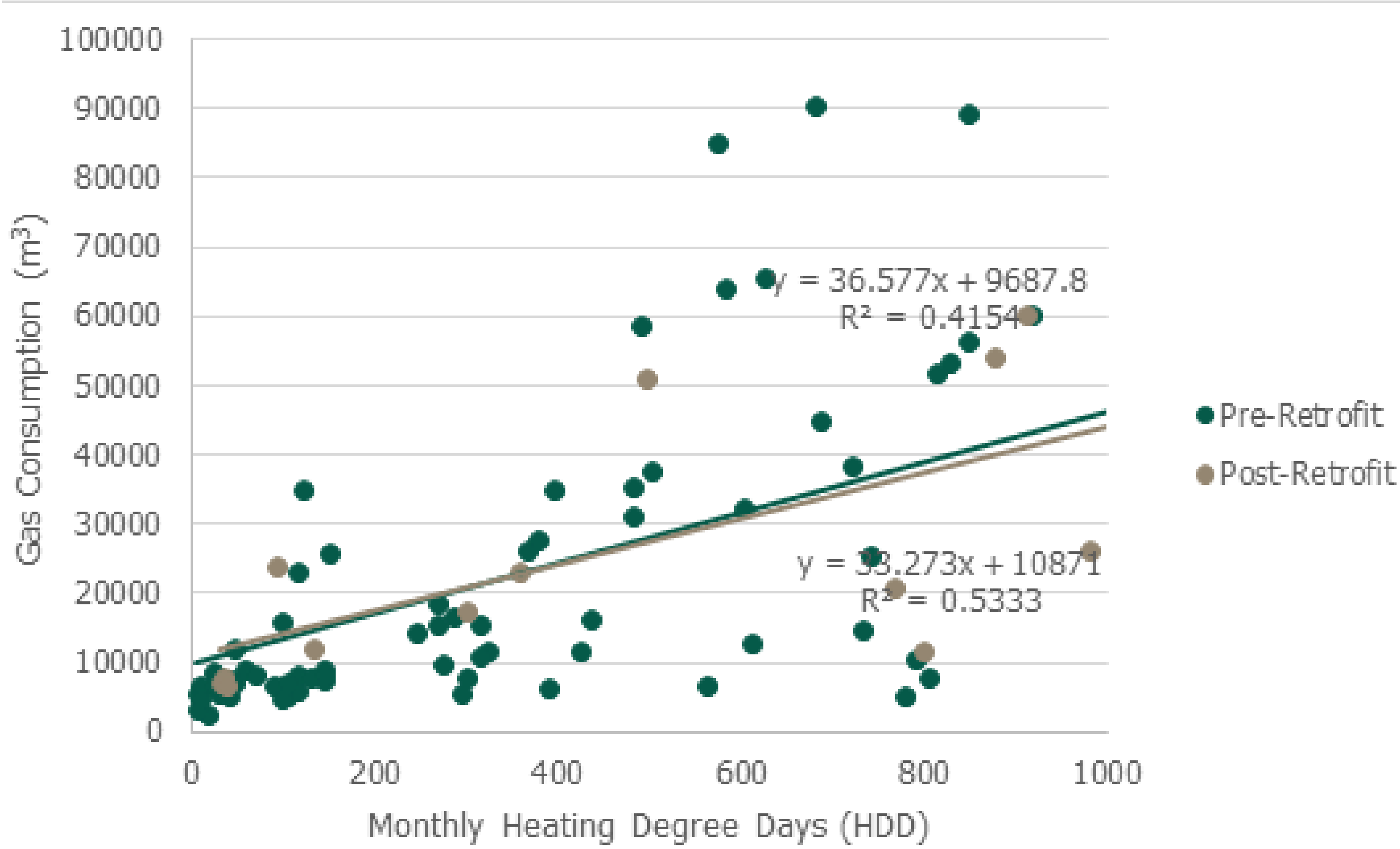


Figure 10 Rochester Predicted and Actual Heating Electricity Consumption

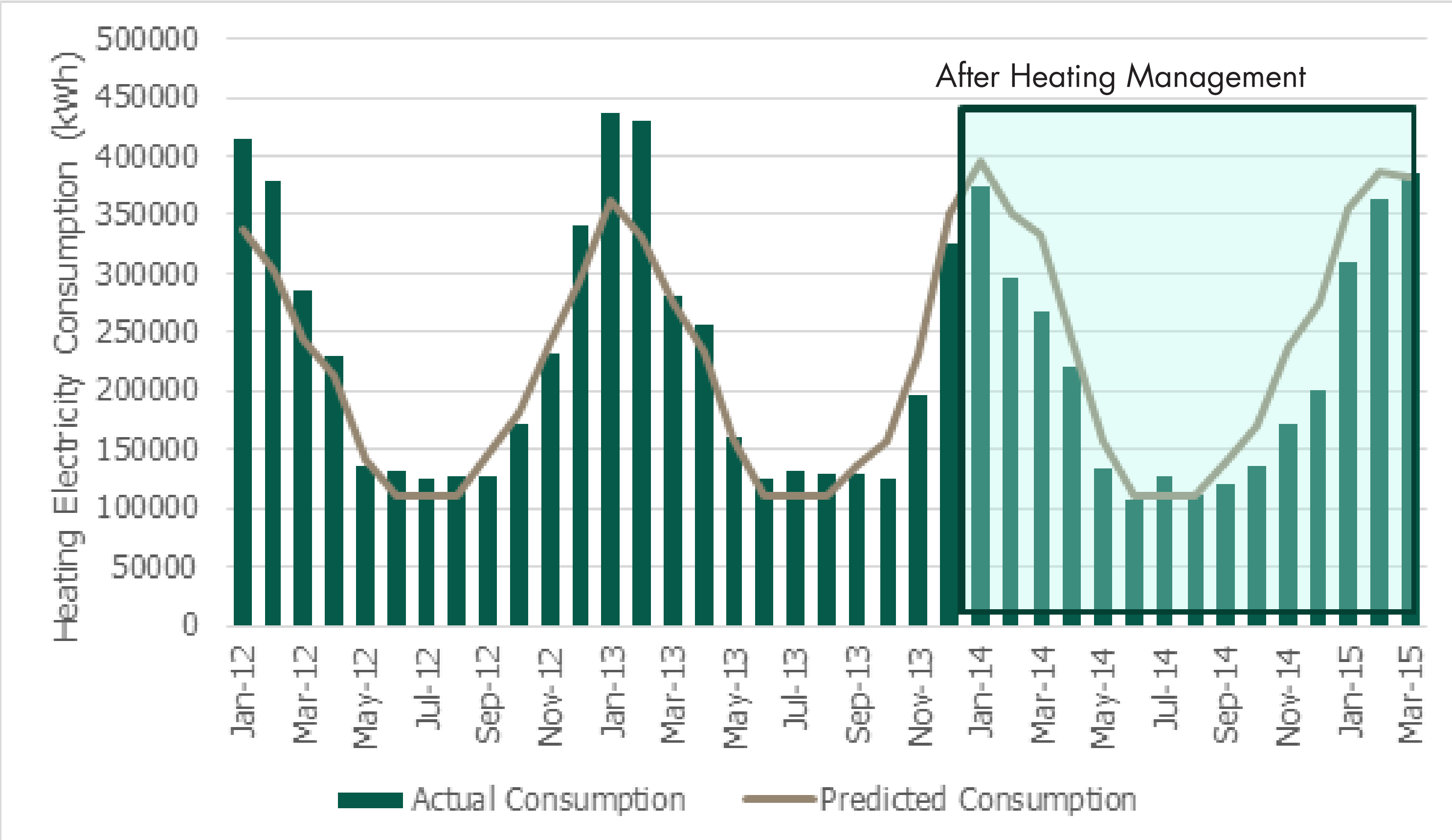
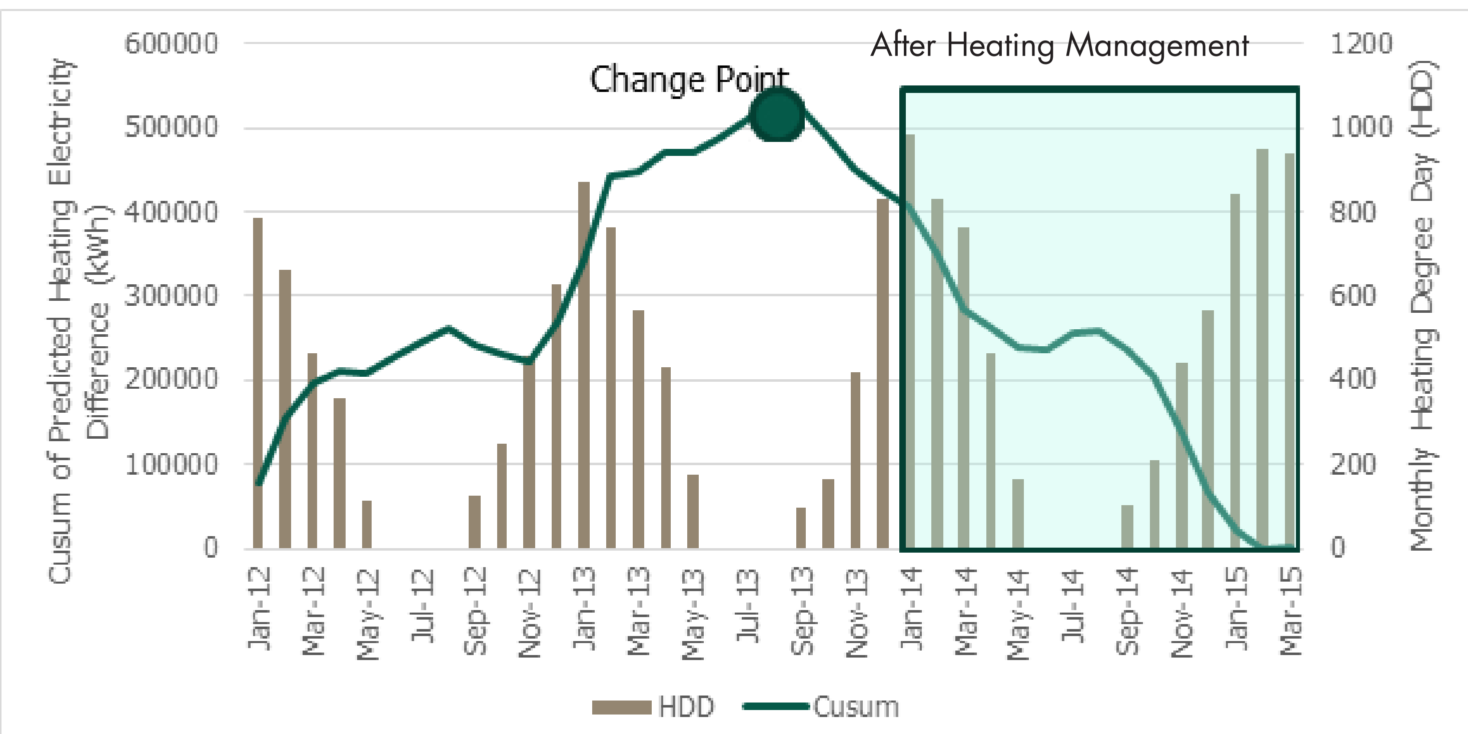


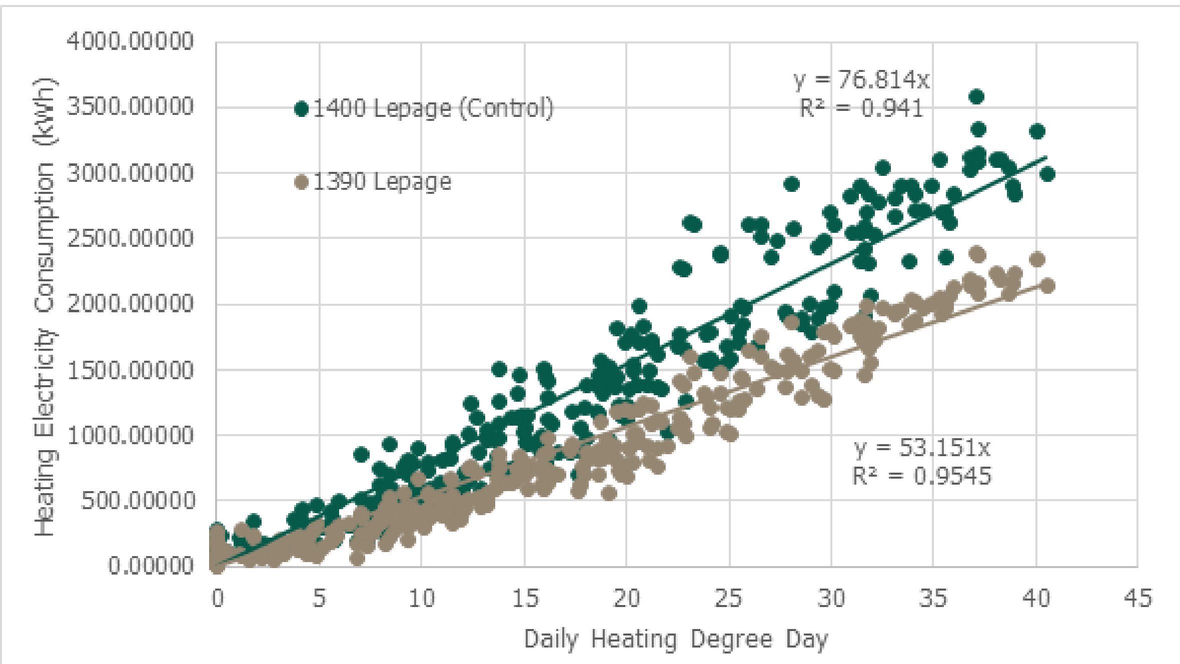
Figure 11 : 280 Rochester Cumulative Sum of Predicted Heating Electricity Consumption Difference



The comparison of the daily heating electricity consumption of the 1390 and 1400 Lepage buildings is shown in Figure 12. The data points were measured with daily resolution from April 1st 2014 to April 30th 2015. Compared with 1400 Lepage building, 1390 Lepage uses much less electricity to satisfy the heating demand, with a decreased electricity consumption rate of 30.2% per heating degree day. Since 1390 and 1400 Lepage buildings are essentially identical with the same vacancy rate, the results suggest that with the installed new heating management system, the building at 1390 Lepage uses less heating electricity than the control building (1400 Lepage). Total heating electricity consumption over this period is also compared in Figure 13.

Gas consumption of 1390 Lepage was also investigated. As shown in Figure 14, the gas consumption did not significantly change before and after the new heating management system installation, and the reduction in heating electricity consumption is not compensated for by extra common area heating supply

Figure 12 : 1390 & 1400 Lepage Heating Electricity Consumption Comparison after Installation



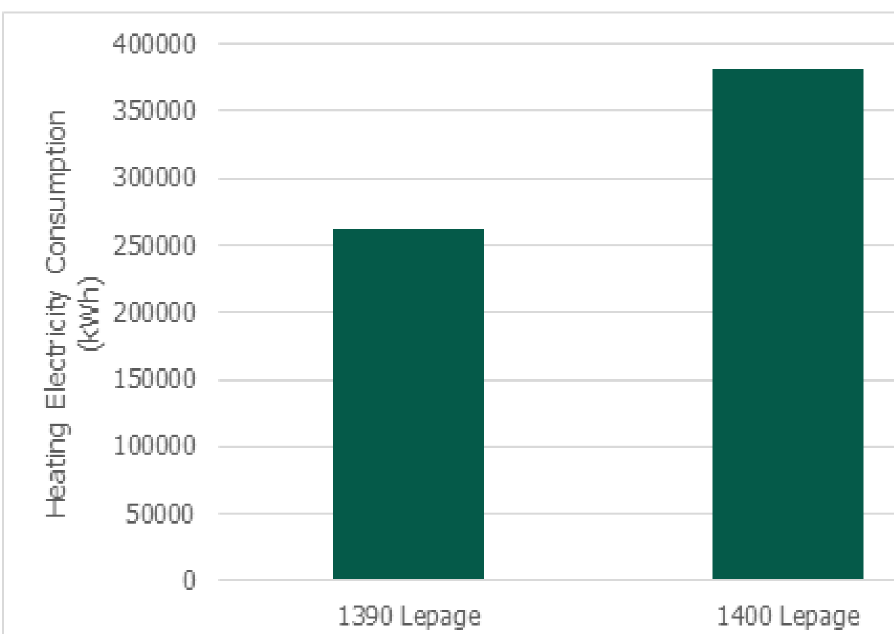
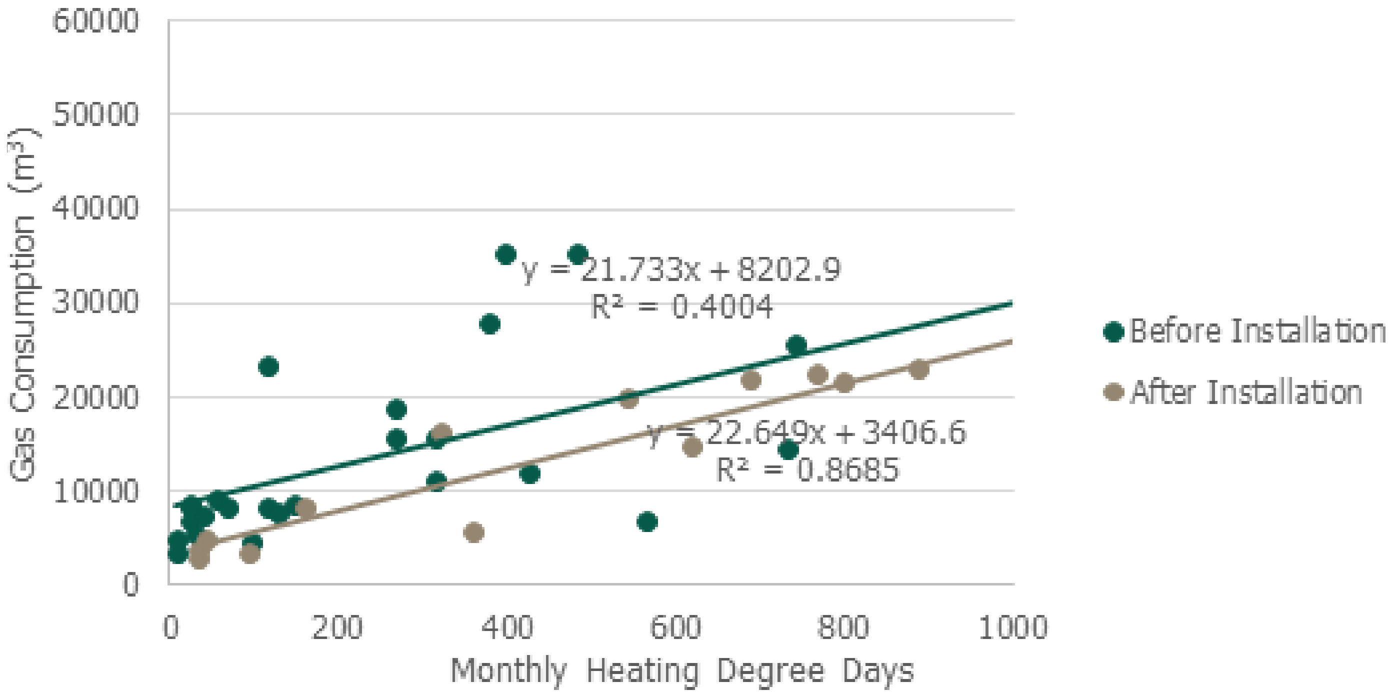


Figure 13 : Total Heating Electricity Consumption from April 2014 to April 2015

Figure 14 : 1390 Lepage Gas Consumption



ECONOMIC ANALYSIS

Based on the heating energy consumption analysis performed above, a simple economic pay back analysis was performed. As shown in Table 3, 280 Rochester achieved a significant economic benefit with only 2.15 years of simple pay back. For the 1390 Lepage building, a simple pay back of 5.67 years was achieved.

Overall the new heating management system achieved very promising economic savings. Table 3 outlines some of the details of the projects economic feasibility. The annual reduction of the heating electricity consumption is estimated using average annual heating degree days and the improvements of the electrical heating efficiency.

Table 3: Simple Pay Back Analysis

	280 Rochester	1390 Lepage
Annual Average Heating Degree Days (2000-2014)	4,380.00	4,380.00
Electric Heating Efficiency Before Retrofit (kWh/HDD)	403.56	76.81
Electric Heating Efficiency After Retrofit (kWh/HDD)	275.81	53.15
Improvement in Electrical Heating Efficiency (%)	31.8	30.23
Heating Electricity Energy Reduction (kWh/year)	547,219.68	101,136.83
Annual Heating Electricity Cost Reduction ($) *	71,138.56	13,147.79
Installation Cost ($)	152,937.73	74,580.00
Simple Pay Back (Years)	2.15	5.67
*** Electricity cost is $0.13/kWh based on past rates**		

TENANT SURVEY RESULTS

Overall, the reduction in electricity consumption and cost associated with the pilot installation of the heating management system is promising, but it is important that tenant comfort is not compromised. In order to investigate the tenants' thermal comfort and obtain first-hand feedback from the tenants, a face-to-face thermal comfort survey (see Appendix B) was conducted at 280 Rochester, 1390 Lepage and 1400 Lepage. Since no heating energy management system was installed at 1400 Lepage, and this building is identical to 1390 Lepage, it is considered to be the control building for 1390 Lepage. The survey was conducted between December 2014 and February 2015, approximately one year after the heating management system was installed. Several tenants were not aware of the new system and were informed about it during the survey. To keep the anonymous nature of the survey, unit information and tenant names were kept optional. A total number of 168 responses were collected, 75 from 280 Rochester, 54 from 1390 Lepage and 39 from 1400 Lepage. This represented about 30% of the total tenants in those buildings. Since the survey was conducted face to face, much valuable feedback from the tenants was also obtained in the comment section during the process.

THERMAL COMFORT ANALYSIS

Question 1 and 3 are most relevant to the tenants' perception of thermal comfort and its change. The first question in the survey inquired about the overall thermal comfort during the heating seasons, and the responses are shown in Figure 15. All three buildings have very similar thermal comfort responses, with very little percentages of tenants reported either very cold or very warm thermal conditions during the heating seasons.

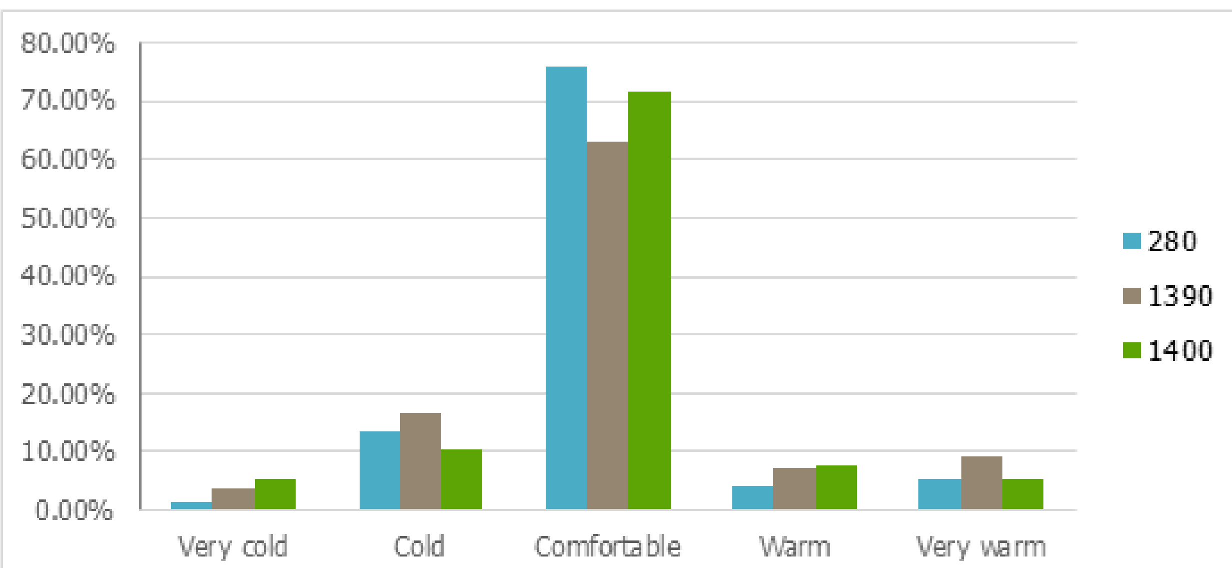


Figure 15 Overall Thermal Comfort

Question 3 investigates the change in thermal comfort after the new heating management system was installed and the results are shown in Figure 16. In the control building (1400 Lepage), 10% more tenants reported "no difference" in thermal comfort than its twin building (1390 Lepage), and both buildings with new heating management systems (1390 Lepage and 280 Rochester) have almost the same percentage of tenants reported no change in thermal comfort. Also percentages of decreased thermal comfort and increased thermal comfort in two retrofitted buildings are almost identical. Overall the change in thermal comfort caused by the new heating management system is very small; the responses of change in thermal comfort were very close between the retrofitted buildings and the control building. To further investigate responses with less comfortable thermal conditions, thermal comfort responses from question 1 and change in thermal comfort from question 3 were compared against each other as shown in Figure 15.

In Figure 17 it is clear that compared with the control (1400 Lepage), 1390 Lepage has smaller percentage of "less comfortable" tenants who responded cold or very cold thermal comfort. However for 280 Rochester, more than half of the tenants who responded cold or very cold thermal comfort have experienced reduced thermal comfort since the new heating management system was installed; this suggests that the new heating management system may have caused decreased thermal comfort in some of the units in this building, although this percentage is very small.

Figure 16 Change in Thermal Comfort

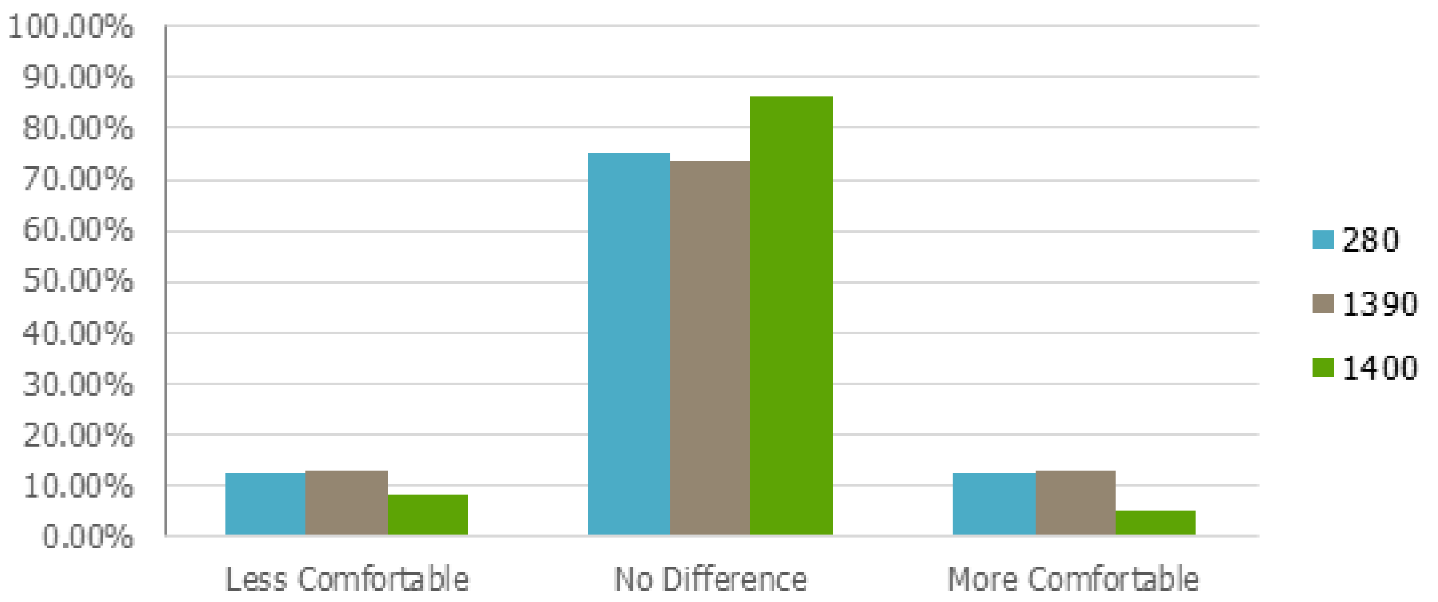
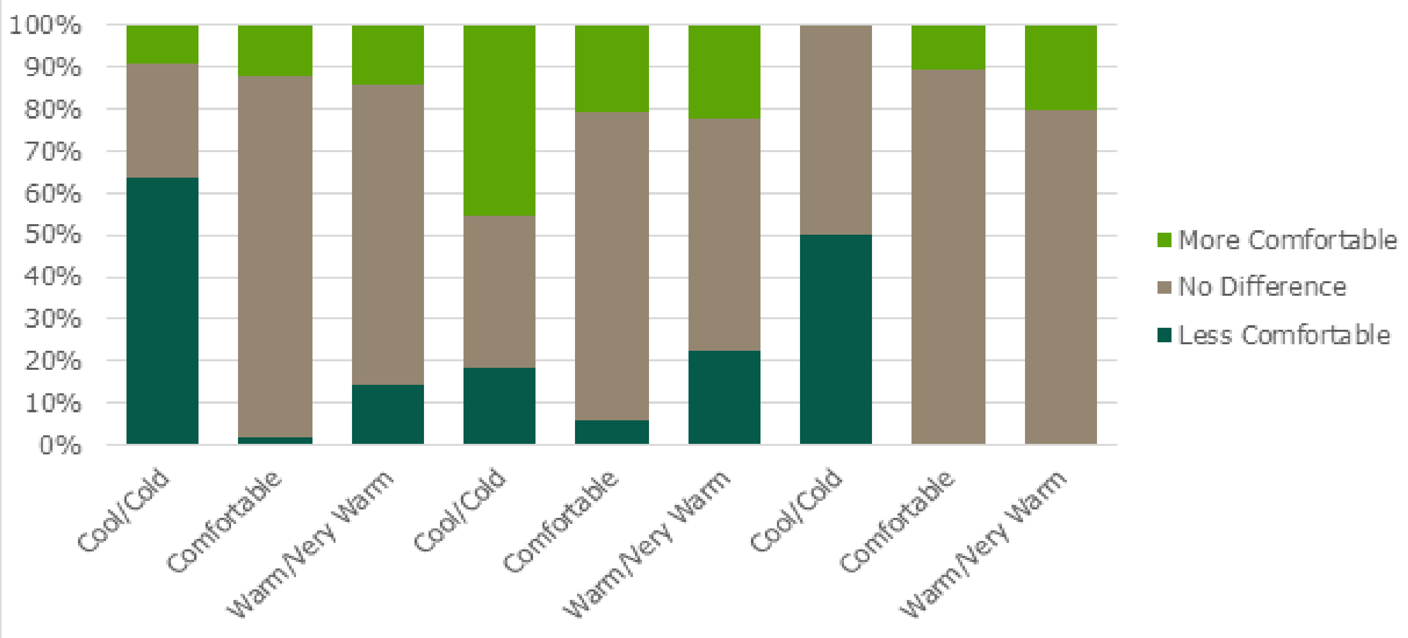


Figure 17: Change in Thermal Comfort and Thermal Comfort Response



TENANTS' HEATING HABIT ANALYSIS

In the previous section (Figure 16), it was observed that the same proportion of tenants reported increased thermal comfort and decreased thermal comfort after the new heating management system was installed. However the new heating management system only limits the maximum rate of heating available to each unit. This suggests that for some tenants, thermal comfort was increased while the amount of heating supplied to the unit was actually decreased.

During the survey conversations, it was discovered that many tenants don't know what a thermostat is or don't understand how to use the thermostat properly. As shown in Figure 18, many tenants reported unrealistic or "I don't know" thermostats settings (that is, set points higher than 26 and 'NA' settings); and many tenants never change their thermostat settings (Figure 19). This had previously caused some overheating issues in some suites since some tenants accidentally set their thermostat very high and never changed it back. Thus by managing the amount of heat supplied to apartment units, some over-heating of the units was prevented and overall thermal comfort was maintained for the majority of tenants and improved for a small portion of tenants.

Figure 18: Tenant Thermostat Set points (°C)

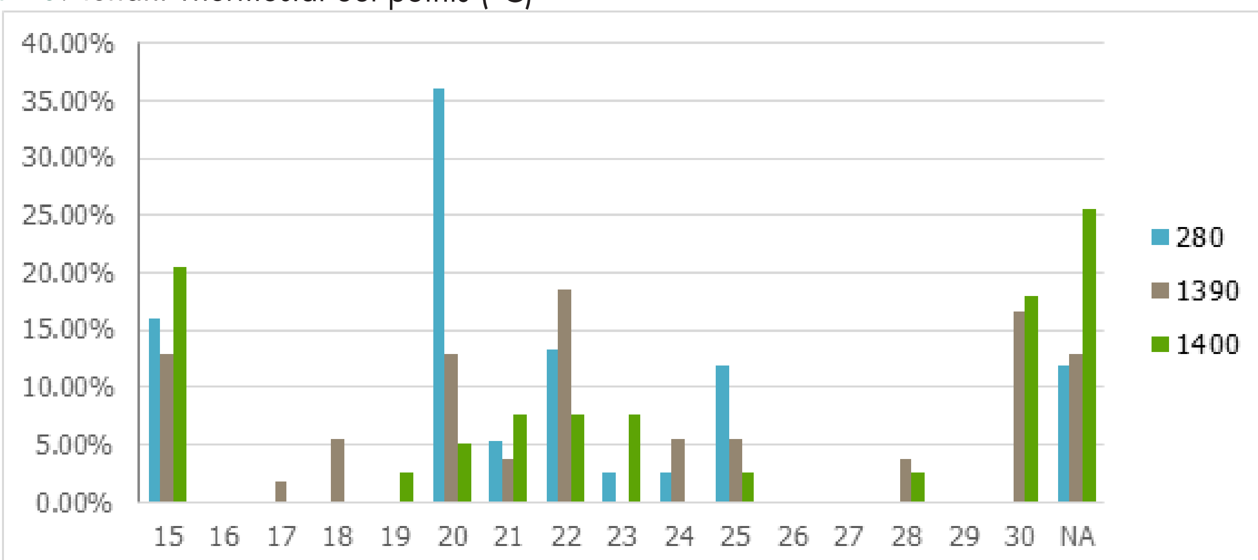
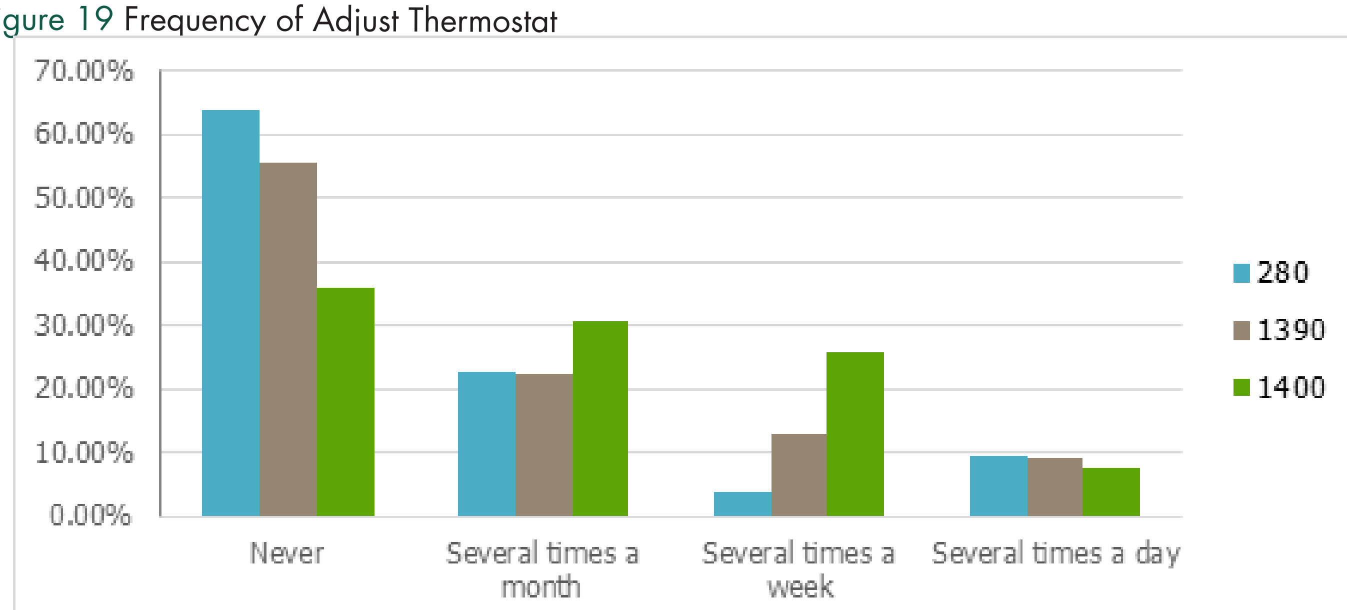


Figure 19 Frequency of Adjust Thermostat



STACK EFFECT AND UNIT ORIENTATIONS

Thermal comfort, as reported by the tenants on different floors and building orientations was also analyzed as the new heating management system is calibrated based on unit orientation and floor height (stack effect). No clear correlation between the thermal comfort and unit orientation has been observed. Also for the low rise building (1390 and 1400 Lepage), stack effect did not affect the overall thermal comfort on different floors. For 280 Rochester, although thermal comfort was consistent across all floors, due to small number of units on each floor and a limited number of responses (IE., only 36% of the tenants provided their unit information), a correlation between thermal comfort and building height could not be assessed . Overall the new heating management system appears to suit various orientations and building height but more research is needed to further investigate its performance on high rise buildings.

CONCLUSION

A new heating management system was installed in two buildings managed by the Ottawa Community Housing (OCH) as part of a pilot project to evaluate opportunities to reduce electric heating energy loads (and costs) in their portfolio of buildings; the buildings are located at 280 Rochester and at 1390 Lepage. Based on the monitoring of the electrical consumption for heating and the ensuing tenant survey, the following conclusions can be reached:

- The comparison of the energy consumption, before and after the installation of the heating management system at the 280 Rochester demonstrated an electrical heating energy savings of up to 32%, with a 2.15 years payback period
- The building located at 1390 Lepage achieved a 30% heating electricity saving when compared with an identical building located at 1400 Lepage resulting in payback period of 5.67 years
- The majority of tenants (70%) in both the 280 Rochester and 1390 Lepage buildings responded that, during the winter season, they found their units thermally comfortable.
- A similar 70% response rate noted that there was no difference in the thermal comfort level in their units after the installation of the heating management system compared with before the installation.
- The tenant survey revealed that the majority of respondents never or rarely adjusted the thermostat; and a small portion of them don't know how to use thermostat properly and had very high set points which caused unwanted over-heating. The new heating management system improved those tenants' thermal comfort as an unexpected effect.

Overall this new heating management system showed promise. Ottawa Community Housing is considering installation of the energy management system in additional buildings to further determine its performance potential and improve opportunities for reducing heating energy demand and reducing electrical heating costs in their portfolio of buildings.

REFERENCE

Gunay, Burak, et al. "On the behavioral effects of residential electricity sub-metering in a heating season." Building and Environment (2014): 396-403.

Ottawa Community Housing
Logement Communautaire d'Ottawa

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Heating System Survey

We would like your feedback on the new heating system that was installed in your building. Please take a few minutes to complete the survey and return it to the box in the lobby.

Please check the box that applies:

1) Generally, my unit is:
☐Much too cold ☐A little cold ☐Perfectly comfortable ☐A little warm ☐Much too warm

2) Since January 2014, have you noticed a difference in the heating system performance?
☐ There is less heat than before
☐ There is more heat than before
☐ There has been no difference
☐ I moved here after January 2014

3) Since January 2014, has there been a change in your level of comfort in your unit
☐ My unit is not as comfortable
☐ My unit is just as comfortable as before
☐ My unit is more comfortable
☐ I moved here after January 2014

4) What temperature is your thermostat set to? ________________

5) How often do you adjust your thermostat?
☐Never ☐A Few times a month ☐A few times a week ☐A few times a day

6) How often do you open your windows or door for fresh air?
☐Never ☐A Few times a month ☐A few times a week ☐A few times a day
☐Constantly Open

7) Do you have an Air Conditioning Unit?
☐Yes ☐No
If yes, do you remove it during the winter?
☐Yes ☐No

8) (Optional) What unit do you live in? ________________

9) Other comments on the heating system:

Thank You!

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APPENDIX B –TABLE OF RECENT ENERGY USAGE

280 ROCHESTER

280 Rochester		
Month	Electricity (kWh)	Gas (m^3)
Jan-13	414,587.52	25,550
Feb-13	430,064.16	14,616
Mar-13	280,908.96	6,805
Apr-13	256,049.76	11,065
May-13	161,584.80	7,857
Jun-13	124,296.00	8,435
Jul-13	131,753.76	5,454
Aug-13	129,267.84	7,438
Sep-13	129,267.84	8,473
Oct-13	124,296.00	15,753
Nov-13	196,387.68	27,795
Dec-13	325,655.52	33,615
After Retrofit		
Jan-14	375,373.92	20,734
Feb-14	295,824.48	11,624
Mar-14	268,479.36	20,953
Apr-14	221,246.88	23,123
May-14	134,239.68	24,148
Jun-14	106,894.56	7,743
Jul-14	126,781.92	7,252
Aug-14	111,866.40v	6,928
Sep-14	119,324.16	12,171
Oct-14	136,725.60	17,517
Nov-14	171,528.48	51,063
Dec-14	201,359.52	53,519
Jan-15	310,740.00	54,246
Feb-15	362,944.32	60,116

APPENDIX B –TABLE OF RECENT ENERGY USAGE

1390 & 1400 LEPAGE

	Electricity (kWh)	**1390 Lepage Gas (m^3)**	**1400 Lepage Gas (M^3)**
Month			
Jan-13	189,493.92	20,949	26,048
Feb-13	223,947.36	22,917	20,912
Mar-13	182,111.04	12,971	17,073
Apr-13	140,274.72	8,045	9,003
May-13	135,352.80	5,459	4,864
Jun-13	137,813.76	4,603	3,524
Jul-13	150,118.56	2,161	1,541
Aug-13	127,969.92	3,076	2,666
Sep-13	118,126.08	3,875	3,051
Oct-13	150,118.56	9,343	9,535
Nov-13	169,806.24	18,682	19,603
Dec-13	270,705.60	28,920	27,852
Jan-14	226,408.32	23,269	17,663
After Retrofit			
Feb-14	219,025.44	22,538	16,742
Mar-14	169,806.24	21,750	17,297
Apr-14	142,735.68	14,739	13,105
May-14	123,048.00	5,799	6,530
Jun-14	132,891.84	3,456	3,303
Jul-14	150,118.56	2,776	1,997
Aug-14	130,430.88	3,683	4,850
Sep-14	118,126.08	4,762	4,683
Oct-14	155,040.48	8,266	5,972
Nov-14	172,267.20	16,144	12,456
Dec-14	211,642.56	19,934	13,733
Jan-15	248,556.96	21,954	11,515
Feb-15	273,166.56	23,198	12,292
Mar-15	118,126.08	22,524	14,286

APPENDIX C – TABLE OF HISTORICAL ENERGY USAGE

1390 & 1400 LEPAGE

	Gas Consumption (M^3)	Electricity Consumption (kWh)
Jan-06	65702	278584.32
Feb-06	5075	300970.56
Mar-06	58874	261172.8
Apr-06	5599	161366.4
May-06	5249	146471.04
Jun-06	5249	161366.4
Jul-06	5599	99302.4
Aug-06	16098	139023.36
Sep-06	9141	143988.48
Oct-06	6309	394727.04
Nov-06	16508	193639.68
Dec-06	12713	265633.92
Jan-07	89380	317767.68
Feb-07	10469	295424.64
Mar-07	85139	240808.32
Apr-07	11589	203569.92
May-07	34897	163848.96
Jun-07	11962	131575.68
Jul-07	2645	134058.24
Aug-07	7061	139023.36
Sep-07	6748	126610.56
Oct-07	7854	183709.44
Nov-07	63989	211017.6
Dec-07	8094	307837.44
Jan-08	90374	240808.32
Feb-08	56409	312802.56
Mar-08	32259	255703.68
Apr-08	14362	198604.8
May-08	26040	151436.16
Jun-08	7711	131575.68

APPENDIX C – TABLE OF HISTORICAL ENERGY USAGE

1390 & 1400 LEPAGE

	Gas Consumption (m^3)	Electricity Consumption (kWh)
Aug-08	7560	139023.36
Sep-08	5856	121645.44
Oct-08	26314	203569.92
Nov-08	37650	183709.44
Dec-08	60407	297907.2
Jan-09		258186.24
Feb-09	53474	752215.68
Mar-09	31135	270599.04
Apr-09	10002	211017.6
May-09	16836	173779.2
Jun-09		131575.68
Jul-09		255703.68
Aug-09		99302.4
Sep-09	7435	121645.44
Oct-09	64810	218465.28
Nov-09		223430.4
Dec-09		389761.92
Jan-10	126260	341103.74
Feb-10		350289.21
Mar-10		21019.51
Apr-10	15585	187185.02
May-10	23310	138526.84
Jun-10	9190	141257.66
Jul-10	3516	131823.93
Aug-10	6785	107494.84
Sep-10	8256	130086.14
Oct-10	91207	210272.83
Nov-10		270350.78
Dec-10		400933.44
Jan-11	97570	408629.37
Feb-11		299644.99
Mar-11	35413	27891.49

APPENDIX C – TABLE OF HISTORICAL ENERGY USAGE

1390 & 1400 LEPAGE

	Gas Consumption (M)	Electricity Consumption (kWh)
Apr-11	35168	203569.92
May-11	8304	168814.08
Jun-11		132072.19
Jul-11	4967	127355.33
Aug-11	8660	113701.25
Sep-11	4685	125865.79
Oct-11	18779	178744.32
Nov-11	11903	243290.88
Dec-11	38644	427000.32
Jan-12	52038	414587.52
Feb-12	45147	379831.68
Mar-12	165300	285494.4
Apr-12		228704.64
May-12		136725.6
Jun-12		131753.76
Jul-12		124296
Aug-12		126781.92
Sep-12		126781.92
Oct-12		171528.48
Nov-12		231190.56
Dec-12		340571.04