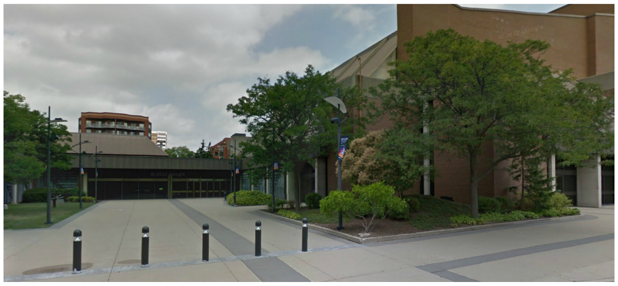

Electricity Survey and Analysis

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Sign-off Sheet

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

Centre in the Square commissioned Stantec Consulting Ltd. (Stantec) to conduct an energy assessment of the buildings located at 101 Queen St. North in Kitchener, Ontario, in order to determine performance and identify conservation opportunities. The purpose of this assessment was to identify and quantify energy conservation opportunities within the facility. To that end, Stantec conducted a walk-through energy assessment of the building on August 22, 2013. The walk-through assessment did not include a code or standards and regulation review of building equipment and processes.

The following list summarizes potential energy conservation measures that were identified for the building. Further analysis is required to more accurately determine the potential savings and costs of these measures. It is recommended that The Centre in the Square move forward to review and incorporate these measures into the existing site energy and environmental management strategy.

Energy Conservation Measures

- ECM-1: Replace Variable Air Volume Boxes in the Building
- ECM-2: Upgrade BAS
    - Fresh Air Control Through Carbon Dioxide Monitoring
    - Free Cooling
    - Fan VSD Control
    - Stop/Start Optimization
    - Zone Temperature Control
    - Pump VSD Control
    - RTU Control
- ECM-3: Upgrade DHW Boiler and Storage Tank
- ECM-4: Install Variable Speed Drives on Fan Systems
- ECM-5: Install Variable Speed Drives on Pump Systems
- ECM-6: Upgrade Rooftop Units
- ECM-7: Retrofit Lighting Controls
- ECM-8: Upgrade Interior Lighting
    - Install Occupancy Sensors in Basement
    - Replace Incandescent Lamps

- ECM-9: Upgrade Exterior Lighting to Photocell Control
- ECM-10: Retrofit Art Gallery Humidification
- ECM-11: Complete a Roof Cut Test to Evaluate the R-Value of the Original Roof
- ECM-12: Incorporate Window Tinting on the South Wall
- ECM-13: Recover Heat From Refrigeration Equipment

The opportunity costs, savings and potential incentives are summarized in the table below:

Centre in the Square - Energy Management Opportunity Summary

		Savings						
ECM #	**Description**	**kWh**	**m3**	**$**	**Cost-$**	**Incentive - $**	**Simple Payback w/ Incentive**	**Comment**
1	Replace VAV Boxes	3,417	4,957	$2,200	$18,200	$342	8.1	
2	Upgrade BAS	25,148	36,490	$16,190	$139,650	$2,515	8.5	
3	Replace DHW Boiler		3,104	$1,115	$10,000	$0	9.0	
4	Install VSDs on Fan Motors	20,714		$2,539	$11,675	$2,071	3.8	
5	Install VSDs on Pump Motors	62,952		$7,717	$15,325	$6,295	1.2	
6	Upgrade Rooftop Units			$0		$0	0.0	More Analysis Needed
7	Retrofit Lighting Controls			$0		$0	0.0	More Analysis Needed
8	Upgrade Interior Lighting	7,450		$913	$1,665	$745	1.0	
9	Upgrade Exterior Lighting Control			$0		$0	0.0	More Analysis Needed
10	Retrofit Art Gallery Humidification			$0		$0	0.0	More Analysis Needed
11	Roof Cut Test			$0		$0	0.0	More Analysis Needed
12	Window Tinting South Wall			$0		$0	0.0	More Analysis Needed
13	Recover Heat from Refrig Equip.			$0		$0	0.0	More Analysis Needed
	Total	***119,682***	***44,551***	***$30,673***	***$196,515***	***$11,968***	***6.0***	

Average Electricity Cost	$0.12	per kWh
Average Natural Gas Cost	$0.36	per m3

Electricty Savings Incentive	$0.10	per kWh

1.0 Introduction

Stantec Consulting Ltd. (Stantec) was retained by Centre in the Square Inc. to conduct a walk-through energy audit on 101 Queen St. North in Kitchener, ON. To complete the audit, Stantec used the Procedures for Commercial Building Energy Audits published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) as a guideline, and modified the contents to suit the Ontario Power Authorities requirements for an electricity survey and analysis audit.

The walk-through energy assessment consisted of an analysis of two (2) years of the facility's utility consumption history, a description of the building envelope, a summary of all major mechanical and lighting systems, and identification of Energy Conservation Measures (ECMs) related to the lighting systems and Heating Ventilation and Air Conditioning (HVAC). The utility analysis identifies notable trends and irregularities in monthly energy use, and relates consumption to climate using Heating Degree Days (HDD) and Cooling Degree Days (CDD). The result is the development of energy and cost indices, which are then compared with the Office of Energy Efficiency (OEE) benchmarks, to assess the facility's performance against similar buildings.

There were no previous energy assessments conducted at this site.

2.0 Building Description and Condition

2.1 OVERVIEW

The property at 101 Queen St. North in Kitchener, Ontario consists of a theatrical performance theatre that includes one tenant, an art gallery located in the west section of the building. The entire gross floor area is approximately 14,872 m^2 (160,000 ft^2). The building is comprised of a large theatre with an occupancy rating of 2047 people, several offices, storage and meeting rooms and an art gallery.

The building located at 101 Queen Street was reportedly constructed in 1979 and officially opened in 1980. A two storey addition was added in 2000 along the north elevation to house the majority of the administration offices. Mechanical equipment is located in designated mechanical rooms in the lower level of the main building and on the rooftop.

An employee parking area is located at the east end of the property. There is no parking provided for theatre patrons onsite.

2.2 RECENT UPGRADES/CHANGES

The original building has received some major upgrades/replacements to its HVAC equipment within the last five years. A Multi-Stack chiller was installed to replace the original chiller system in 2005. The new unit can supply 260 Tons of cooling at full load. The Multi-Stack chiller was reported to provide a reasonable reduction in cooling costs as the system could be run at reduced loads. During the site assessment, there was 17% load on the compressors with a limited cooling demand in the building.

The cooling tower that operates in conjunction with the chiller is located on the art gallery rooftop and was also replaced in 2005. The current tower was manufactured by Baltimore Aircoil Company and has model number VLT-290D.

Also located on the art gallery roof is a rooftop multi-zone air handling unit manufactured by Fisen. The multi-zone unit was installed in 2005 and supplies the art gallery. The multi-zone unit is visible on the building automation system. Four condensers are located on the rooftop that were installed in 2006 and supply cooling to the associated Liebert units located within the art gallery. The split units were manufacture by Liebert and operate on a standalone system, however, are visible on the building automation system.

The boiler system was renovated in 2012, which included replacement of the original boilers with two condensing style boilers manufactured by Harsco Industrial Patterson-Kelley and replacement of all hot water circulation pumps associated with the system. The boilers have a separate control system that is not visible on the building automation system.

Two packaged rooftop units supply the atrium lobby and studio. The equipment was manufactured by Carrier and installed in 2010 and 2008 respectively. Both units are visible on the building automation system, however, can only be monitored, not controlled.

A large walk-in fridge was installed in the basement utility room in 2009. The fridge provides cooling for theatre patron beverages. The ice machines are located in the same room.

Upgrades to common area interior lighting (excluding theatre lighting) has been completed in several areas within the building. Common areas that use T8 linear fluorescent fixtures are replaced with LED fixtures as they fail. Some of the dressing rooms and hallways are equipped with LED fixtures as well. The lobby area has motion sensors for lighting control.

2.3 OCCUPANCY

The building office and maintenance personnel generally work from 8AM to 5PM, Monday to Friday with the exception of show nights. The building occupancy level fluctuates depending on the production schedule. Regular office personnel include approximately 20 people while the building can be occupied by as many as 2047 during show times.

Typical show schedules are 7:30PM start times during the weekdays, weekend matinées and evening productions and children shows at 1PM, 4PM and 7PM during scheduled weeks. In the months of July and August, there is typically only a single production.

2.4 BUILDING ENVELOPE

The theatre is a four storey construction that is mainly clad with a brick veneer with the exception of a large portion of prefabricated metal panels located on the east elevation. The brick veneer was observed to have been recently repaired and resealed in areas where the mortar was cracking. It was reported that the metal panels on the east elevation do not provide an additional function and are often covered with a banner publicizing the upcoming presentation. The fascia provided around the perimeter of the building is a combination of prefabricated metal panels and concrete panels. All windows are insulated glass units (IGU) that date to the construction of the building in 1979. Select windows have been replaced in the building as they fail or are damaged. The majority of windows are located at the main entrance and in the art gallery. The main theatre building is not equipped with many windows. The main entrance doors are metal with IGU viewing panels.

The roof on the theatre is a combination of a modified bitumen type consisting of two plies of factory fabricated synthetically reinforced membrane sheets and a typical built-up roof (BUR) assembly. The BUR roof primarily covers the administration addition and the studio area located behind the main theatre. The remainder of the roof is the two ply modified bitumen roof assembly that was reportedly replaced on a phased basis beginning approximately 8 years ago. A small portion of the roof assembly on the north side of the theatre is also comprised of prefabricated metal panels that are original to the construction of the building. It was reported that these panels are anticipated to be replaced within the next five years. It was unclear the extent of insulation applied between the metal panels and the interior of the building.

2.5 MECHANICAL SYSTEMS

2.5.1 Controls

The main building is equipped with a building automation system (BAS) that was initially installed in the mid-1990s. The system is comprised of Honeywell control devices and has not received any significant upgrades since initial installation. The system controls or monitors the following equipment,

- Rooftop Unit 1 – Administration, Engineered Air (Setpoint)
- Rooftop Unit 2 – North Lobby (Atrium Lobby), Carrier (Setpoint)
- Rooftop Unit 3 – Box Office, Engineered Air (Setpoint)
- Gallery Multizone Unit – Gallery, Fisen (Setpoint)
- Exterior lighting (schedule)
- Main & Eastman Gallery - Liebert Fans (F6, F7, F8, F9) (monitoring only)
- Lower Gallery – Carrier (monitoring only)
- Studio Room – Studio, Carrier (monitoring only)
- Auditorium, mezzanine, balcony, orchestra and main floor temperatures
- Air Handler F1 – Theatre supply and return (setpoint)
- Air Handler F2 – Stage supply and return (setpoint)
- Air Handler F3 – Lobby/Administration (setpoint)
- Chiller Control – Chiller supply and return temperature, cooling tower fan load (setpoint)

The BAS uses pneumatic devices to control and provide signals back to the operating system. The majority of pneumatic devices are original to the building, however, are replaced as they fail. Dampers on air handling equipment and valves on the heating and cooling loops are all actuated by pneumatic devices.

The boilers are equipped with their own standalone control system that can only be monitored at the equipment. Forced flow ventilators are located in vestibules and isolated areas in the building. These terminal units are controlled locally by thermostats mounted in the vicinity of the equipment. Equipment that is only monitored by the BAS is typically equipped with standalone thermostats located in the affected area. For instance, the lower gallery Carrier unit is provided with an original thermostat located in the meeting room.

2.5.2 Heating

Building heating is provided by a combination of systems. The theatre, stage and lobby/administration area is supplied with tempered air from the air handling units that utilize boiler heating water in their heating coils. The heating coils were recently replaced in F3. Perimeter and terminal heating is provided in the gallery and vestibules with hydronic baseboard heaters and forced flow unit heaters that utilize boiler heating water. The remainder of the building (i.e. atrium lobby, administration and studio) is supplied with heating from packaged RTUs. The RTUs are supplied with natural gas for combustion.

2.5.3 Cooling

The majority of the building is cooled using the chilled water loop supplied by the Multi-Stack chiller. The chilled water loop feeds the coils located in the three main air handling units, F1, F2 and F3. It was reported that the cooling coils have been replaced in F1 and F2. The remaining isolated areas; box office, art gallery, atrium lobby, administration building and studio, are equipped with rooftop units that supply cooling.

It was reported that free cooling is occasionally utilized; however, it depends on the heating load generated in the building during a performance.

2.5.4 Ventilation

The theatre building is equipped with three main central air handling units (AHUs) identified as F-1, F-2 and F-3. These AHUs are original to the construction of the building and were manufactured by Canadian Blower. F-1 feeds the theatre and currently has a high, low and off setpoint. F-2 feeds the back stage and also operates on High or Low and F-3 feeds the lobby and administration areas but operates with the use of a VFD. The theatre has supply air venting in from the ceiling and the return located at the base of the theatre. It was reported that there is reasonable stratification of temperature in the theatre that varies by 2-4 °C.

The duct work is fitted with variable air volume boxes that are controlled pneumatically. It was reported that 60% of these are no longer functional, therefore, are left fully open.

The building is also equipped with exhaust fan for the washrooms, carpentry room and spot lights. The majority of exhaust fans for the washrooms are controlled by a local switch. Other area exhaust fans maybe controlled by a thermostat (i.e. spot light).

2.6 ILLUMINATION SYSTEMS

The majority of lighting at use in the common areas is T8 linear fluorescent lamps and compact fluorescent (CFL) recessed fixtures. Some areas such as dressing rooms and hallways have been fitted with linear and spot light LED fixtures. Areas in the lobby's outside the theatre exits still operate with the original incandescent lamps. The lamps consume 25W each and the fixtures require 9 lamps each. There are approximately 40 fixtures in the building that are typically on only during performances. The Box Office Lobby uses CFL lamps that are reportedly on constantly. The CFL lamps in use in the building were rated for 25W.

The Art Galley was observed to use LED fixtures in the front entrance/lobby area, incandescent spot lights in the gallery and recessed incandescent fixtures in the office area. The incandescent lamps were observed to be rated for 90W at 130V.

Exterior lighting is comprised of metal halide, 400W pole mounted fixtures located around the perimeter of the property. These fixtures are identified as “sail lighting” due to their unique design. Bollard high pressure sodium fixtures are located at main entrances and are reported to use 100W lamps. Three spot lights were observed outside the building to illuminate the building itself, however, these were reportedly no longer in use. Several wall mounted, high pressure sodium fixtures are located facing the employee parking area and emergency exits. The main entrance to the theatre is equipped with recessed CFL fixtures located in the soffit. The majority of exterior lighting is operated by a timer.

2.6.1 Lighting Operation System

The majority of theatre lighting is controlled manually. Common areas such as lobby’s, washrooms and hallways are controlled with occupancy sensors. The basement level hallway and area lighting is only controlled manually. This space is typically only occupied by theatre staff.

2.7 ANCILLARY SYSTEMS

The theatre lighting systems are maintained by a separate group that focuses only on production systems such as lighting and sound. The theatrical lighting is maintained and replaced as budget permits. The sound system was reportedly upgraded in 2003 to a digital system.

Two ice machines and a walk-in refrigeration system are located in the basement. The refrigerator was installed in 2009 and is utilized only for beverage and food storage during productions.

2.8 PLUG LOAD

The majority of workstations in the office space include a desktop computer. These computers remain on unless their user powers them down at the end of the day. An energy management program is in place to encourage users to shut-down computers when they have left for the day.

3.0 Utility Analysis and Benchmarking

The following sections detail the energy analysis that was performed on the facility located at 101 Queen Street North, and includes a utility analysis, a comparison to a benchmark, and a breakdown by energy fuel type.

Energy consumption at 101 Queen Street North is controlled and affected by daily administrative operations of the facility as well as rehearsals and performances. Performances draw many visitors, increasing lighting and HVAC requirements above daily levels. Lighting throughout the facility and all other plug load also impacts consumption. It is estimated that the 101 Queen Street North site is approximately 166,000 ft^2 (15,400 m^2). Given this approximate area, the 2012-2013 site energy intensity is as follows:

101 Queen Street North		
BEPI	262.02	ekWh/m^2/year
BEPI	0.943	GJ/m^2/year

BEPI – Building Energy Performance Index

The following table summarizes the utility data for the 12 month periods from May 2011 to April 2013. The data was obtained from utility bills provided by the local distribution company.

Table 3-1 Summary of Utility Data

Year	Electricity		Natural Gas		Total	
	Consumption (kWh)	Cost ($)	Consumption (m^3)	Cost	Energy Index (GJ/m^2)	Cost Index ($/$m^2$)
May/11-Apr/12	1,519,339	186,236.32	230,050	82,653.22	0.927	17.46
May/12-Apr/13	1,653,342	214,554.34	224,109	68,492.57	0.943	18.38

3.1.1 Electricity

Two (2) years of electricity utility data was collected, analyzed and plotted to illustrate trends and identify any irregularities. The following table summarizes the electricity energy and cost indices for the two, 12 month periods between May 2011 and April 2013.

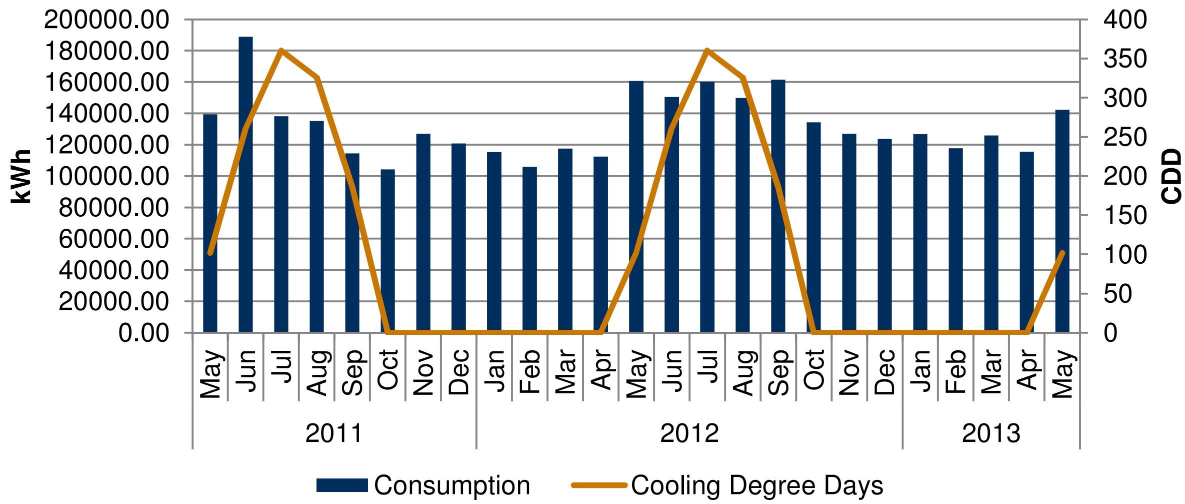
Table 3-2 Electricity Energy and Cost Indices

Year	Consumption (kWh)	Energy Index (GJ/m^2)	Cost ($)	Cost Index ($/$m^2$)
May/11-Apr/12	1,519,339	0.355	186,236.32	12.09

May/12-Apr/13	1,653,342	0.386	214,554.34	13.93

The figures below illustrate the electrical consumption data for the subject facility over two (2) years.

Figure 3-1 Monthly Electricity Consumption



Typically, a peak in cooling degree days correlates to the periods of highest electrical consumption. While this is demonstrated by the above plots, there is also high consumption throughout the rest of the year. This demonstrates that the facility has high base load energy consumption year round, with a variable portion resulting due to increased cooling requirements. It is expected that the variable load is due to cooling, while the base load is due to other high energy users such as lighting, which depend on the length and frequency of rehearsals and performances.

3.1.2 Natural Gas

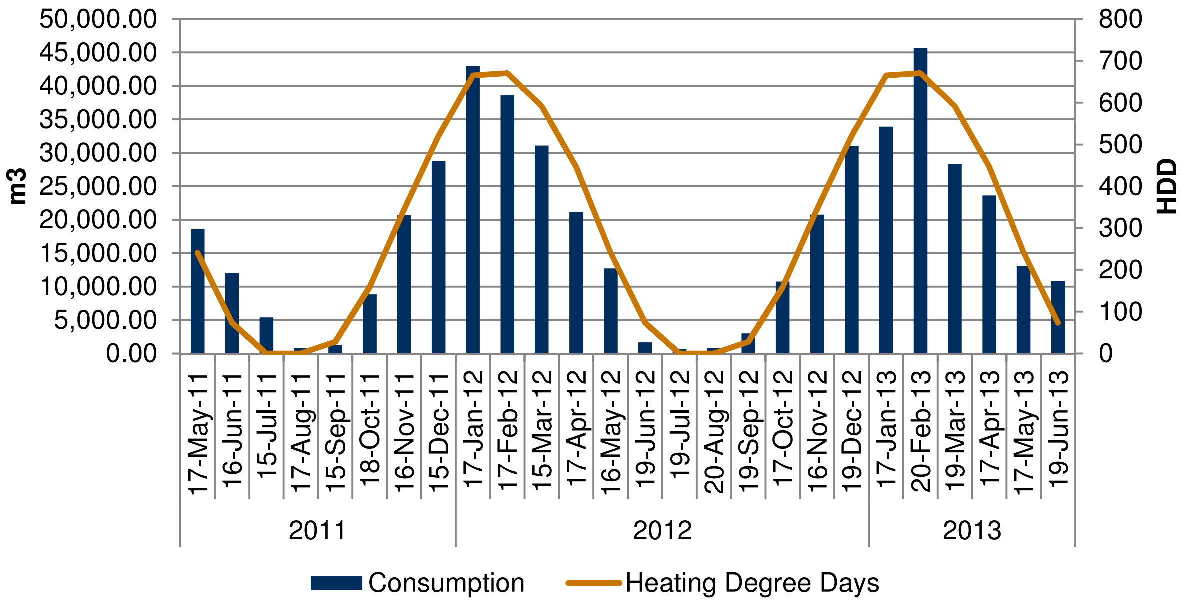
Two (2) years of natural gas utility data was collected, analyzed, and were plotted to illustrate trends and identify any irregularities. The following table summarizes the natural gas energy and cost indices for the two 12 month periods from May 2011 to April 2013.

Table 3-3 Natural Gas Energy and Cost Indices

Year	Consumption (m^3)	Energy Index (GJ/m^2)	Cost ($)	Cost Index ($\$/m^2$)
May/11-Apr/12	230,049.57	0.57	82,635.22	5.37
May/12-Apr/13	224,109.18	0.56	68,492.57	4.45

The figures below illustrate the natural gas consumption data for the subject facilities over two (2) years.

Figure 3-2 Monthly Natural Gas Consumption



The previous figures clearly illustrate the correlation between natural gas use and heating degree days. It is evident that as the number of heating degree days increases and the need for heating becomes greater, consumption will increase. This trend is to be expected. It should be noted, that due to the nature of this facility, little internal heat production is created, necessitating significant heating during winter months.

3.1.3 Annual Energy Profile by Fuel Type

Electrical and natural gas energy consumption figures have been converted to common units of energy to be able to compare the total amount of energy from each source at this facility.

Figure 3-3 Annual Energy Profile by Fuel Type for May 2011 to April 2012

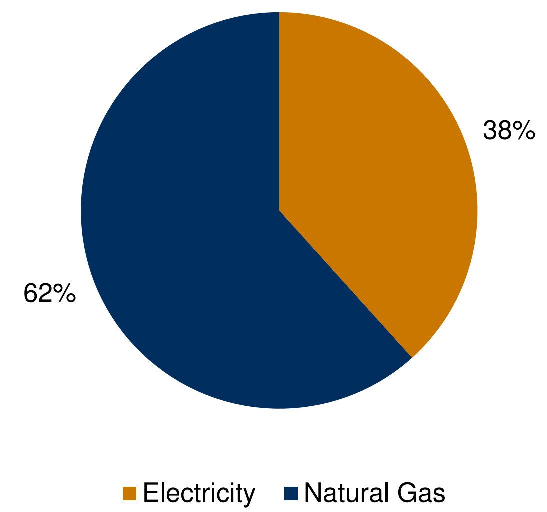
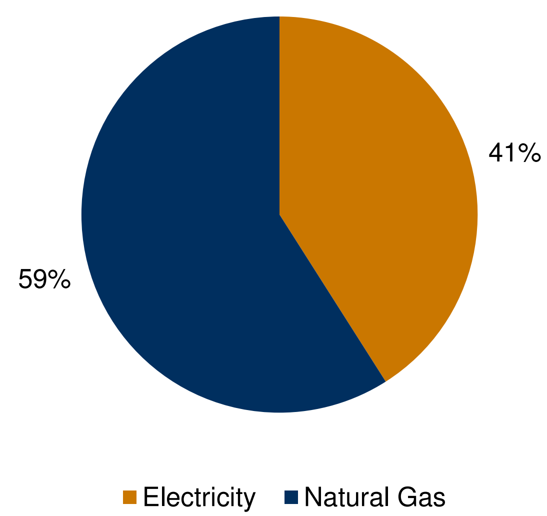


Figure 3-4 Annual Energy Profile by Fuel Type for May 2012 to April 2013



Natural gas accounts for approximately 60% of energy consumption in the facility, with electricity accounting for 40%. The major consumers in the facility are lighting, heating, and cooling, suggesting that significant levels of energy are required to keep the building heated since little internal heat gains are experienced. Furthermore the high-ceilinged architecture of the building lowers the cooling requirements, while increasing heating efforts, explaining the lower use of electricity than natural gas.

3.1.4 Building Energy Performance Benchmarking

The building Energy Utilization Index (EUI) was calculated by dividing the total annual energy used (all energy utilities in common units) by the floor space recorded in 2011-2012. The table below compares the EUI at this facility to the Office of Energy Efficiency (OEE) benchmarks to assess the facility's performance against similar industries.

Table 3-4 Office of Energy Efficiency (OEE) Standards for Various End-Uses

End-Use	% of Total Consumption	GJ/m2
Space Heating	44.1	0.732965
Water Heating	8.8	0.146945
Auxiliary Equipment	23.0	0.38239
Auxiliary Motors	7.4	0.122856
Lighting	8.9	0.148267
Space Cooling	7.6	0.127021
TOTAL	100	1.66

(Source: *Natural Resources Canada, 2010. http://oee.nrcan.gc.ca/home)*

Table 3-5 Office of Energy Efficiency (OEE) Standards for Energy Sources

Energy Soucre	% of Total Consumption	GJ/m2
Electricity	48.7	0.809395
Natural Gas	47.1	0.782621
Light Fuel Oil and Kerosene	1.1	0.017916
Heavy Fuel Oil	0.2	0.002939
Steam	0.0	0
Other (Coal and propane)	2.9	0.047572
TOTAL	100	1.66

(Source: *Natural Resources Canada, 2010. http://oee.nrcan.gc.ca/home)*

Analyzing the current indices of the facility, it can be seen that the average energy per area is approximately 0.935 GJ/m^2, which is far lower than the industry average of 1.66. This may be largely impacted by the number of performances compared to the industry average, as this plays a major impact on total consumption, while floor area remains constant.

From and energy source usage perspective, the facility appears to use significantly less electricity than the industry average. Again, this lower consumption is likely due to reduced performance frequencies and lower overhead activities compared to the industry.

4.0 Assessment Findings

4.1 HVAC SYSTEM

4.1.1 VAV System (ECM-1)

The main fan systems (F-1, F-2 and F-3) deliver conditioned air to the theatre, stage and lobby areas with pneumatically controlled variable air volume (VAV) boxes. According to site staff approximately 60% aren't functioning. This results in a loss of building efficiency and comfort. Conversion to electric actuators and BAS control would establish precise temperature control and allow for the installation of variable speed drives on the supply and return fan motors. There are approximately 25 VAV boxes in the system. Retrofit would cost approximately $18,000.

4.1.2 Upgrade BAS (ECM-2)

As previously discussed the building automation system is dated from the 1990s. It is limited in its capability; it does not control VAV boxes or all of the individual rooftop units. Its control is also limited to set points and scheduling. An up to date system has many different capabilities including:

- Fresh air control through CO2 monitoring. Installing carbon dioxide sensing in return air ducts and select occupied areas (auditorium) will allow for the regulation of fresh air supply to the monitored areas. Typically the control set point is to regulate fresh air supply to maintain building space CO2 readings to 800 ppm above ambient levels (approximately 350 ppm). As area occupancy decreases, so will the area CO2 levels. This will allow the fresh air supply to be proportional to the occupancy level, maintaining occupant comfort and saving energy.

- Free cooling. The system can monitor inside and outside temperature and humidity and provide free cooling when conditions permit. There are many occasions during performances that cooling is required and outside air temperatures are lower than inside.

- Fan variable speed drive control. The system would be able to determine the heating and cooling load in each space and adjust fan motor speed to match reducing fan motor energy costs.

- Stop/start optimization. The system would anticipate time required for system start up by calculating heat up and cooling down times (measuring inside and outside temperatures).

- Zone temperature set back.

- Pump variable speed drive control.

- Control of all rooftop units.

The estimated budget cost to replace the facility BAS system is $139,500. BAS control is capable of producing utility savings of 5% to 10%. The expected savings for this facility is $16,190 annually resulting in a payback 8.5 years with incentive.

4.1.3 Upgrade domestic hot water (DHW) boiler and storage tank (ECM-3)

The DHW heater is an atmospheric unit with an estimated efficiency in the 60% to 70% range. The units rely on natural draft; air is constantly flowing across the heat exchanger regardless if the boiler is operating or not; which results in large standby losses. The heat exchanger is also a low efficiency single pass design. A new high efficiency condensing DHW heater/storage tank has an efficiency of 90%. Installation of this system would reduce DHW natural gas usage by approximately 3,000 m3 annually ($1,115). Installation costs would be $10,000 resulting in a payback of 9.0 years.

4.1.4 Variable Speed Drives (VSDs) on Fan Systems (ECM-4)

The theatre facility uses three fan systems to condition and ventilate the space. Implementation of a VSD on the fan systems optimizes the fan speed for the current demand. With BAS control and CO2 sensing, the addition of a VSD allows for regulation of the fan speed. This would ensure that the fan systems would operate according to occupancy and heating or cooling load. The addition of VSDs on fan systems can reduce motor electrical usage. Installing VSDs on the F1 to F3 fan systems could reduce fan electrical usage by 30% to 40%. This would amount to savings of approximately $2,539 annually at an estimated cost of approximately $11,675. Payback would be 3.8 years.

4.1.5 Variable Speed Drives on Pump Systems (ECM-5)

The facility has separate chilled water and heating water pumping systems. The pumps are sized to carry the required flows at maximum heating and cooling loads. This is only required during short periods of the heating and cooling seasons. For the remainder of the year, flow control is accomplished with the utilization of two-way control valves on fan system heating and cooling coils or radiator control valves. While regulating flow in the terminal units they serve the valves also affect the system head pressure. With the addition of variable speed drive control, flow would be regulated by a combination of supply and return pressure and temperature sensing, BAS feedback of control valve positions in order to match the required output. This method of control will take advantage of the cubed savings; i.e. for every 10% reduction in flow energy use is decreased 17%.

Pump	HP	Estimated kW	Hours Per Yr	kWh/yr	VSD Savings	VSD Cost	Simple Payback - Yrs
Condenser	20	12.6	2786	35,028	$2,320	$4,750	2.2
Chilled Water	25	15.7	2786	43,786	$2,900	$5,725	2.2
P-4 Heating	5	3.1	5998	18,853	$1,248	$2,425	3.2
P-5 Heating	5	3.1	5998	18,853	$1,248	$2,225	5.0
Total	55	34.5		116,521	$7,717	$15,325	2.6

This measure would have an eligible incentive of $6,295 bringing the simple payback to 1.2 years.

4.2 GENERAL BUILDING MEASURES

4.2.1 Rooftop Heating and Cooling System Upgrades (ECM-6)

The facility 5 rooftop units that are approaching or operating beyond their industry standard expected useful life of 20 years. The units installed pre-2000 were evaluated based on their energy efficiency ratio (EER) that was provided from the manufacturer. The majority of units had an EER of less than 9 while more modern equipment on the market can provide an EER of 12.0. Based on the improved operating efficiency, a savings was calculated for the units listed. A summary of these findings is provided below in Table 4-1. To evaluate an input power, it was assumed that the equipment cooling operates with a duty cycle at 75% of the time and the cost of electricity is 0.12$/kWh.

Table 4-1 RTU Replacement Summary

Unit	Description	Estimated EER	Replacement EER	Annual Savings	Incentive ($)	Incremental Cost -$	Payback (year)
Studio	20 Ton Original	8	12	$672	1,120	$3,000	2.8
Art Gallery	20 Ton (2005)	8	12	$672	1,120	$3,000	2.8
Box Office	12 Ton Original	8	12	$384	640	$1,800	3.0
Atrium	10 Ton Original	8	12	$336	560	$1,500	2.8
Admin	10 Ton Original	8	12	$336	560	$1,500	2.8

*The Engineered Air unit was provided with the input amp ratings instead of an EER, therefore, to calculate its input power we assumed a power factor of 0.86. Incremental cost is cost premium with the selection of a premium efficiency unit.

A phase out of rooftop units approaching or that have exceeded their useful life is recommended to improve operating efficiency. It is recommended that equipment with a cooling capacity exceeding 10 tons, should be two stage designs and all equipped with economizers to further improve their operating efficiency.

The Retrofit Program provided by OPA is an incentive tool that reduces the cost of improvements and limits the payback period of the replacement. This program provides $0.10/kWh on every kilowatthour saved from an improvement in the heating, ventilation and air conditioning systems. The previous table illustrates the savings available with the recommended replacement equipment as well as the anticipated payback.

4.2.2 Retrofit Lighting Controls (ECM-7)

It was reported, during the site assessment, that occupancy sensors were used in all areas except the basement. It is recommended that sensors be installed in all areas of the basement similar to the rest of the building. Multi-technology sensors are superior to passive infrared sensors as they have the capability to 'hear' which is necessary when the occupant is standing behind a shelf or washroom stall divider. A multi-technology occupancy sensor including labor will cost approximately $150. The simple payback period will be more attractive in spaces with three (3) or more two-lamp fluorescent fixtures.

It is recommended that existing mechanical/electrical rooms with manual lighting controls be retrofitted with inexpensive timer controls. Timer controls can be manually set to various time intervals (from five (5) minutes to twelve (12) hours), depending on users estimate of requirements, and will ensure lights are switched off after the designated period, should they be left on by accident. For safety reasons, instructions for use of the switch should be posted in these areas to ensure that lights are not deactivated during a vision-critical task. Timer controls cost as little as $3 each and have a payback period of less than a year.

4.2.3 Upgrade Interior Lighting (ECM-8)

Currently, the facility is equipped with T8 fixtures with electronic ballast in most areas with the exception of some stairways where decorative incandescent lamps remain. These fixtures (9) consist of nine 25 watt incandescent decorative bulbs. It is recommended that these lamps be replaced with a single two lamp 25 watt T-8 fixture.

The table below provides a summary of the probable energy savings and capital costs for one (1) fixture given typical annual operating hours. A simple payback of approximately three (3) to four (4) years is expected from this measure. The following table also illustrates the comparison between replacing with T8 lamps and LED fixtures.

Table 4-2 Estimate on Payback for Lighting Upgrade

Source	Linear Fluorescent T8	LED (low-end)	LED (high-end)
Total Price (lamps+fixture)	131	185	365
Input Power per Fixture	58	36	36
Retrofit – 9 Fixtures,			
Cost	$1,179	$1,665	$3,285

Simple Payback (years)	2.2	2.7	5.3

(Source: U.S. Department of Energy, http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led-t8-flourescent-replacement.pdf)

4.2.4 Upgrade Exterior Lighting to Photocell Control (ECM-9)

The exterior lighting is presently controlled by time clock. Retrofitting photocell sensors into the control loop would permit reduced hours of operation. The time clock could be used to define permissible operating hours of the exterior fixtures and the photocell sensor would ensure that the lights do not operate when sunlight is sufficient. This type of control would apply to all the exterior lighting circuits in the building. It may require more than one time clock and photocell sensor. A more detailed analysis is required in order to determine sensor locations.

4.2.5 Retrofit Art Gallery Humidification (ECM-10)

The Liebart cooling units in the art gallery also have humidifiers. The existing humidifiers are electrode immersion type which used an electric element to boil off water. High pressure atomizing humidification uses 1% of the energy of an electronic humidifier. Atomizing humidification uses high pressure de-ionized water spraying through stainless steel engineered nozzles to atomize water droplets into the HVAC units air stream. Further investigation is required for this recommendation in order to:

- Complete a cost-benefit analysis for converting to atomizing humidification.
- Identifying how and where a water de-ionizing station can be located in the art gallery.
- Determine if the existing HVAC system can overcome the cooling effect of adding unheated humidification water into the air stream.

4.2.6 Complete a Roof Cut Test to Evaluate the R-Value of the Original Roof (ECM-11)

During the walk through, staff identified several areas of the building sloped roof which are subject to interior condensation during the heating season. It is evident that substantial areas of the sloped roof have experienced shifting and settling of insulation. It is recommended that test cuts or thermal imaging be made to identify areas that require insulation upgrade.

4.2.7 Install Reflective Film on South Exposure Windows (ECM-12)

The installation of reflective film on south exposure windows would increase occupant comfort and reduce air conditioning load. Typically air conditioning load is reduced 1 ton for every 100 square feet of window film. This measure requires further analysis in order to properly assess it's feasibility and benefit.

4.2.8 Heat Recovery From Refrigeration Equipment (ECM-13)

The existing facility food and beverage coolers located in the basement reject heat to the surrounding area of the mechanical room they are located in. This represents an opportunity for heat recovery during the heating season and additional cooling load during the air conditioning season. Utilizing temperature sensors, ducting and dampers, the condenser heat could be redirected into building space during the heating season and rejected outside during the cooling season. This measure requires further analysis in order to properly assess its feasibility and benefit.

5.0 Conclusions and Recommendations

Capital Improvement Measures:

Further analysis is required to more accurately determine the potential savings and costs of these measures. It is recommended that Centre In the Square Inc. move forward to review potential to incorporate these measures into the existing site energy and environmental management strategy.

Stantec would be pleased to assist Centre in the Square Inc. to pursue funding to complete detailed analysis of capital intensive modifications. Funding is provided by the OPA to further study the ECMs listed in this report with the goal of giving the Centre in the Square more accurate cost and savings estimates in order to make capital investment decisions.

The study incentive is equal to the lesser of:

- $.05 per square foot of building area.
- 50% of the study costs.
- $10,000.

Although not included in the scope of this study, Union gas offers incentives to implement ECMs that reduce facility natural gas consumption. That would include the DHW boiler replacement, BAS upgrade and VAV box replacement.

6.0 Study Limitations

This report was prepared by Stantec Consulting Ltd. for Centre In The Square Inc.. The material in it reflects our professional judgment in light of the following:

- Our interpretation of the objective and scope of works during the study period;
- The scope did not include a code or standards and regulation review;
- Information available to us at the time of preparation;
- Third party use of this report, without written permission from Stantec, are the responsibility of such third party;
- Measures identified in this report are subject to the professional engineering design process before being implemented.

The savings calculations are our estimate of saving potentials and are not guaranteed. The impact of building changes in space functionality, usage, equipment retrofit and weather; need to be considered when evaluating the savings.

Any use which a third party makes of this report, or any reliance on decisions to be made are subject to interpretation. Stantec accepts no responsibility or damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Appendix A Utility Information

Electricity Consumption:

Year	Month	Days	Consumption		Cost	degree days			
			kWh	kWh/day	$	HDD	HDD/d	CDD	CDD/d
2011	May	31	139,320	4,494	16,628	146	4.71	102	3.29
	Jun	30	188,856	6,295	24,298	0	0.00	261	8.70
	Jul	31	138,288	4,461	17,470	0	0.00	360	11.61
	Aug	31	135,192	4,361	15,783	0	0.00	326	10.52
	Sep	30	114,552	3,818	14,951	54	1.80	186	6.20
	Oct	31	104,232	3,362	12,947	264	8.52	0	0.00
	Nov	30	126,936	4,231	14,596	426	14.20	0	0.00
	Dec	31	120,744	3,895	14,280	614	19.81	0	0.00
2012	Jan	31	115,328	3,720	13,556	716	23.10	0	0.00
	Feb	29	105,912	3,652	12,837	624	21.52	0	0.00
	Mar	31	117,629	3,794	12,993	558	18.00	0	0.00
	Apr	30	112,350	3,745	15,896	336	11.20	0	0.00
	May	31	160,657	5,182	20,462	146	4.71	102	3.29
	Jun	30	150,533	5,018	19,894	0	0.00	261	8.70
	Jul	31	159,966	5,160	22,152	0	0.00	360	11.61
	Aug	31	149,889	4,835	18,619	0	0.00	326	10.52
	Sep	30	161,423	5,381	19,685	54	1.80	186	6.20
	Oct	31	134,268	4,331	17,003	264	8.52	0	0.00
	Nov	30	126,932	4,231	18,213	426	14.20	0	0.00
	Dec	31	123,660	3,989	15,335	614	19.81	0	0.00
2013	Jan	31	126,715	4,088	15,157	716	23.10	0	0.00
	Feb	28	117,816	4,208	16,862	624	22.29	0	0.00
	Mar	31	126,004	4,065	15,328	558	18.00	0	0.00
	Apr	30	115,480	3,849	15,845	336	11.20	0	0.00
	May	31	142,354	4,592	18,448	146	4.71	102	3.29

Natural Gas Consumption:

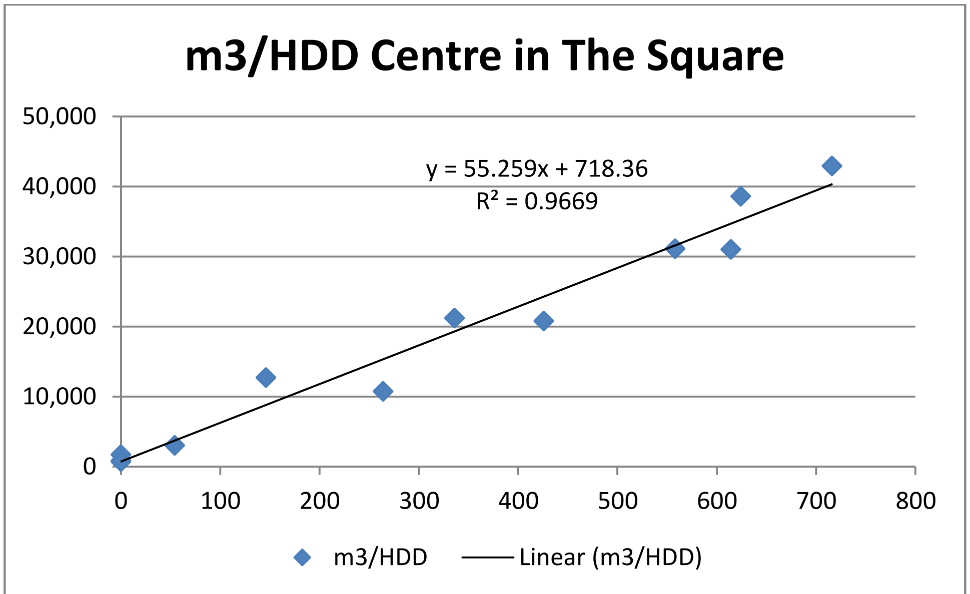
Year	Month	Days	Consumption			Cost	degree days		
			ft^3	m3	m3/d	$	HDD	HDD/d	CDD
2011	17-May-11	32	65,997	18,652	583	$6,725	241	7.53	0
	16-Jun-11	30	42,385	11,979	399	$4,350	73	2.43	0
	15-Jul-11	29	19,022	5,376	185	$1,999	0	0.00	0
	17-Aug-11	33	2,911	823	25	$381	0	0.00	0
	15-Sep-11	29	4,339	1,226	42	$515	27	0.93	102
	18-Oct-11	33	31,278	8,840	268	$3,243	159	4.82	261
	16-Nov-11	29	73,044	20,644	712	$7,422	345	11.90	360
	15-Dec-11	29	101,667	28,733	991	$10,269	520	17.93	326
2012	17-Jan-12	33	151,941	42,942	1,301	$15,281	665	20.15	186
	17-Feb-12	31	136,516	38,582	1,245	$13,741	670	21.61	0
	15-Mar-12	27	109,976	31,081	1,151	$11,091	591	21.89	0
	17-Apr-12	33	74,913	21,172	642	$7,618	447	13.55	0
	16-May-12	29	44,978	12,712	438	$4,608	241	8.31	0
	19-Jun-12	34	5,949	1,681	49	$690	73	2.15	0
	19-Jul-12	30	2,353	665	22	$299	0	0.00	0
	20-Aug-12	32	2,840	803	25	$339	0	0.00	0
	19-Sep-12	29	10,629	3,004	104	$1,034	27	0.93	102
	17-Oct-12	28	38,051	10,754	384	$3,472	159	5.68	261
	16-Nov-12	30	73,492	20,770	692	$6,628	345	11.50	360
	19-Dec-12	33	109,738	31,014	940	$9,825	520	15.76	326
2013	17-Jan-13	28	119,900	33,886	1,210	$10,708	665	23.75	186
	20-Feb-13	34	161,697	45,699	1,344	$14,399	670	19.71	0
	19-Mar-13	27	100,280	28,341	1,050	$8,977	591	21.89	0
	17-Apr-13	29	83,602	23,628	815	$7,515	447	15.41	0
	17-May-13	30	46,381	13,108	437	$4,220	241	8.03	0
	19-Jun-13	33	38,233	10,805	327	$3,504	73	2.21	0

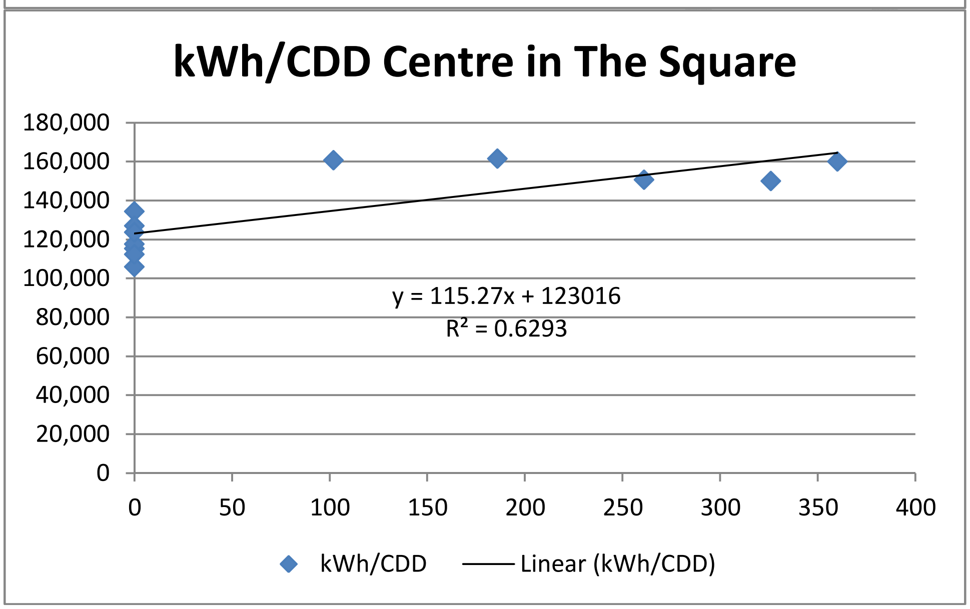
Appendix B Saving and Cost Calculations

Historical weather for a typical year

Month	HDD	CDD	Gas - m3	Electricity - kWh
Jan	716	0	42,942	115,328
Feb	624	0	38,582	105,912
Mar	558	0	31,081	117,629
Apr	336	0	21,172	112,350
May	146	102	12,712	160,657
Jun	0	261	1,681	150,533
Jul	0	360	665	159,966
Aug	0	326	803	149,889
Sep	54	186	3,004	161,423
Oct	264	0	10,754	134,268
Nov	426	0	20,770	126,932
Dec	614	0	31,014	123,660
Total	***3738***	***1235***	*215,180*	*1,618,546*

End Use	Units		% of Total
Space Heating	206,558	m3	96.0%
Cooling	142,358	kWh	8.8%


m3/HDD Centre in The Square
y = 55.259x + 718.36
R² = 0.9669
50,000
40,000
30,000
20,000
10,000
0
0
100
200
300
400
500
600
700
800
m3/HDD
Linear (m3/HDD)


kWh/CDD Centre in The Square
y = 115.27x + 123016
R² = 0.6293
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0
50
100
150
200
250
300
350
400
kWh/CDD
Linear (kWh/CDD)

ECM1 - Replace VAV Boxes

% of Building w/VAV	50.0%	
% Boxes Failed	60.0%	
Estimated Heating Error	8.0%	
Estimated Cooling Error	8.0%	
Heating Savings	4,957	m3
Cooling Savings	3,417	kWh
Savings	$2,200	

VAV Box Replacement Cost	Qty	Unit Cost - $	Total Cost-$
VAV Box (Average 8")	22	$500	$11,000
Sensor	22	$22	$484
Wiring Installation	22	$100	$2,200
Sub Total			***$13,684***
Engineering	10.0%		$1,368
Project Management	10.0%		$1,368
Contingency	10.0%		$1,368
Commissioning	3.0%		$411
Total Project Cost			***$18,200***

ECM2 -Upgrade BAS

New Heating Usage	201,601	m3/yr
New Cooling Usage	138,942	kWh/yr
Estimated Outside Air	7,000	CFM

		Savings	
Measure	**% Reduction**	**KWh**	**m3**
Set back Scheduling Savings	9.0%	12,505	18,144
Outside Air Savings	10.0%	12,644	18,346
		25,148	***36,490***

ECM2 -Upgrade BAS	Qty	Unit Cost - $	Total Cost-$
Retrofit Costs	140000	$0.75	$105,000
			$0
			$0
Sub Total			***$105,000***
Engineering	10.0%		$10,500
Project Management	10.0%		$10,500
Contingency	10.0%		$10,500
Commissioning	3.0%		$3,150
Total Project Cost			***$139,650***

ECM3 - Upgrade DHW Boiler and Storage Tank

Existing DHW Usage	8,276	m3/yr
Existing System Efficency	60.0%	
New Heater Efficiency	96.0%	
New System Usage	5,173	m3/yr
Savings	3,104	m3/yr

ECM3 - Upgrade DHW Boiler and Storage Tank	**Qty**	**Unit Cost - $**	**Total Cost-$**
A.O. Smith Cyclone Heater	1	$8,000	$8,000
Demolition	1	$2,000	$2,000
			$0
Sub Total			***$10,000***
Engineering	0.0%		$0
Project Management	0.0%		$0
Contingency	0.0%		$0
Commissioning	0.0%		$0
Total Project Cost			***$10,000***

ECM4 - Install VSD on Fan Motors

ECM4 - Install VSD on Fan Motors	Qty	Unit Cost - $	Total Cost-$
5 hp VSD	2	$2,425	$4,850
3 hp VSD	1	$2,275	$2,275
2 hp VSD	1	$2,275	$2,275
1 hp VSD	1	$2,275	$2,275
Sub Total			***$11,675***
Engineering	10.0%		$0
Project Management	10.0%		$0
Contingency	10.0%		$0
Commissioning	3.0%		$0
Total Project Cost			***$11,675***

Fan	Hp	Load	pf	Eff	kW	Existing hrs/day	kWh/yr	% Operating Time
F-1 Supply	5	0.75	0.89	0.89	3.1	10	11,473	41.7%
F-1 Return	3	0.75	0.89	0.89	1.9	10	6,884	41.7%
F-2	5	0.75	0.89	0.89	3.1	10	11,473	41.7%
F-3 Supply	2	0.75	0.89	0.89	1.3	10	4,589	41.7%
F-3 Return	1	0.75	0.89	0.89	0.6	10	2,295	41.7%
					10.1		***36,713***	

Balance Temp Heating	65
Balance Temp Cooling	72

VSD Savings	20,714	kWh/yr

Avg Deg F	Hours	Heating Load	Cooling Load	Fan Energy - kWh	VSD Reduction	VSD kWh
-2.2	0	100.0%	0.0%	0	100.0%	0
1.4	0	100.0%	0.0%	0	100.0%	0
5	2	94.3%	0.0%	8	94.3%	7
8.6	15	88.7%	0.0%	63	88.7%	44
12.2	18	83.0%	0.0%	75	83.0%	43
15.8	57	77.4%	0.0%	239	77.4%	111
19.4	79	71.7%	0.0%	331	75.0%	140
23	153	66.0%	0.0%	641	75.0%	271
26.6	272	60.4%	0.0%	1,140	75.0%	481
30.2	524	54.7%	0.0%	2,196	75.0%	926
33.8	720	49.1%	0.0%	3,018	75.0%	1,273
37.4	695	43.4%	0.0%	2,913	75.0%	1,229
41	596	37.7%	0.0%	2,498	75.0%	1,054
44.6	428	32.1%	0.0%	1,794	75.0%	757
48.2	425	26.4%	0.0%	1,781	75.0%	751
51.8	479	20.8%	0.0%	2,007	75.0%	847
55.4	521	15.1%	0.0%	2,184	75.0%	921
59	540	9.4%	0.0%	2,263	75.0%	955
62.6	474	3.8%	0.0%	1,987	75.0%	838
66.2	545	0.0%	0.0%	2,284	75.0%	964
69.8	551	0.0%	0.0%	2,309	75.0%	974
73.4	541	0.0%	8.9%	2,267	75.0%	957
77	425	0.0%	31.6%	1,781	75.0%	751
80.6	316	0.0%	54.4%	1,324	75.0%	559
84.2	204	0.0%	77.2%	855	77.2%	394
87.8	111	0.0%	100.0%	465	100.0%	465
91.4	65	0.0%	100.0%	272	100.0%	272
95	18	0.0%	100.0%	75	100.0%	75
98.6	10	0.0%	100.0%	42	100.0%	42
102.2	0	0.0%	100.0%	0	100.0%	0
	8784			36,814		16,100

ECM5 - Install VSD on Pump Motors

ECM5 - Install VSD on Pump Motors	**Qty**	**Unit Cost - $**	**Total Cost-$**
25 hp VSD	1	$5,725	$5,725
20 hp VSD	1	$4,750	$4,750
5 hp VSD	2	$2,425	$4,850
			$0
Sub Total			***$15,325***
Engineering	10.0%		$0
Project Management	10.0%		$0
Contingency	10.0%		$0
Commissioning	3.0%		$0
Total Project Cost			***$15,325***

Fan	**Hp**	**Load**	**pf**	**Eff**	**kW**	**Existing hrs/yr**	**kWh/yr**	**% Operating Time**
Chilled Water Pump	25	0.75	0.89	0.89	15.7	2786	43,786	31.8%
Condenser Water Pump	20	0.75	0.89	0.89	12.6	2786	35,028	31.8%
Heating Pump 4	5	0.75	0.89	0.89	3.1	5998	18,853	68.5%
Heating Pump 5	5	0.75	0.89	0.89	3.1	5998	18,853	68.5%
Heating Pump 6	5	0.75	0.89	0.89	3.1	0	0	0.0%
					28.3		***116,521***	
					6.3			

Balance Temp Heating 65
Balance Temp Cooling 65

VSD Savings 62,952 kWh/yr

Avg Deg F	Hours	Heating Load	Cooling Load	Heating Pump Energy - kWh	Cooling Pump Energy - kWh	Cooling VSD Reduction	Cooling VSD kWh	Heating VSD Reduction	Heating VSD kWh
-2.2	0	100.0%	0.0%	0	0	75.0%	0	100.0%	0
1.4	0	100.0%	0.0%	0	0	75.0%	0	100.0%	0
5	2	94.3%	0.0%	13	0	75.0%	0	94.3%	11
8.6	15	88.7%	0.0%	94	0	75.0%	0	88.7%	66
12.2	18	83.0%	0.0%	113	0	75.0%	0	83.0%	65
15.8	57	77.4%	0.0%	358	0	75.0%	0	77.4%	166
19.4	79	71.7%	0.0%	497	0	75.0%	0	75.0%	210
23	153	66.0%	0.0%	962	0	75.0%	0	75.0%	406
26.6	272	60.4%	0.0%	1,710	0	75.0%	0	75.0%	721
30.2	524	54.7%	0.0%	3,294	0	75.0%	0	75.0%	1,390
33.8	720	49.1%	0.0%	4,526	0	75.0%	0	75.0%	1,910
37.4	695	43.4%	0.0%	4,369	0	75.0%	0	75.0%	1,843
41	596	37.7%	0.0%	3,747	0	75.0%	0	75.0%	1,581
44.6	428	32.1%	0.0%	2,691	0	75.0%	0	75.0%	1,135
48.2	425	26.4%	0.0%	2,672	0	75.0%	0	75.0%	1,127
51.8	479	20.8%	0.0%	3,011	0	75.0%	0	75.0%	1,270
55.4	521	15.1%	0.0%	3,275	0	75.0%	0	75.0%	1,382
59	540	9.4%	0.0%	3,395	0	75.0%	0	75.0%	1,432
62.6	474	3.8%	0.0%	2,980	0	75.0%	0	75.0%	1,257
66.2	545	0.0%	5.3%	0	15,418	75.0%	6,504	75.0%	0
69.8	551	0.0%	21.1%	0	15,587	75.0%	6,576	75.0%	0
73.4	541	0.0%	36.8%	0	15,305	75.0%	6,457	75.0%	0
77	425	0.0%	52.6%	0	12,023	75.0%	5,072	75.0%	0
80.6	316	0.0%	68.4%	0	8,939	75.0%	3,771	75.0%	0
84.2	204	0.0%	84.2%	0	5,771	84.2%	3,446	75.0%	0
87.8	111	0.0%	100.0%	0	3,140	100.0%	3,140	75.0%	0
91.4	65	0.0%	100.0%	0	1,839	100.0%	1,839	75.0%	0
95	18	0.0%	100.0%	0	509	100.0%	509	75.0%	0
98.6	10	0.0%	100.0%	0	283	100.0%	283	75.0%	0
102.2	0	0.0%	100.0%	0	0	100.0%	0	75.0%	0
	8784			***37,707***	***78,814***		**37,598**		**15,970**

ECM8 -Upgrade Interior Lighting

Fixtures	9	
Bulbs per Fixture	9	
Bulb Wattage	25	
Wattage	2025	
LED wattage	36	
Number of tixtures	9	
LED Total Wattage	324	
Wattage Savings	1701	
Daily Operating Hours	12	
Annuall Savings	7,450	kWh

ECM8 -Upgrade Interior Lighting	Qty	Unit Cost - $	Total Cost-$
LED Fixtures	9	$185.00	$1,665
			$0
			$0
Sub Total			***$1,665***
Engineering	0.0%		$0
Project Management	0.0%		$0
Contingency	0.0%		$0
Commissioning	0.0%		$0
Total Project Cost			***$1,665***

Centre in the Square - Energy Management Opportunity Summary

		Savings						
ECM #	**Description**	**kWh**	**m3**	**$**	**Cost-$**	**Incentive - $**	**Simple Payback w/ Incentive**	**Comment**
1	Replace VAV Boxes	3,417	4,957	$2,200	$18,200	$342	8.1	
2	Upgrade BAS	25,148	36,490	$16,190	$139,650	$2,515	8.5	
3	Replace DHW Boiler		3,104	$1,115	$10,000	$0	9.0	
4	Install VSDs on Fan Motors	20,714		$2,539	$11,675	$2,071	3.8	
5	Install VSDs on Pump Motors	62,952		$7,717	$15,325	$6,295	1.2	
6	Upgrade Rooftop Units			$0		$0	0.0	More Analysis Needed
7	Retrofit Lighting Controls			$0		$0	0.0	More Analysis Needed
8	Upgrade Interior Lighting	7,450		$913	$1,665	$745	1.0	
9	Upgrade Exterior Lighting Control			$0		$0	0.0	More Analysis Needed
10	Retrofit Art Gallery Humidification			$0		$0	0.0	More Analysis Needed
11	Roof Cut Test			$0		$0	0.0	More Analysis Needed
12	Window Tinting South Wall			$0		$0	0.0	More Analysis Needed
13	Recover Heat from Refrig Equip.			$0		$0	0.0	More Analysis Needed
	Total	***119,682***	***44,551***	***$30,673***	***$196,515***	***$11,968***	***6.0***	

Average Electricity Cost	$0.12	per kWh
Average Natural Gas Cost	$0.36	per m3

Electricty Savings Incentive	$0.10	per kWh