Centre for Addiction and Mental Health College Street and Russell Street Sites Energy Conservation and Demand Management Plan

An Integrated Approach to Conservation and Renewal

The Centre for Addiction and Mental Health's two facilities at 250 College Street and 33 Russell Street in Toronto combine patient care and administration with world-class research, all housed in aging buildings. This plan presents the energy and utility cost savings to be achieved through updating old equipment and technology, and further integrating central plant and building systems with the diverse uses and requirements of the buildings.

JUNE 16, 2014

DRAFT

The Government of Ontario enacted the Green Energy Act Regulation 397/11 on January 1, 2012. This legislation requires broader public sector organizations to develop and publish a five-year Energy Conservation and Demand Management (ECDM) plan by July 1, 2014.

This document was prepared in accordance with Ontario Regulation 397/11 for the Centre for Addiction and Mental Health by Enerlife Consulting.

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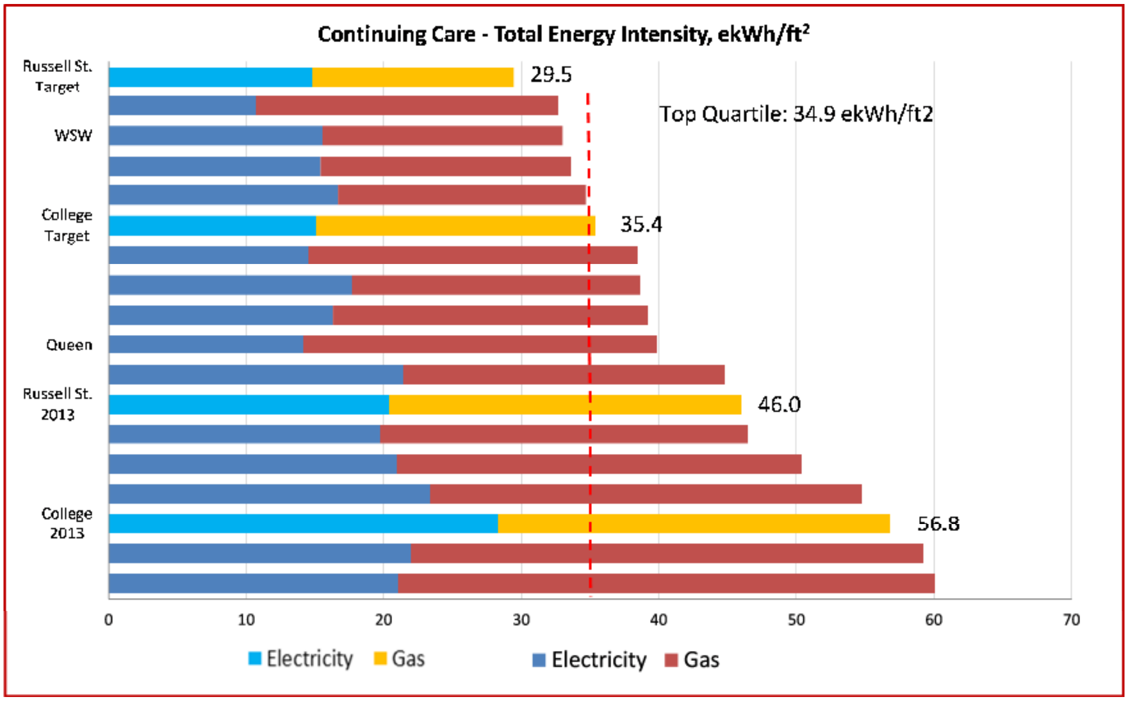
Summary

The Centre for Addiction and Mental Health (CAMH) operates two sites at 250 College Street and 33 Russell Street, which provide inpatient care and administration alongside intensive research operations. Both sites have undergone capital projects over the years to replace parts of their central plant and aging infrastructure. As well, over the past few years, College Street site has seen major new research equipment with corresponding cooling and heating supporting systems, (including an expanded West Wing penthouse plant). This Energy Conservation and Demand Management (ECDM) plan, prepared in accordance with Ontario's Green Energy Act Regulation 397/11, presents a systematic approach to renewing the remaining older plant and equipment, and integrating systems to more efficiently address the different user requirements at the two facilities.

The 2013 energy performance for College Street and Russell Street sites is shown in Figure 1, along with their projected benchmark energy intensity positioning following attainment of the target energy use presented in Section 2.3 of the plan. College Street site is the more energy intensive of the two because of its greater level of research programming. For reference purposes, the chart also indicates 2013 energy performance of the CAMH Queen Street campus older buildings (Queen) and White Squirrel Way (WSW - four buildings opened in 2008 as Phase 1A of new development of the Queen Street campus). Refer to the companion ECDM Plan for the Queen Street campus for further information on these facilities. This energy performance benchmarking is taken from the Greening Health Care database[1].

[1] Greening Health Care program, founded in 2003, helps hospitals to work together to lower their energy costs and raise their environmental performance. Members use a powerful online system to manage data, assess their performance and track savings. Program includes workshops and webinars to help plan, implement and verify improvements, and to share best practices. Greening Health Care is managed by Toronto and Region Conservation.

Figure 1: CAMH College St and Russell St Sites 2013 Total Energy Intensity



1 A History of Energy Efficiency

1.1 Previous Energy Initiatives

Replacements and additions of boilers, chillers, roof-mounted HVAC systems and other equipment over the past 5 years have incorporated energy efficiency features such as variable speed drives and linkage-less burner controls. A new electric steam boiler was installed at College Street site for summer use so that new West Wing steam plant can be shut down. A new variable speed drive domestic water booster pump set has been installed at College Street site. Incremental lighting improvements have been made at both buildings as areas were renovated or lamps and ballasts burned out. The ongoing elevator modernization program at College Street site is also contributing to electricity savings.

However, the biggest contribution to relatively good and steadily improving overall energy performance has been the active and thoughtful operation of building systems. Management and staff have adjusted operating schedules and temperature set-points, shut down redundant equipment and upgraded controls. They have effectively eliminated the simultaneous cooling and heating which are common to healthcare facilities, operating below target levels in some components of energy use.

The monthly performance chart in Figure 2 shows the weather-normalized changes in energy use (electricity and gas combined) of College Street site since 2010. Savings in 2011 are attributed to operational improvements, while the small increases in 2012 and 2013 are due to the addition of research equipment and related cooling and heating plant.

Figure 2: CAMH College St Site 2010-2014 Total Energy Savings

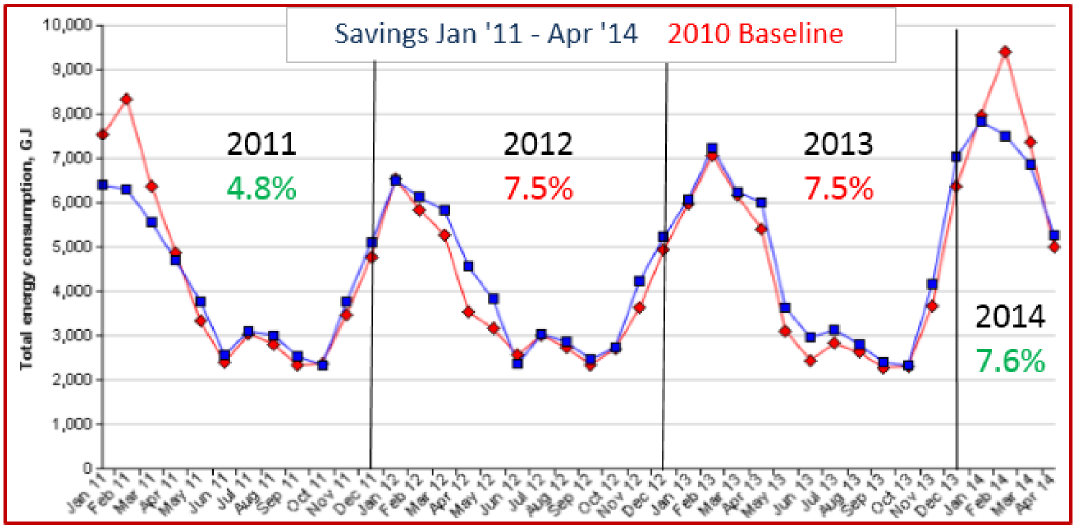
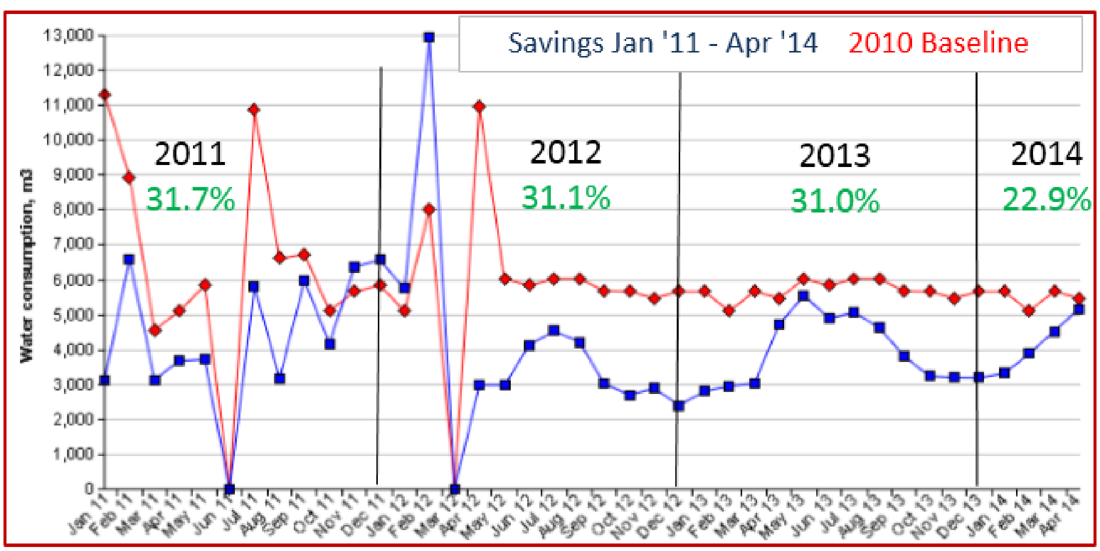


Figure 3 below illustrates changes in water use at College Street site from 2011-2014. Meter reading anomalies at Toronto Water account for the fluctuations in 2011 and 2012, but the overall savings seen in 2012 and 2013 are attributed to improved plant operations. Rising consumption in 2014 is attributed to the new research equipment and plant.

Figure 3: CAMH College St Site 2010-2014 Water Savings



The substantial energy (Figure 4) and water (Figure 5) savings for Russell Street site shown below are primarily due to operational improvements introduced in 2012.

Figure 4: CAMH Russell St Site 2011-2014 Total Energy Savings

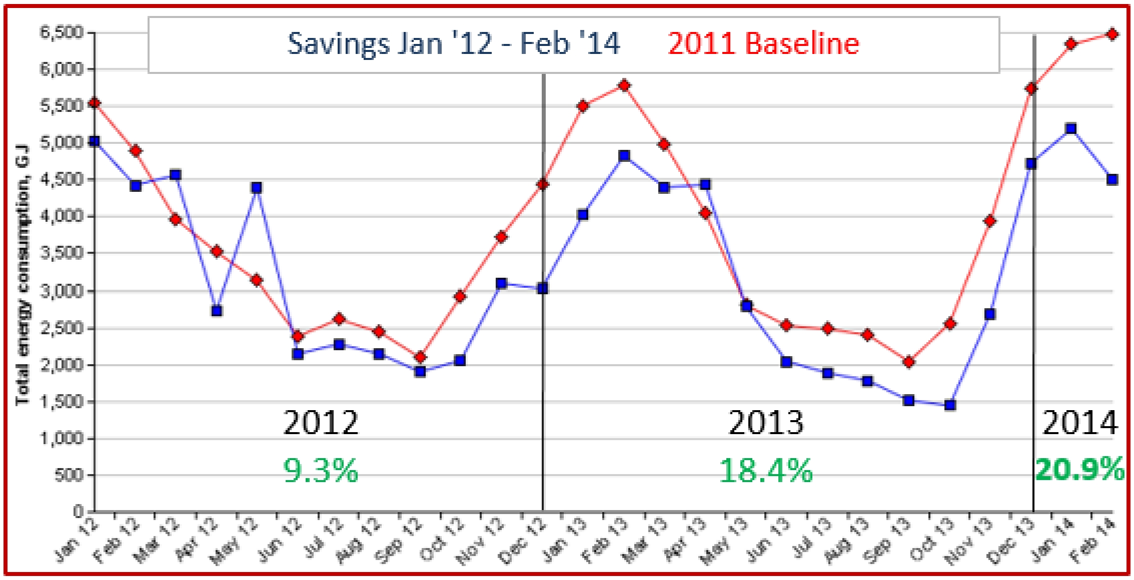
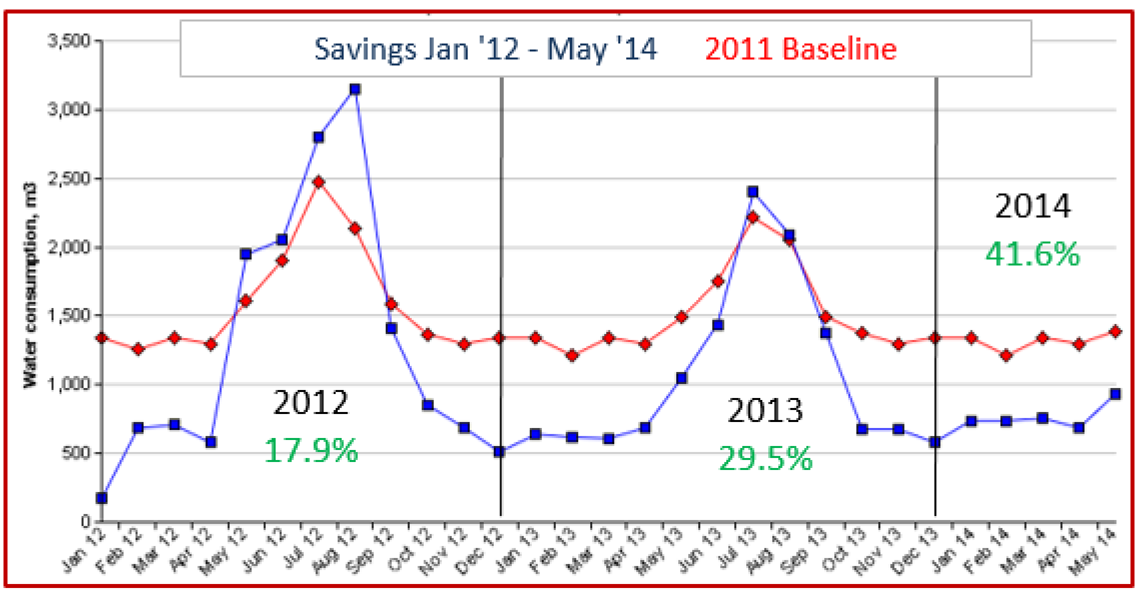


Figure 5: CAMH Russell St Site 2011-2014 Water Savings



1.2 Current Initiatives

CAMH staff is visibly committed to energy conservation action, tracking performance, responding to variances and operating and maintaining their facilities as well as possible. Adjustments to operating schedules and set-points continue. The 6-year capital plan for these buildings includes ongoing renewal of aging plant and equipment with new, more energy efficient technology. CAMH is also an active member of the Greening Health Care program, continuously seeking new ideas for improving operations while sharing their own experiences with other hospitals.

1.3 Organizational Commitment

CAMH's commitment to sustainability is grounded in the culture and values of its staff, which are reflected in management and operations, and in inter-departmental initiatives. Facilities, housekeeping and security staff are actively involved in conservation and environmental efforts. Inter-departmental challenges and regular communications maintain awareness and participation in stewardship, supported by CAMY, their own environmental mascot. In-house champions take responsibility for new conservation ideas. The focus on monitoring energy and water use, as well as systems and operations, can be seen in the good energy performance relative to comparable facilities.

2 Building on Success – The 5-Year Plan (2014-2019)

2.1 Goals and Objectives

CAMH's goal for College Street and Russell Street sites is to achieve integrated, sustainable and energy efficient facilities which reflect its leadership role and values in 21st century healthcare service delivery, and its contribution to the renaissance of our city.

The objectives for the duration of this plan are to operate the existing buildings as energy and cost efficiently as possible, while working towards better integrated systems which can achieve high levels of energy performance excellence.

2.2 2013 Energy and Water Performance

Due primarily to their unusual levels of research activity, 2013 energy use by the CAMH College Street and Russell Street sites place them at the more energy intensive end of the Greening Health Care database of continuing care facilities, as previously shown in Figure 1. College Street site used over 7.5 million kWh of electricity and 717 thousand m3 of gas, spending over $1.2 million (including water). Russell Street site used more than 4.5 million kWh of electricity, over 540 thousand m3 of gas, and spent approximately $816,000 (including water). The floor areas of the two buildings may be higher than indicated, which would affect benchmark results, and will be confirmed as part of this plan.

2013 energy use and cost breakdowns are presented below. Natural gas typically accounts for the largest share of energy use and greenhouse gas (GHG) emissions. The relatively low current price of gas is responsible for electricity's larger share of utility costs. Electricity, natural gas and water prices are forecast to rise faster than the rate of inflation for the foreseeable future, further improving economic returns on investment in energy efficiency.

Figure 6: CAMH College St Site 2013 Energy Use and Cost Breakdown

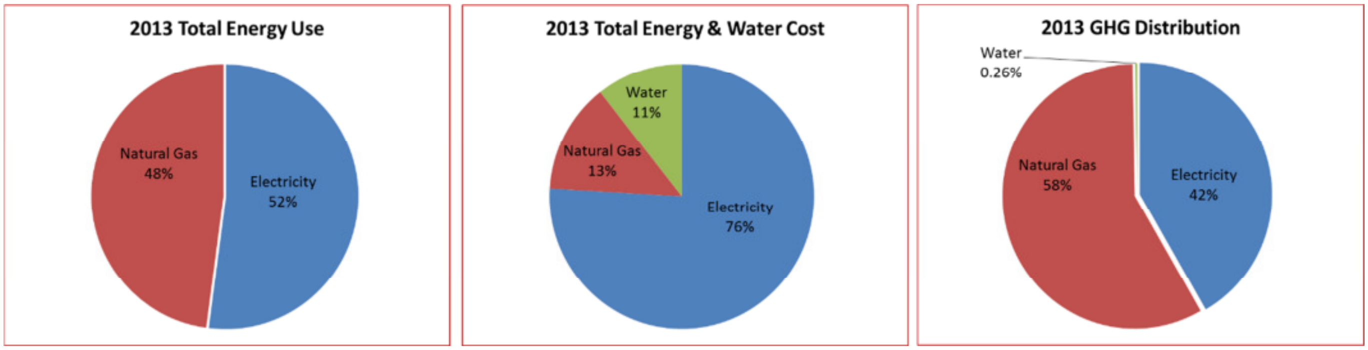
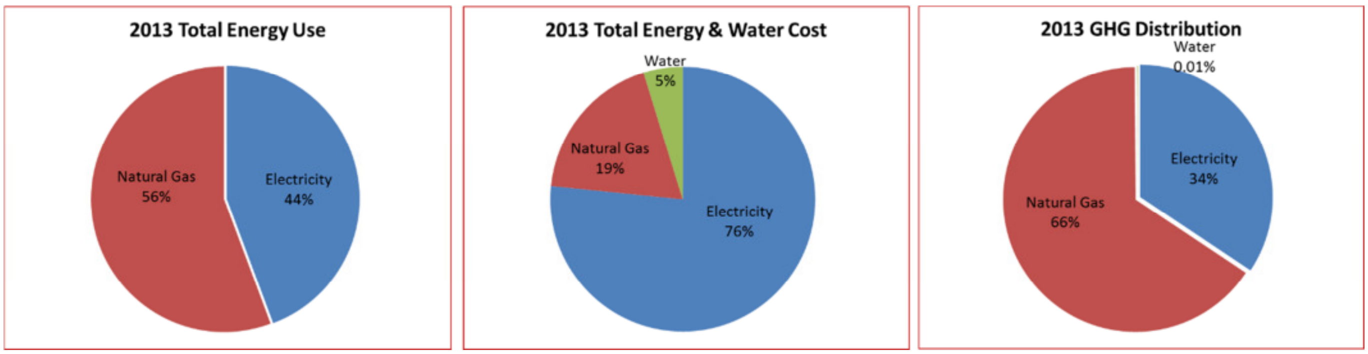


Figure 7: CAMH Russell St Site 2013 Energy Use and Cost Breakdown



2.3 Energy Targets

The energy targets presented in Table 1 for College Street site, and in Table 2 for Russell Street site, are based to the extent possible on good performance standards from comparable healthcare facilities combined with the actual energy usage profiles and data collected for the two buildings. The component targets identify current areas of inefficiency which this ECDM plan addresses, and the dollar savings if the buildings were operating at these levels of efficiency in 2013.

Table 1: College St Site Component Energy Target Performance

Component	Target Performance		Areas for Attention
	Percent	$/year	
Electrical Base	14%	$108,004	Fan power, lights and equipment
Electric Cooling	29%	$18,519	Cooling plant and ventilation system controls
Electric Heating	80%	$23,629	Ventilation reheat and system controls
Heating Thermal	28%	$54,474	Boiler plant and ventilation system controls
Base Thermal	10%	$2,423	Domestic hot water heating
Water	21%	$29,847	Metering, fixtures, losses
TOTAL		**$236,895**	

Table 2: Russell St Site Component Energy Target Performance

Component	Target Performance		Areas for Attention
	Percent	$/year	
Electrical Base	29%	$138,787	Fan power, lights and equipment
Heating Thermal	48%	$75,861	Heating plant and ventilation system controls
TOTAL		**$214,649**	

2.4 College Street Site Energy Efficiency Improvements

The energy conservation measures along with associated energy savings and preliminary budget costs are summarized in Table 3, and described more fully below. The focus of the work is on renewing and retrofitting older equipment and technology, making more use of the building automation system, and strategy development for rationalizing building systems in research areas and better managing energy use in the longer term. The measures are forecast to achieve a large part, but not all of the target savings shown in Table 1. More in-depth investigation which is the first stage of implementation will verify the potential savings, firm up budget costs and incentives, and may identify additional measures for consideration.

Table 3: College St Site Proposed Energy Efficiency Measures

#	Site	Description	Budget Implementation Cost $	Annual Savings $/year	Estimated Incentives $	Simple Payback years
1	College	South Tower Ventilation Improvements	$224,000	$53,673	$40,146	3.43
2	College	North and West Buildings HVAC Rationalization	$32,500	$ -	$ -	-
3	College	South Tower Chiller Plant Retrofit	$97,500	$11,111	$10,101	7.87
4	College	BAS Optimization	$131,135	$31,647	$13,478	3.72
5	College	Lighting System Improvements	$377,012	$53,662	$24,392	6.57
6	College	Water Conservation	$37,500	$7,462	$ -	5.03
7	College	Departmental/Staff Engagement	$10,000	$7,560	$6,873	0.41
8	College	Electricity Sub-metering	$60,000	$ -	$ -	-
9	College	Project Direction, M&V and reporting	$72,000	$ -	$ -	-
		TOTALS	**$1,041,646**	**$165,114**	**$94,989**	**5.73**

2.4.1 South Tower Ventilation Improvements

The floors of the South Tower are evenly divided between patient care and administration. The tower is served by two main air handling systems which have to run continuously for the patients. Airflow and associated energy use can be reduced when the administration areas are unoccupied. Staff is already experimenting with using a lower capacity fan during those periods.

This measure will test and adjust the ventilation systems as required, and install variable speed drives on the fans and zone dampers on the administration floors. The new equipment will be connected to the building automation system, programmed for energy efficiency and monitored to ensure it is working as intended.

Measure Life: This measure should remain effective for 15 years, with periodic monitoring and re-testing to see if adjustments are required.

2.4.2 North and West Buildings HVAC Rationalization - Study

Relatively high energy use components indicate plant inefficiencies which are attributed in part to the intensive and complex building systems in the research areas of the building. Gas-fired steam boilers and hot water heat exchangers are supplemented by an electric steam boiler and gas-fired heat exchangers in air handling units, and by standalone domestic water heaters. Electric reheat coils in some units are energy intensive, and have insufficient capacity to maintain building temperature in extreme cold weather. Chillers are supplemented by direct expansion refrigeration units in air handling units as well as standalone air conditioners, and dry coolers which operate in winter.

This measure will investigate and test all these systems in order to develop a rationalization strategy which has flexibility and capacity for current and future research needs, while using the most efficient equipment, minimizing reheat and making best possible use of free cooling. The energy savings to be achieved through this initiative will be determined through this study.

Measure Life: This study will set the stage for long-term optimization of equipment type, system design and capacity as well as energy use.

2.4.3 South Tower Chiller Plant Retrofit

The existing cooling plant design features two older chillers which have been de-rated due to refrigerant change-out, with series evaporator configuration which is inherently less efficient than parallel flow. Pump flow rates may now be mismatched with chiller and cooling tower capacities. Recent installation of control valves on chilled water coils may not be working as intended.

This measure will redesign piping for parallel chilled water flow. The chillers, along with chilled and condenser water flow rates and cooling tower performance, will be tested and adjusted as required for best performance. Updated control of plant enable/disable and supply water temperature will maintain optimal energy efficiency. Trend logs from the building automation system will confirm actual control operation, and help verify improvements.

Measure Life: This measure will remain effective for 5 years at which time equipment re-testing should be performed.

2.4.4 Building Automation System Optimization

College Street site has a powerful building automation system (BAS) which controls the operation of the large number of interrelated components of its building systems. Many of the thoughtful and innovative control strategies practised by staff can be made permanent and in some cases optimized by updating the BAS operating sequences. A review of outdoor temperatures recorded by the BAS indicates that re-calibration of sensors is required. Setting up trend logs will enable malfunctioning devices such as airflow dampers and control valves to be identified and corrected.

This measure will provide a comprehensive analysis, updating and upgrade of the BAS to address operation of sensors and control devices, smart programming and full use by staff of the system's capabilities.

Measure Life: This measure will remain effective for 5 years, subject to ongoing monitoring, at which time a further review will be appropriate.

2.4.5 Lighting System Improvements

Existing lighting has a mix of older and current technologies, including some remaining obsolete T12 fluorescent, incandescent, MR16 and metal halide. This measure will conduct a lighting audit of the building, leading to selectively retrofitting and replacing lighting in areas with older technology and higher power densities than current good practice standards. Occupancy and photo controls will be applied where appropriate as well as additional centralized or local switching.

Measure Life: This measure will replace old technology and standardize products in use, and will continue in effect for fifteen years or until newer technology makes further retrofits and replacements cost effective.

2.4.6 Water Conservation

Water use at College Street site is relatively high. This measure will monitor and analyze flow rates at different times of day through a central interval meter, and follow up with targeted testing and inspections to identify, and correct where cost-effective, inefficient equipment and fixtures as well as leaks and losses.

Measure Life: This measure will repair and replace fixtures and equipment, and will continue in effect for ten years subject to ongoing monitoring of consumption.

2.4.7 Departmental/Staff Engagement

Use of lighting, along with IT and other equipment used by hospital staff, account for a significant portion of electricity use and costs. Engaging the IT Department in network control strategies can significantly lower electricity use. Broader departmental engagement in switching off lights and equipment when not in use can also contribute material energy and cost savings. Such a campaign will help reinforce the CAMH conservation culture, and make everyone part of energy efficiency success.

Measure Life: This measure will set the stage for continuing, active departmental involvement in raising energy performance.

2.4.8 Electricity Sub-metering

This measure provides for sub-metering to enable monitoring and management of equipment and areas of the building with substantially different use and occupancy profiles.

Measure Life: This measure will continue in effect for the life of the facility subject to periodic revisions if equipment or usage patterns change significantly.

2.5 Russell Street Site Energy Efficiency Improvements

The energy conservation measures along with associated energy savings and preliminary budget costs are summarized in Table 4, and described more fully below. The focus of the work is on renewing the remaining older equipment and technology (including the building automation systems in particular), along with strategy development for integrating building systems and better managing energy use in the longer term. The measures are forecast to achieve a large part, but not all of the target savings shown in Table 2. More in-depth investigation which is the first stage of implementation will verify the potential savings, firm up budget costs and incentives, and may identify additional measures for consideration.

Table 4: Russell St Site Proposed Energy Efficiency Measures

#	Site	Description	Budget Implementation Cost $	Annual Savings $/year	Estimated Incentives $	Simple Payback years
1	Russell	Ventilation Systems Retrofit and Re-Balancing	$390,000	$83,828	$67,156	3.85
2	Russell	HVAC System Controls and BAS Expansion	$252,000	$37,284	$15,791	6.34
3	Russell	Cooling Plant and System Controls	$97,500	$-	$-	-
4	Russell	Heating Plant and System Controls	$162,500	$30,345	$9,483	5.04
5	Russell	Lighting System Improvements	$373,750	$55,405	$25,184	6.29
6	Russell	Departmental/Staff Engagement	$10,000	$7,787	$7,079	0.38
7	Russell	Selectively sub-meter large loads	$30,000	$-	$-	-
8	Russell	Project Direction, M&V and reporting	$72,000	$-	$-	-
		TOTALS	**$1,387,750**	**$214,649**	**$124,693**	**5.88**

2.5.1 Ventilation Retrofits and Re-Balancing

The most recent testing of the main air handling systems indicates that overall airflows, and the balance between supply, return and exhaust, are close to design, but potentially higher than required for current use. Testing also reveals unusually high static pressures in a number of systems. Relatively high use of base electricity (fans) indicates potential for savings through modifications and better control of ventilation systems.

Ventilation for the parking garage is provided by the cooling tower (for the air conditioning system) which is located in a central well drawing air through all three parking levels. The fan power consumed by this arrangement appears to be several times what would be required for conventional exhaust fans. A recent engineering report recommends replacement of this tower, with consideration given to new, standalone exhaust fans with carbon monoxide control for the garage.

This measure will advise on the parking garage ventilation, as well as identifying and correcting excessive airflows and restrictions in the main air handling units, along with any identified faulty dampers and control valves. The high static pressures in the air supply systems will be corrected as far as economically practical, and recommendations made on longer term system modernization. Operating sequences programmed into the building automation system will be assessed and upgraded as necessary. More in-depth system testing, along with trend logs of actual control performance, will isolate the issues, identify corrective actions and verify savings. These measures typically obtain good energy savings, incentive payments and payback periods.

Measure Life: This measure should remain effective for 5 years, at which time systems should be retested to see if adjustments are required. Monitoring of the building automation system, along with electricity and gas use will identify any significant efficiency losses during this period.

2.5.2 HVAC Controls and BAS Expansion

The existing building automation system (BAS) is rudimentary and both replaces and is supplemented with mechanical time-clocks for some equipment. Upgrade and/or expansion appear to only occur when new systems are replaced (e.g. the DHW system). Russell Street site is a large and relatively complex building which requires a more functional control system to optimize operations and energy use. Expansion of the automation system and upgrading to smarter control strategies for HVAC systems will help make permanent the savings already achieved, while further improving energy performance, particularly heating gas use. The viability of replacement rather than expansion will be reported on, which would require a somewhat bigger capital budget (e.g. almost all actuators are pneumatic).

The upgraded system will make use of smart operating sequences which respond to actual demand from the building at different times of day and weather conditions. Importantly it will incorporate the exceptional operating practices being employed by staff to maximize free cooling with outdoor air and prevent simultaneous heating and cooling. Trend log functionality will enable close monitoring of actual system operation and environmental conditions so that performance can be optimized over time. Operating staff will participate in system selection and design so that they can make full use of the new capabilities.

Measure Life: This measure will bring the building up to date and remain effective for 15 years, at which time technology advances may lead to a further upgrade. Monitoring of the system as well as ongoing electricity and gas use will identify any significant efficiency losses during this period.

2.5.3 Cooling Plant and System Controls

The recently installed new chillers are more efficient than their predecessors. The cooling tower was not replaced and is now potentially mismatched with the new chillers. The cooling coils on the air handling units do not have control valves, which limits the potential for smart control.

The cooling tower is planned for replacement (see Section 2.5.1), and that capital cost is not included in this plan. This measure will advise on tower selection and location, test and adjust pump flow rates as necessary, install variable speed drives on pumps and control valves on coils, and implement smart operating sequences to get the best performance out of the cooling plant.

Notwithstanding the existing system disadvantages, cooling electricity use at Russell Street site is relatively efficient. These improvements, along with current operating practices, can be expected to lower electricity use below the good practice target energy consumption used for this plan.

Measure Life: This measure will provide a high performance cooling plant and remain effective for 20 years, at which time technology advances may lead to a further upgrade. Monitoring and periodic re-testing will identify any significant efficiency losses during this period.

2.5.4 Heating Plant and System Controls

Gas consumption has been significantly reduced over the past 3 years through operational measures and, more recently, installation of upgraded controls on the main heating boilers. Seasonal performance is now inconsistent, with generally lower gas consumption relative to degree-days in the spring and higher in the fall. Maintenance issues being experienced with the boilers may be due to reduced heating water temperatures causing corrosion.

This measure will install primary/secondary piping on the main heating circuit, and will allow full control of heating water temperatures without damage to the boilers. The work includes boiler condition testing to establish remaining useful life and identify any remedial work required.

Measure Life: This measure will preserve and enhance the gas savings being recorded now without damaging the boilers, and will continue in effect for the remaining useful life of the plant.

2.5.5 Lighting System Improvements

Existing lighting has a mix of older and current technologies, including some remaining obsolete T12 fluorescent, incandescent and metal halide. This measure will conduct a lighting audit of the building, leading to selectively retrofitting and replacing lighting in areas with older technology and higher power densities than current good practice standards. Occupancy and photo controls will be applied where appropriate as well as additional centralized or local switching.

Measure Life: This measure will replace old technology and standardize products in use, and will continue in effect for fifteen years or until newer technology makes further retrofits and replacements cost effective.

2.5.6 Departmental/Staff Engagement

Use of lighting, along with IT and other equipment used by hospital staff, accounts for a significant portion of electricity use and costs. Engaging the IT Department in network control strategies can significantly lower electricity use. Broader departmental engagement in switching off lights and equipment when not in use can also contribute material energy and cost savings. Such a campaign will help reinforce the hospital's conservation culture, and make everyone part of energy efficiency success.

Measure Life: This measure will set the stage for continuing, active departmental involvement in raising energy performance.

2.5.7 Electricity Sub-metering

This measure provides for limited sub-metering to enable monitoring and management of areas of the building with substantially different use and occupancy profiles.

Measure Life: This measure will continue in effect for the life of the facility subject to periodic revisions if usage patterns change significantly.

2.6 Renewable and Geothermal Energy

There is no renewable or geothermal installation at CAMH College Street or Russell Street sites, and none is planned for the term of this ECDM Plan.

3 Implementation

Most of the measures described in Section 2 are planned for implementation over the duration of this plan, as funds become available and in order to realize the economic and operational benefits. The next stage of the work involves targeted, in-depth investigation, metering, measurement and testing of existing systems to establish the overall vision and strategy, and to then fully define the individual measures, and firm up the preliminary budget costs and savings potential presented in the plan. Approved projects will be designed and tendered, and monitored to ensure the efficiency gains are realized. The implementation budget includes energy management direction and coordination, measurement and verification of savings, and reporting on results. CAMH will continue to closely monitor ongoing energy performance and savings through the Greening Health Care online energy management system.

Where practical, electricity conservation measures for implementation in 2015 will be identified by the end of 2014 so that applications can be submitted for Toronto Hydro incentives.