Mount Sinai Hospital
Murray Street and Orde Street Sites
Energy Conservation and Demand Management Plan

Leadership in Energy Efficiency

Mount Sinai Hospital's two facilities at 60 Murray Street and 25 Orde Street in Toronto house administration, medical services and world-class research in new or modernized buildings. This plan presents the energy and utility cost savings to be achieved through targeted retrofits and comprehensive operation and control improvements to the building systems to match the specific uses and requirements of the buildings.

JULY 1, 2014

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 Mount Sinai Hospital by Enerlife Consulting.

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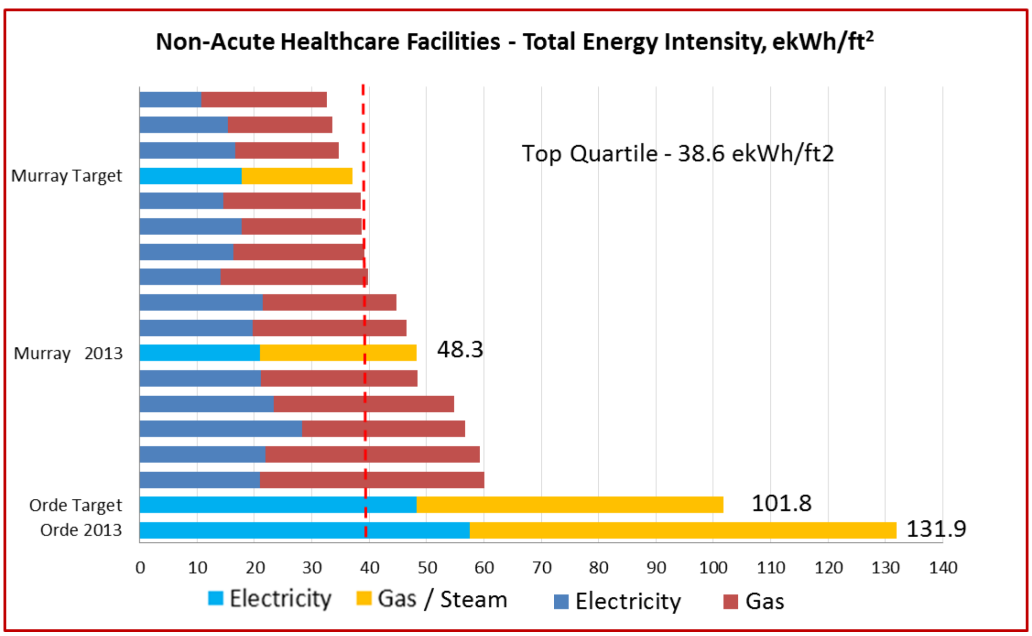
Summary

Mount Sinai Hospital's two sites at 60 Murray Street (Murray Street) and 25 Orde Street (Orde Street) in Toronto house important and energy intensive research, medical services and administration functions, in relatively new or modernized facilities. Building systems incorporate modern technology, and staff have implemented a number of operational and control changes aimed at lowering energy use. This Energy Conservation and Demand Management (ECDM) plan, prepared in accordance with Ontario's Green Energy Act Regulation 397/11, lays out the current energy performance of the two buildings, and the savings to be achieved through comprehensively addressing building system inefficiencies. The plan projects energy targets for the two sites – the attainable performance levels when inefficiencies have been rectified - and identifies key areas for attention and initiatives as the hospital works towards these goals over the next five years.

The 2013 energy performance of Murray Street (Murray 2013) and Orde Street (Orde 2013) sites is shown in Figure 1 along with the projected benchmark positioning of the two sites following attainment of the energy target presented in Section 2.3 of this plan (Murray Target and Orde Target). The energy-intensive nature of the research activities at Orde Street accounts for its relatively high energy use. The two sites are compared with peer facilities in the Enerlife database[1].

Figure 1: Mount Sinai Murray St Site and Orde St Site Total Energy Intensity



[1] Enerlife Consulting has developed and manages a large, dynamic national database of hospital energy use. Many hospitals use the database for benchmarking their buildings' energy use, setting targets, and tracking energy performance over time.

1 Commitment to Energy Efficiency

1.1 Previous Energy Initiatives

Orde Street is less than 10 years old, and Murray Street began a full renovation in 2004 and was occupied by 2010. With relatively new equipment and technology, energy conservation efforts have been primarily directed towards operational improvements.

The monthly performance chart in Figure 2 shows the weather-normalized changes in energy use at Murray Street since 2010. Small increases in 2012 and 2013 are attributed to growth in use of the building.

Figure 2: Mount Sinai Murray St Site 2011-2014 Total Energy Savings

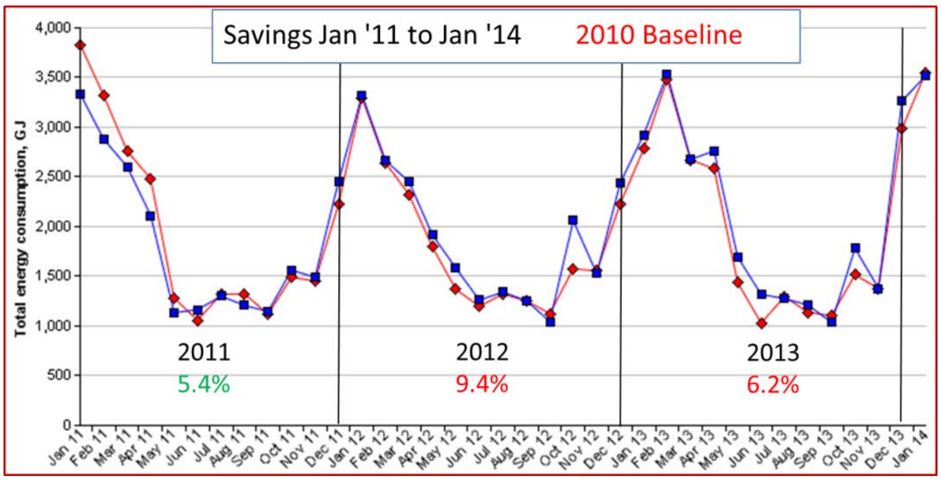
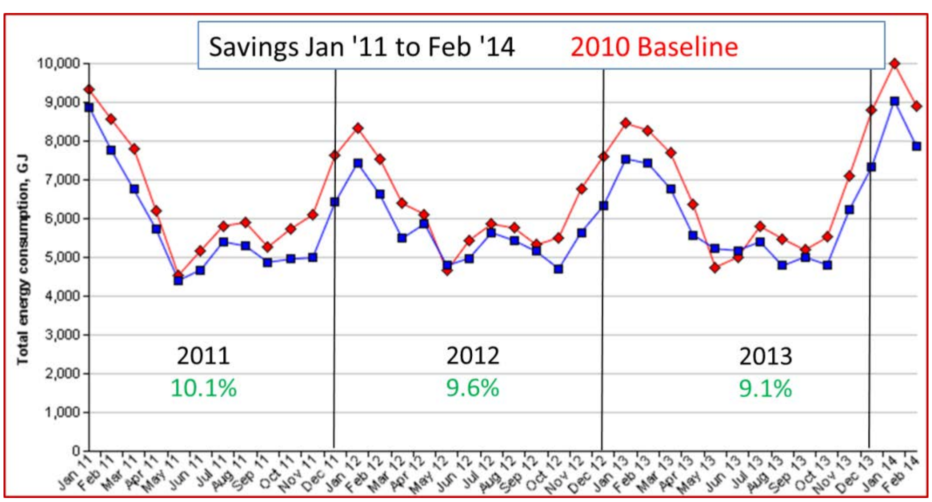


Figure 3 presents the energy savings at Orde Street since 2010, which are due to operational changes made by staff.

Figure 3: Mount Sinai Orde St Site 2011-2014 Total Energy Savings



1.2 Current Initiatives

Apart from the previously mentioned attention to facility operations, there are no current energy conservation initiatives underway.

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

2.1 Goals and Objectives

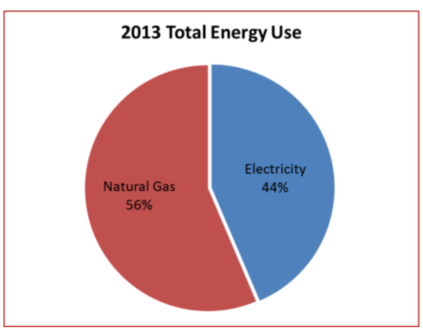
Mount Sinai's commitment to leadership in research and patient care is central to the hospital's strategic plan. The overarching goal for these buildings is to provide excellent working environments for research programming and staff. Within this context, improved cost performance is a core business strategy, and Mount Sinai's objective with respect to energy conservation is to optimize utility expenditures consistent with excellence in research and patient care.

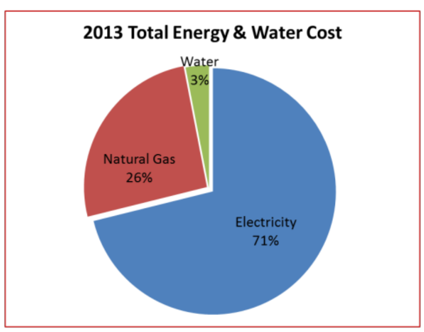
2.2 2013 Energy and Water Performance

In 2013, Murray Street site used more than 3 million kWh of electricity and over 380 thousand m3 of gas, spending a total of approximately $560,000 (including water). Orde Street site used almost 8.7 million kWh of electricity and over 32Mlbs of steam, spending a total of more than $1.5 million (including water). Murray Street 2013 water use at 41.9 litres/ft2 was efficient relative to comparable administrative buildings. Water consumption at Orde Street in 2013 was considerable at 244.6 litres/ ft2, and is attributed primarily to the research programs along with significant use by the cooling plant.

2013 energy use and cost breakdowns for each site are presented below. Natural gas (Murray Street) and steam (Orde Street) account for the largest share of energy use and greenhouse gas (GHG) emissions. The relatively high electricity price is responsible for electricity's larger share of utility costs. Electricity, gas, steam 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 4: Mount Sinai Murray St Site 2013 Energy Use and Cost Breakdown





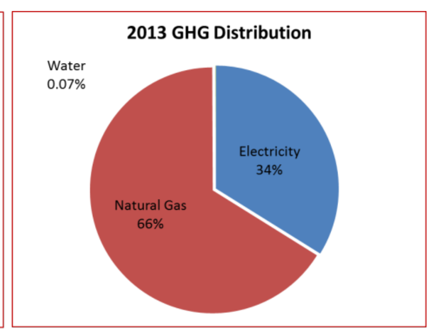
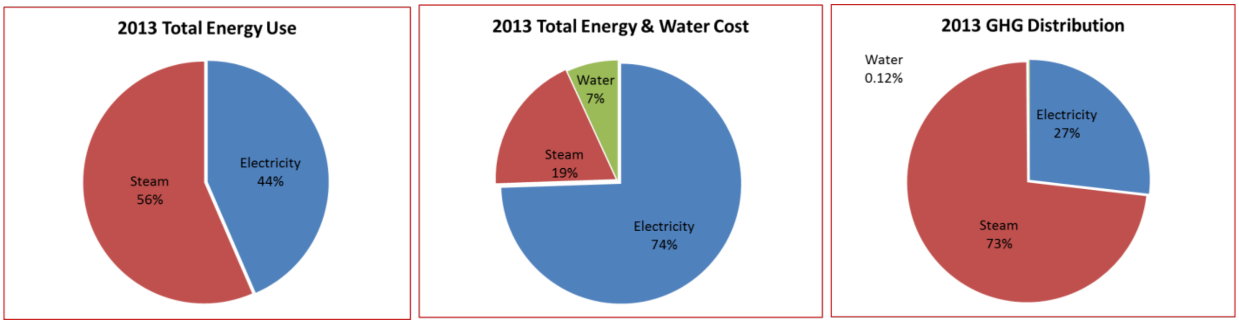


Figure 5: Mount Sinai Orde St Site 2013 Energy Use and Cost Breakdown



2.3 Energy Targets

"Top-down" energy targets shown in Tables 1 and 2 below are based, to the extent possible, on good performance standards for individual energy use components from other comparable facilities. This analysis serves to quantify the overall savings potential to be expected from systematically tackling all building systems, operations and occupant behaviour, and also points to the areas of current inefficiency which this ECDM plan addresses in order to work towards the targeted performance.

Table 1: Mount Sinai Murray St Site Component Energy Target Savings

Component	Target Savings		Primary Areas for Attention
	Percent	$/year	
Electric Base	16%	$60,611	Fan power, operation of lights and equipment
Electric Cooling	6%	$1,476	Ventilation control and cooling plant
Thermal Heating	33%	$41,490	Ventilation system operation and controls
TOTAL	**23%**	**$103,578**	

Table 2: Mount Sinai Orde St Site Component Energy Target Savings

Component	Target Savings		Primary Areas for Attention
	Percent	$/year	
Electric Base	14%	$131,535	Fan power, operation of lights and equipment
Thermal Base	33%	$57,325	Heating system controls (reheat)
Electric Cooling	29%	$45,420	Ventilation control and cooling plant
Thermal Heating	20%	$22,171	Ventilation system operation and controls
Water	5%	$5,683	Metering, plumbing fixtures, and losses
TOTAL	**23%**	**$262,134**	

2.4 Murray Street Energy Efficiency Improvements

Specific initiatives included in this five year ECDM plan for Murray Street are shown in Table 3, along with preliminary budgets and savings estimates. These measures, described in more detail below, are projected to deliver a substantial part, but not all of the targeted top-down savings potential shown in Table 1. Further testing, monitoring and investigation of individual systems, which is the next stage of plan implementation, can be expected to verify the magnitude of the savings for these measures and/or identify additional measures for consideration. As scopes of work are further developed, budget costs and available incentives will be firmed up.

Table 3: Murray St Site Proposed Energy Efficiency Measures

#	Description	Budget Cost $	Annual Savings $/year	Estimated Incentives $	Simple Payback years
1	Ventilation System Retrofit and Re-Balancing	$142,999	$29,178	$17,711	4.29
2	HVAC System Controls	$126,000	$32,487	$15,522	3.40
3	Heating Plant and System Controls	$97,500	$16,596	$3,298	5.68
4	Lighting System Improvements	$120,750	$18,294	$14,072	5.83
5	Departmental/Staff Engagement	$10,000	$3,031	$2,331	2.53
6	Energy Advisor/coordination (24 months)	$48,000	$-	$-	
	TOTALS	**$545,249**	**$99,586**	**$52,935**	**4.94**

2.4.1 Ventilation Systems Retrofit and Re-Balancing

Ventilation systems account for the largest part of the building's energy use, and of its estimated conservation potential. This measure will be informed by in-depth testing of the main systems in order to identify airflow imbalances, undue static pressures and other system conditions contributing to high energy use. Corrective actions will be identified which will firm up savings, implementation costs and incentive amounts. Where appropriate dampers will be installed to facilitate zone control. The work will also evaluate actual airflow rates against current standards, and the airflow balance of the building as a whole to avoid excessive air movement between areas due to imbalances. This initiative also includes identification and repair or replacement of any leaking, oversized or undersized airflow control valves or dampers.

Measure Life: This measure should remain effective for 5 years, at which time systems should be retested to see if adjustments are required.

2.4.2 HVAC System Controls

The heating, ventilation and air conditioning systems comprise many interrelated elements, including central heating and cooling plants, unitary/package roof-mounted equipment, heating and cooling coils and control valves, air control dampers and actuators, and pumps, fans and drives. Proper operation and control of these elements through the building automation system delivers good indoor environmental quality with optimal energy use and cost. Targeted savings indicate potential for better HVAC system control.

Operating schedules will be revisited based on current use and occupancy of different areas of the building. Where practical HVAC systems will be shut down during unoccupied periods instead of the current practice of supply pressure reset. Trend logs of ventilation systems have been set up to reveal specific inconsistencies in temperature controls which cause higher than necessary heating and cooling energy use. This initiative includes re-programming of the building automation system with smart operating sequences such as demand-based temperature resets, and verification that controls are working correctly through use of trend logs. A tune-up of sensors, controllers, operating sequences and control devices will lower energy consumption and provide consistent environmental controls.

Measure Life: This measure should remain effective for 2 years, at which time the trend log diagnostic exercise should be repeated. Close monitoring of electricity and gas use in the interim will identify any significant efficiency losses.

2.4.3 Heating Plant and System Controls

This measure will test boiler efficiencies and pump flow rates, and make necessary adjustments to ensure that heating energy is produced as efficiently as possible.

Measure Life: This measure will require boiler re-testing every 1-2 years and pump re-testing every 5 years.

2.4.4 Lighting System Improvements

While the existing lighting was installed with up-to-date technology as part of the renovation, there are areas with unduly high power densities including corridors and local halogen lamps. This measure will conduct a targeted audit of high power density areas to identify specific improvements with budget implementation costs and confirmed energy savings and incentives.

Measure Life: This measure will last for ten years or more, subject to future changes in standards or available technology.

2.4.5 Departmental/Staff Engagement

Operation of lighting, along with IT, medical and other equipment used by 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 Mount Sinai'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 the energy performance of Mount Sinai.

2.5 Orde Street Energy Efficiency Improvements

Specific initiatives included in this ECDM plan for Orde Street are shown in Table 4, along with preliminary budgets and savings estimates. The measures include in-depth testing, monitoring and investigation of mechanical systems which are expected to deliver the largest part of the targeted energy and cost savings. This study will identify immediate improvements, and also develop any recommended system design modifications which can provide longer-term energy and operational benefits.

The measures, described in more detail below, are projected, over the duration of this plan, to deliver a substantial part, but not all of the targeted top-down savings potential shown in Table 2. Further testing during the next stage of plan implementation can be expected to confirm the magnitude of savings for individual measures and/or identify additional measures for consideration. As scopes of work are further developed, budget costs and available incentives will be firmed up.

Table 4: Orde St Site Proposed Energy Efficiency Measures

#	Description	Budget Cost $	Annual Savings $/year	Estimated Incentives $	Simple Payback years
1	Lighting System Improvements	$226,950	$34,119	$13,123	6.27
2	HVAC System Testing and Optimization - Study	$70,000		TBD	
3	Water Conservation	$7,500	$5,683	$-	TBD
4	Departmental/Staff Engagement	$10,000	$6,577	$5,059	0.75
5	Energy Advisor/coordination (24 months)	$72,000	$-	$-	

2.5.1 Lighting System Improvements

While the existing lighting was installed with up-to-date technology at the time of construction, there are areas with unduly power density including corridors and the shipping and receiving area. This measure will conduct a targeted audit of high power density areas to identify specific improvements with budget implementation costs and confirmed energy savings and incentives.

Measure Life: This measure will last for ten years or more, subject to future changes in standards or available technology.

2.5.2 HVAC System Testing and Optimization - Study

The most noteworthy elements of energy use at Orde Street are very high cooling electricity use and base (summer) gas consumption, which indicate overcooling of ventilation air and associated reheating to maintain required indoor environmental conditions. The ventilation, heating and air conditioning equipment is generally high quality, the systems are relatively complex, and their performance is vital to the integrity of the research conducted at the facility. The systems appear to have been designed with substantial margins which affect operating performance as well as energy use. System testing at the time of construction indicated ventilation rates close to design.

Control of the building systems is equally important to maintaining required environmental conditions and energy efficiency. Staff has implemented operational changes which are savings energy, and these practices can be made permanent and enhanced through the sophisticated building automation system.

Seasonal efficiency of the cooling plant is the third contributing factor to overall HVAC performance. There have been some operational issues with the plant under low load conditions, and the set-up and sequencing of both the cooling plant and the heating systems have a substantial impact on operating performance and energy efficiency.

This study will conduct in-depth testing of the major ventilation systems, pumps, chillers and cooling tower to determine current operating performance, and identify areas where energy efficiency gains can be made which maintain or enhance indoor environmental conditions. Overall system design will be assessed to determine if modifications can further improve longer-term performance. The study will define immediate improvements with budget implementation costs and estimated energy cost savings and incentives. It will also present options for possible system design improvements along with benefits.

Measure Life: This study will set the stage for immediate HVAC improvements and present a longer-term strategy and rationale for system improvements.

2.5.3 Water Conservation

While research programming accounts for the largest part of water use, about 20% of 2013 consumption is associated with the air conditioning plant. This measure will test and monitor consumption by the cooling plant and throughout the building to identify and correct leaks, losses and other conservation opportunities.

Measure Life: This work will identify and correct water leaks and losses and determine cost-effective retrofit opportunities in plumbing fixtures and equipment.

2.5.4 Departmental/Staff Engagement

Operation of lighting, along with IT, research and other equipment used by 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 Mount Sinai’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 the energy performance of Mount Sinai.

2.6 Renewable and Geothermal Energy

There are no renewable or geothermal installations at either facility, 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 in priority sequence over the life of this plan in order to realize the economic and operational benefits as early as possible. The next stage of the work involves targeted, in-depth measurement and testing of existing systems to fully define the individual measures and firm up budgets and savings estimates. Individual projects will then be designed and tendered, and the work supervised and results monitored to ensure the efficiency gains are realized. A multi-disciplinary implementation team will bring together the best available knowledge and experience with mechanical and electrical system design, testing and balancing and building automation, along with facility management and operators. The team is charged with reviewing performance data, identifying the best measures, verifying savings and driving continuous improvement. The implementation budget includes costs for project direction and coordination, measurement and verification of savings, and reporting on results.

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.