



Markham Stouffville Hospital

2019-2023 Energy Conservation and Demand Management Plan

JUNE 21, 2019

Under Ontario Regulation 507/18, Ontario's broader public sector organizations are required to develop and publish an Energy Conservation and Demand Management (ECDM) Plan by July 1, 2019. Technical advice and analysis for this ECDM Plan were provided by [Enerlife Consulting Inc.](#)

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Executive Summary

Markham Stouffville Hospital's (MSH) Facilities and Corporate Services dedicated team has prepared this Energy Conservation and Demand Management (ECDM) plan (the Plan) that will reduce energy consumption and greenhouse gas (GHG) emissions, lower utility costs, upgrade building systems and provide a positive economic return on investment. The Plan presents energy savings achieved and lessons learned from 2014-2018, and lays out the goals, strategy and business case for the Hospital's energy efficiency investments over the next five years. We are committed to improving our energy efficiency, while maintaining occupant comfort and meeting the expectation of the general public and the Ministry of Health to efficiently deliver the highest quality healthcare services to our community.

The Plan is posted on the MSH website under Greening Initiatives and Energy Performance and forms an integral part of the Hospital's public reporting. It is aligned with the MSH 2019-22 Strategic Plan and serves as a microcosm of the hospital's Strategic Enablers, exemplifying:

- Communication, ensuring that staff has the information they need to play an active part in energy efficiency;
- Learning Organization, with constant internal enquiry and collaboration with other hospitals driving continuous performance improvement;
- Finance, investing in the hospital's energy and water efficiency to drive sustainable operating cost savings;
- Infrastructure, taking a long-term view to keep building systems up to date; and
- IT and Innovation, making full use of technology to support building performance and operational efficiency.

Table 1 presents actual, weather-normalized energy and water savings achieved in 2018 at the Markham Stouffville hospital compared to the 2014 baseline. Overall 4% energy savings were recorded, lowering utility costs by more than \$100,000 and greenhouse gas (GHG) emissions by 273 tonnes. Water use increased by 20%. Further details on the measures implemented between 2014-2018 can be found in Part 3 of the Plan.

Table 1 2018 energy and GHG emissions savings vs 2014 baseline

Actual savings in 2018 (2014 baseline)

Electricity Reduction (kWh)	967,826	5%
Natural Gas Reduction (m3)	132,387	3%
Water Reduction (increase) (m3)	(-17,779)	-20%
Total Energy Reduction (ekWh)	2,338,031	4%
Total Cost Reduction (\$)	\$104,092	2%
GHG reduction (tonnes CO2e)	272	

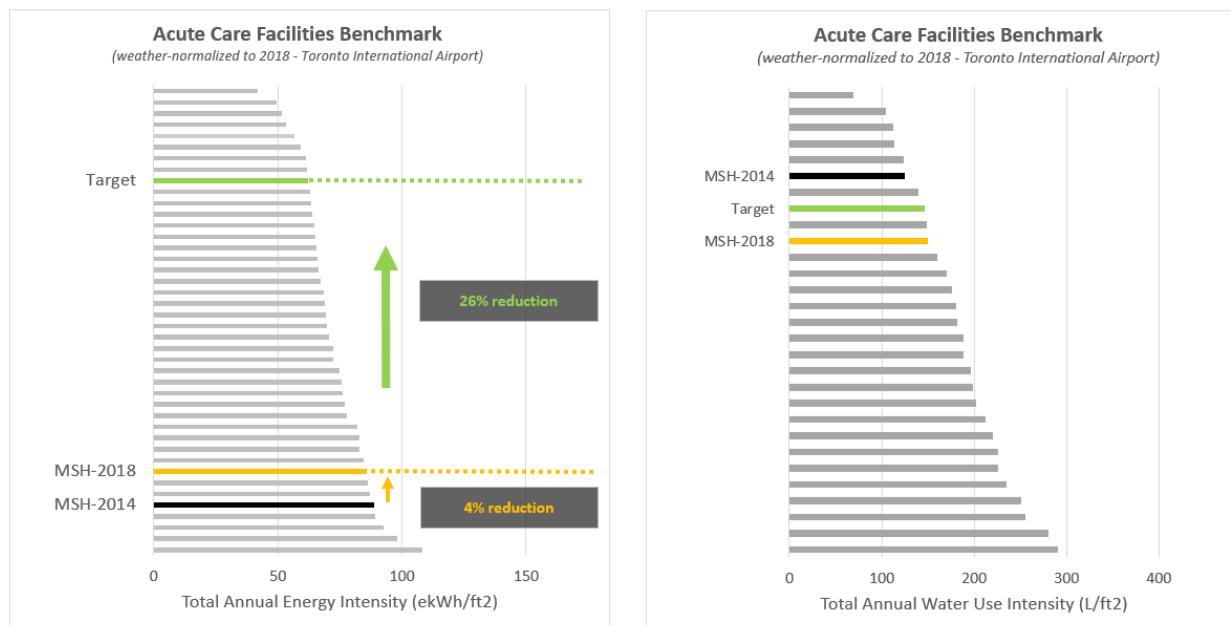
Building on this achievement, lessons learned over the past 5 years can help us do even better in future and have been incorporated into the Plan. Key among these are a focus on long-term planning and building organizational capacity and alignment through training, information and engagement. There is strong organizational support for energy efficiency and sustainability. We have a powerful building

automation technology platform at the Markham Stouffville site and a knowledgeable and engaged facility operations team. Priorities going forward include further integration of technology into facility operations and maintenance and bringing the Uxbridge site up to a high level of energy and operational performance.

Over the past 5 years we have been recognized by Greening Health Care¹ for our achievements. In 2018 we received the CHES Wayne McLellan Award of Excellence, Canadian College of Healthcare Leaders Energy and Environmental Stewardship Award, and the Donald Cousins Environmental Leadership Award sponsored by the Markham Board of Trade. Community-based events have been successful in communicating our actions and accomplishments. We will continue involving hospital departments, staff and the patient community in energy and water efficiency and sustainability to help build a learning organization with a well-integrated and dynamic team. Further effort in the next 5 years will be focused on the business case for investment in high ROI energy and water efficiency projects, along with reinforcing operational effectiveness through staff training, team meetings and further development of our energy data reporting and communication. Lessons learned are presented in more detail in Part 2, Section 3.

Our goal for the Markham Stouffville site over the next five years (2019 to 2023) is to reduce energy use by 26.4% (13.7% electricity and 32.8% natural gas) measured against the new 2018 baselines. The planned improvements will move us into the top quartile of the benchmark chart of acute care hospitals as shown in Figure 1 below. We will also develop a robust efficiency plan and targets for the Uxbridge site.

Figure 1 MSH energy and water benchmarks for 2014, 2018, and the 2023 target



¹ Founded in 2004, Greening Health Care is the largest and longest serving program of its kind in North America, helping hospitals work together to lower their energy costs, raise their environmental performance and contribute to the health and well-being of their communities.

The planned improvements at the Markham Stouffville site prioritize upgraded control sequences to minimize overcooling and reheat in ventilation systems, reduce fan and pumping power and correct the over-pressurization, particularly in the new building. Conversion of lighting to modern LED technology will be completed with power density standards applied so that over-lighting is avoided. We will fully operationalize and integrate the lighting control system. The replacement air handling units being installed in Building A in 2019 will be set up for optimized scheduling, airflows and controls to make them fully energy efficient from the outset.

We will conduct an audit of the Uxbridge site as the foundation of the energy efficiency plan for that facility.

Table 2 below summarizes the energy and water efficiency improvements included in the scope of the Plan. Manageable work packages will be prioritized and scheduled over the 5-year period based on capital availability and project management capacity. Implemented measures are projected to bring in \$344,000 of utility company incentives and yield electricity and natural gas savings worth over \$700,000 per year at current utility rates. The associated GHG emissions reduction is 2,483 tonnes CO₂e per year.

Table 2 Energy and water efficiency projects summary

#	Measures	Description (<i>Note 1</i>)	Budget Costs	Savings \$/year	Incentives	Paybacks (with incentives)
1	Ventilation re-balancing and scheduling	Analysis of air test reports, re-balance to CSA, retrofits to allow zone control and reduce static pressure losses, adjust schedules	\$880,000	\$357,006	\$211,607	1.9
2	Re-programming controls	Automated supply temperature and SP reset, fan and pump speed controls	\$350,000	\$261,353	\$91,961	1.0
3	Lighting retrofit and controls	LED retrofit of patient room and CFL lighting, fully operationalize controls	\$350,000	\$31,926	\$21,284	10.3
4	Building envelope	Install white roofs, conduct thermographic scans, re-point brickwork, local draft-proofing and re-insulation	\$525,000	\$38,425	\$17,038	13.2
5	Renewable energy	Consider solar thermal air intakes, local photo-voltaics	\$115,000	\$5,764	\$2,556	19.5
6	Water conservation	Continue conversion to CHW cooling, implement autoclave water savers, toilet replacements	\$105,000	\$11,181	-	9.4
7	Uxbridge energy audit and plan	Conduct testing and analysis, prepare 5-year plan	\$15,000	-	-	-
8	Contingency		\$200,000	-	-	-
Total			\$2,540,000	\$705,655	\$344,445	<i>Note 2</i>

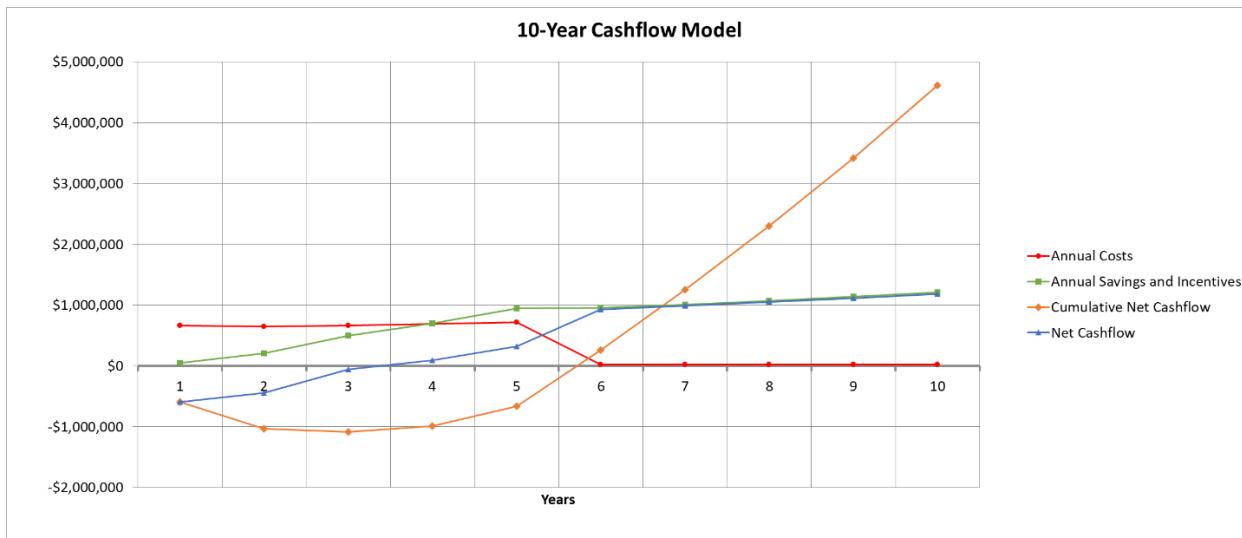
Note 1: Some measures are interrelated and cannot be implemented independently

Note 2: Overall simple payback affected by program management costs discussed in Section 4. These costs are included in Figure 2 cash flow model

The business case for investment is summarized in the cash flow forecast shown in Figure 2. The forecast incorporates all project and ECDM program management costs, along with utility cost savings and estimated incentives phased in over the 5-year period. The forecast accounts for inflation as well as

current utility cost escalation forecasts. Cumulative net cashflow breaks even in year 6. Net positive cash at the end of 5 years is \$323,377. Continuing, escalating savings yield a total cumulative net cashflow of \$4,611,716 at the end of 10 years after payment of all implementation costs.

Figure 2 Cashflow model



The rationale for investment is that the financial value is simply being realigned. MSH is choosing to invest in upgrading building systems, organizational capacity-building and long-term operating cost savings rather than excessive payments to utility companies due to inefficient energy and water consumption.

Part 1: Introduction

1 About MSH

MSH is one of Ontario's leading community hospitals. Across its two sites (Markham and Uxbridge) and the Reactivation Care Centre (RCC), the hospital has 329 beds and provides high quality, patient-centred care to more than 402,000 patients each year. It offers diagnostic and emergency services and delivers clinical programs in acute care medicine and surgery, addictions and mental health, and childbirth and children's services.

At MSH, 560 physicians, 25 midwives, 2,300 staff and 1,200 volunteers serve patients and families with an *honoured to care* mindset. The hospital partners with other providers to take this care beyond its walls and deliver an extraordinary patient experience to the residents of Markham, Whitchurch-Stouffville, Uxbridge and beyond.

The Plan focuses primarily on the main hospital. Energy and water targets and measures are provided for the main site only. Energy use for the Uxbridge site is reported in Part 3, Section 1.

Table 3 Sites in MSH

Site	Address	Building Area (ft ²)	Description	Status in ECDM Plan
Building A	381 Church St, Markham, ON L3P 7P3	325,000	Original hospital re-purposed to primarily patient rooms with clinical and administration services	Primary focus
Building B	381 Church St, Markham, ON L3P 7P3	385,000	New hospital with acute care and diagnostic services	Primary focus
Uxbridge	4 Campbell Dr, Uxbridge, ON L9P 1S4	25,391	20 bed facility with emergency and diagnostic services	Audit to be conducted to develop plan

MSH main hospital is an acute-care facility originally built in 1988. A 385,000 ft² LEED Silver expansion (Building B) was completed in 2013. Substantial ongoing development includes the replacement of most of the air handling units in Building A which will be completed in 2019.

MSH has a history of success with energy efficiency and our senior management is fully supportive of energy conservation projects with a focus on total life cycle costs. Funding is made available for energy and water conservation initiatives and the savings generated have been shown to repay these investments. An energy position was added to the facilities department in 2018 to create the organizational capacity needed to meet the goals of this Plan.

2 Planning horizon and scope

The planning horizon is the 5-year period from 2019 to 2023, prioritizing projects and organizational improvements which are manageable within this timeframe. Our strong partnership with Markham District Energy (MDE) will enable MSH to stay on top of requirements for low-carbon heating and cooling energy sources. We will continue to follow trends in technology in order to be well-prepared for future planning periods.

3 Other goals

MSH aims to be a leader in energy efficiency and corporate sustainability among our peers. We will continue our collaboration with other hospitals, working to raise the level of environmental sustainability across the healthcare sector as a whole. Our vision of “Care beyond our walls” will be exemplified through extending engagement with our surrounding communities, including events such as Earth Day which serve to reinforce a strong community sense of sustainability champions.

Part 2: Successes to date - Results from 2015-2018

1 Energy and water savings achieved

Table 4 presents actual, weather-normalized savings achieved from 2015 to 2018 compared to a 2014 baseline. 4% energy reduction was recorded in 2018, lowering 2018 utility costs by more than \$100,000 with an associated reduction of 273 tonnes CO₂e of greenhouse gas emissions.

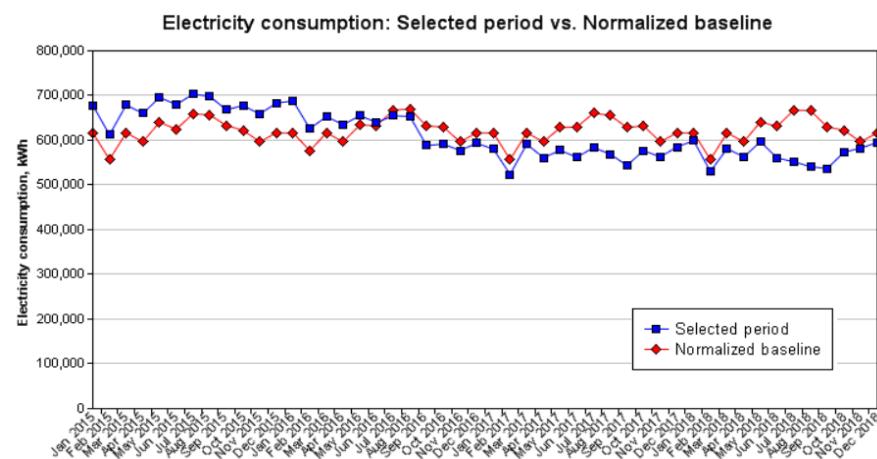
Table 4 2018 energy and GHG emissions savings vs 2014 baseline

Actual savings in 2018 (2014 baseline)

Electricity Reduction (kWh)	967,826	5%
Natural Gas Reduction (m ³)	132,387	3%
Water Reduction (m ³)	-17,779	-20%
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GHG reduction (tonnes CO ₂ e)	272	

The weather-normalized energy trends shown in figures below demonstrate the overall improvement through this period. The blue points are actual monthly energy use and the red points are the comparative, weather-normalized 2014 baselines. Blue points below the red points signify real savings.

Figure 3 Building A electricity usage (kWh) 2015 to 2018 compared to 2014 baseline



Building A electricity use increases in 2015 were due to construction activity associated with the new hospital supplied from the original building. Savings have been improving visibly since the summer of 2016 resulting mostly from lighting retrofits and scheduling of air handling systems. Smaller savings over the same period in Building B are attributed to lighting retrofits.

Figure 4 Building B electricity usage (kWh) 2015 to 2018 compared to 2014 baseline

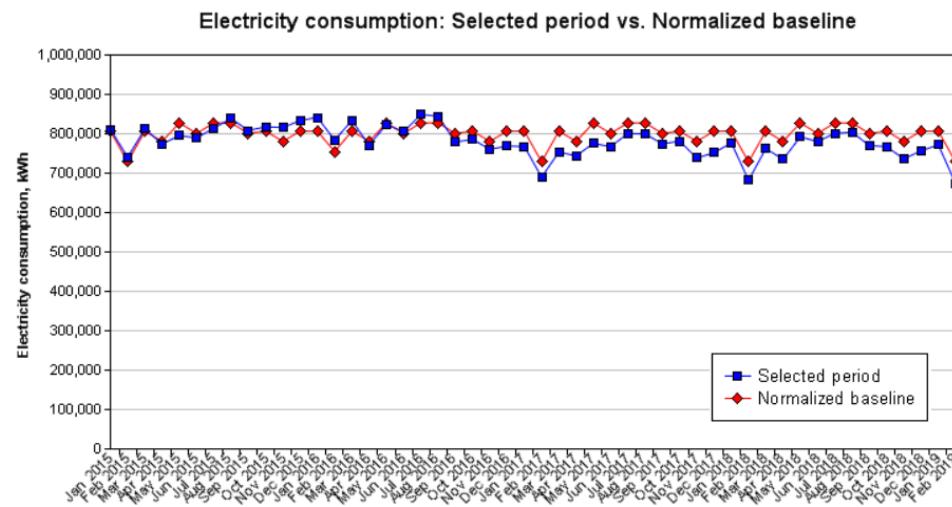
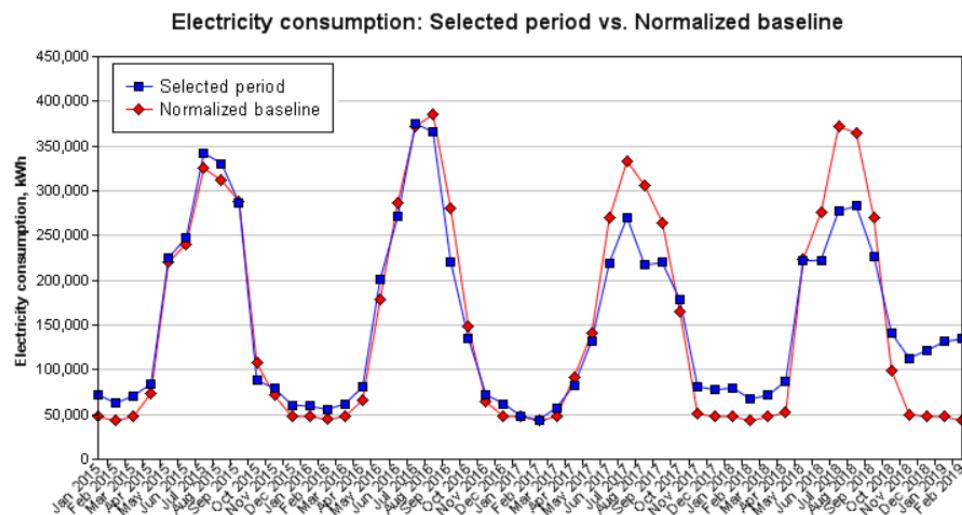


Figure 5 Building A chilled water usage 2015 to 2018 compared to 2014 baseline



Significant Building A chilled water savings (converted to kWh in the charts) seen in the summers of 2017 and 2018 are attributed to the scheduling of air handling systems, resetting supply temperatures and shutting down steam lines to mechanical rooms. The increases during winter months in 2017-18 and 2018-19 are due to medical and IT loads taken off inefficient domestic water cooling and added to the chilled water system, and to roofing projects last winter which required putting ventilation on mechanical cooling to avoid fumes entering the building. There was very little change in Building B chilled water use during this period.

Figure 6 Building B chilled water usage 2015 to 2018 compared to 2014 baseline

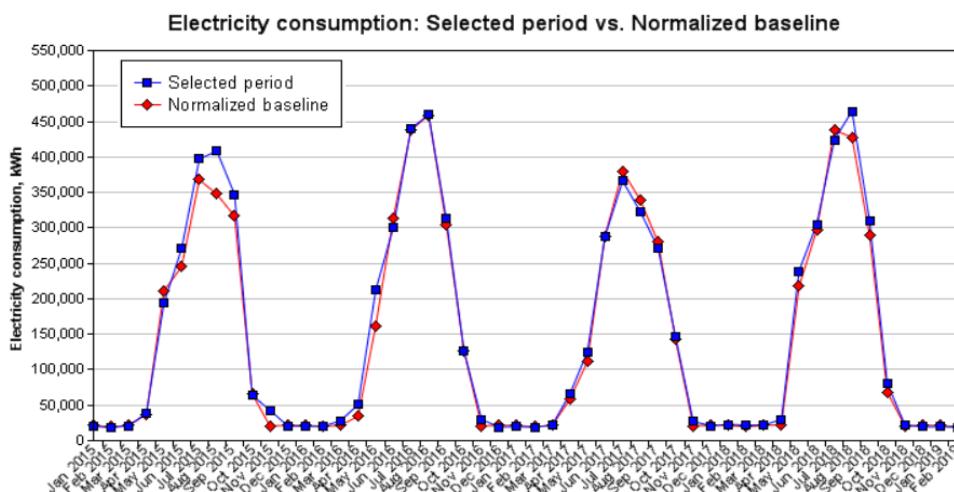
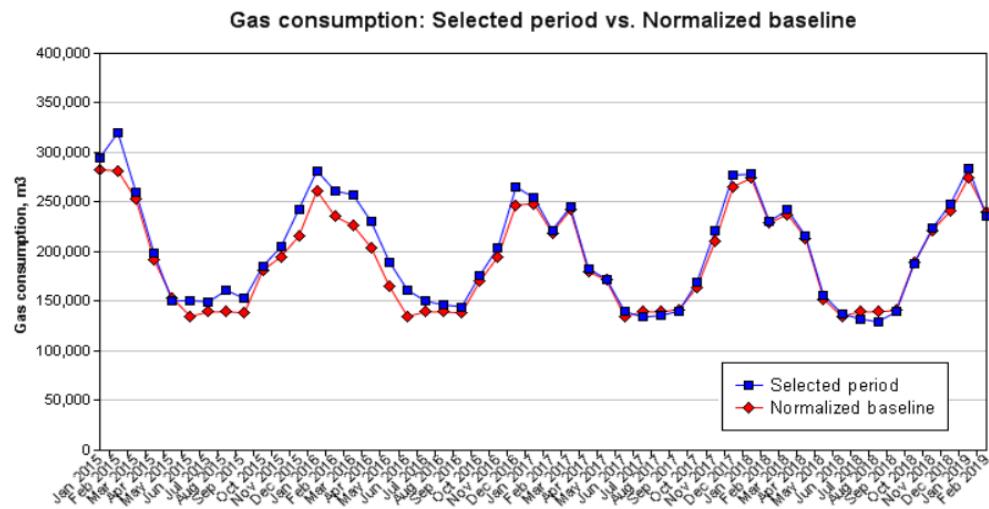


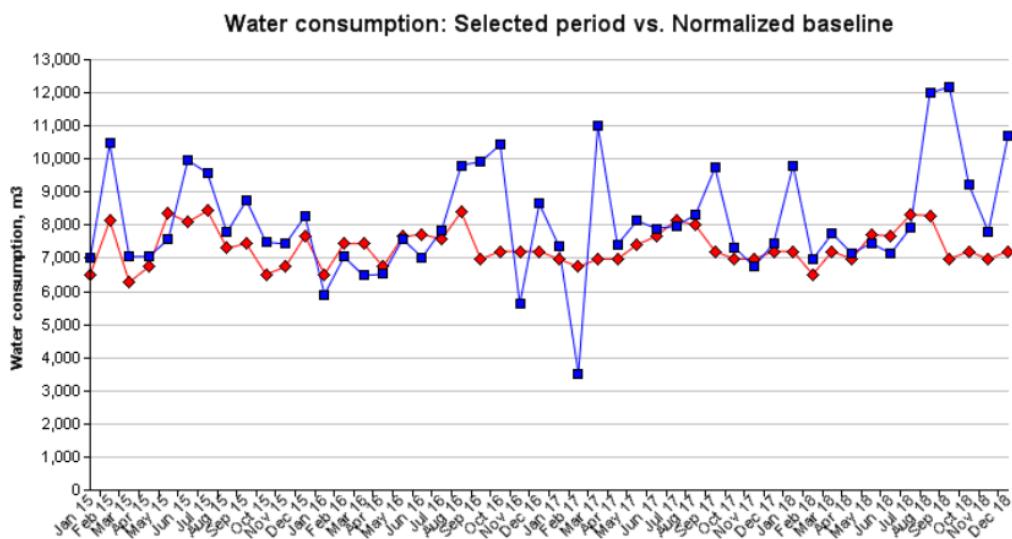
Figure 7 Combined (Building A + Building B) thermal usage (m³) 2015 to 2018 compared to 2014 baseline



Increases in natural gas consumption (Figure 7) seen in 2015-2016 have been offset by controls improvements put in place since 2017. Water use (

Figure 8) has been inconsistent throughout this period, primarily due to periods where domestic water backup was required for cooling, to metering and billing issues in 2017 and, more recently, to high quench water use caused by condensate quality.

Figure 8 Combined (Building A + Building B) water usage (m³) 2015 to 2018 compared to 2014 baseline



2 Measures implemented between 2016-2018

The following summarizes the measures implemented during this period and ongoing at the Markham Stouffville site:

- Comprehensive LED lighting retrofit which was completed in May 2019.
- Scheduling of air handling unit operation to match occupancy periods in building A (2016).
- 20 replacement air handling units (75% of the total) in building A which will be completed in 2019.
- Retrofitted heat recovery wheels and repaired bypasses in air handling units to allow reduced motor speeds.
- Reduced reheat by resetting supply air temperature setpoints.
- Shut down of Building A steam lines in summer and replacement of steam traps.
- Upgraded recirculation controls on air handling units.
- Water audit and beginning of conversion from domestic water to chilled water-cooled equipment.
- Installation of extensive sub-metering and system monitoring capability.
- Energy position hired to supplement organizational capacity.
- Increased operator involvement through Plant Services Committee.
- Annual steam trap audits.

3 Lessons learned

There have been many successes over the past five years along with lessons learned which will help us make further progress in the future. These lessons have informed the development of this Plan, and are summarized as follows:

- We have the advantage of new, state-of-the-art physical infrastructure. The new equipment can be optimized to deliver exceptional energy and environmental performance. Major opportunities lie in correcting the existing over-pressurization conditions and setting up the new Building A air handling units to optimize fan and pump power, heating and cooling energy, occupant comfort and air quality.
- We have a high-powered building automation system which can be programmed to deliver higher levels of energy and operational performance.
- Design and operational standards are needed to ensure that retrofits and renovations achieve consistently high performance, and that occupants are aware of the HVAC operating schedules and temperature and humidity set-points which are to be maintained.
- The Uxbridge site requires its own energy plan to ensure performance and service levels consistent with the main hospital.
- We have an engaged and knowledgeable facility operations and maintenance team which can become more effective through integration with the building automation, metering and monitoring systems.
- MSH has a strong culture which is supportive of energy efficiency and environmental sustainability. Further outreach and departmental engagement can deliver even higher performance while supporting the hospital's Strategic Plan.

Part 3: The plan for the next 5 years (2019-2023)

MSH has the potential to be among the most energy efficient acute care hospitals in Canada and is working towards top-quartile positioning in the Greening Health Care energy efficiency benchmark charts. The targeted further reduction of 25% in total energy use by 2023 compared with the 2018 baseline reflects the quality of the hospital's infrastructure and organization. The projects and management/organizational measures described below are together designed to achieve this goal along with utility cost savings worth \$838,000/year at 2018 rates and GHG emissions reduction of 2,483 tonnes CO₂e/year.

1 2018 and 2017 energy and water use

Table 5 presents 2018 energy and water use, costs and emissions for MSH main hospital and the 2017 energy use (most recent available) for the Uxbridge site.

Table 5 MSH main hospital 2018 energy use

	2018 Consumption	GHG Emissions (tonnes CO ₂ e)	2018 Cost
Electricity (kWh)	19,924,996	398	\$2,988,749
Gas (m ³)	3,861,812	7,399	\$870,940
Water (m ³)	106,683	1.29	\$425,667
Total		7,799	\$4,285,356

Table 6 Uxbridge site 2017 energy use

	2017 Consumption	GHG Emissions (tonnes CO ₂ e)	2017 Cost
Electricity (kWh)	788,149	16	\$118,222
Gas (m ³)	72,989	1,398	\$24,086
Total		1,414	\$142,309

2 Benchmark positioning and targets

Table 7 presents 2018 actual energy intensities and energy intensity targets for the main hospital (Buildings A and B combined) with targeted energy savings of 26.4% and targeted water savings of 2.6%. Achievement of these targets will result in over \$700,000 in annual utility cost savings and 2,483 tonnes CO₂e per year of GHG emissions reduction.

Table 8 presents the preliminary energy target for the Uxbridge site.

The targeted savings potential for the main hospital is further separated by energy components, which help direct efforts to the building systems and improvements with the biggest potential:

- Base electricity systems are fans, pumps, equipment and lighting. The significant savings potential lies mostly in fans and pumps;
- Electric cooling is the MDE chilled water supply with significant further savings potential;
- Base thermal systems are reheat in ventilation systems, domestic hot water, sterilizers and kitchens, with the big savings potential found mostly in reheat;
- Heating thermal systems are space and ventilation heating and humidification with significant savings potential identified in excessive use of outside air associated with the building over-pressurization.

Table 7 Hospital energy and water targets

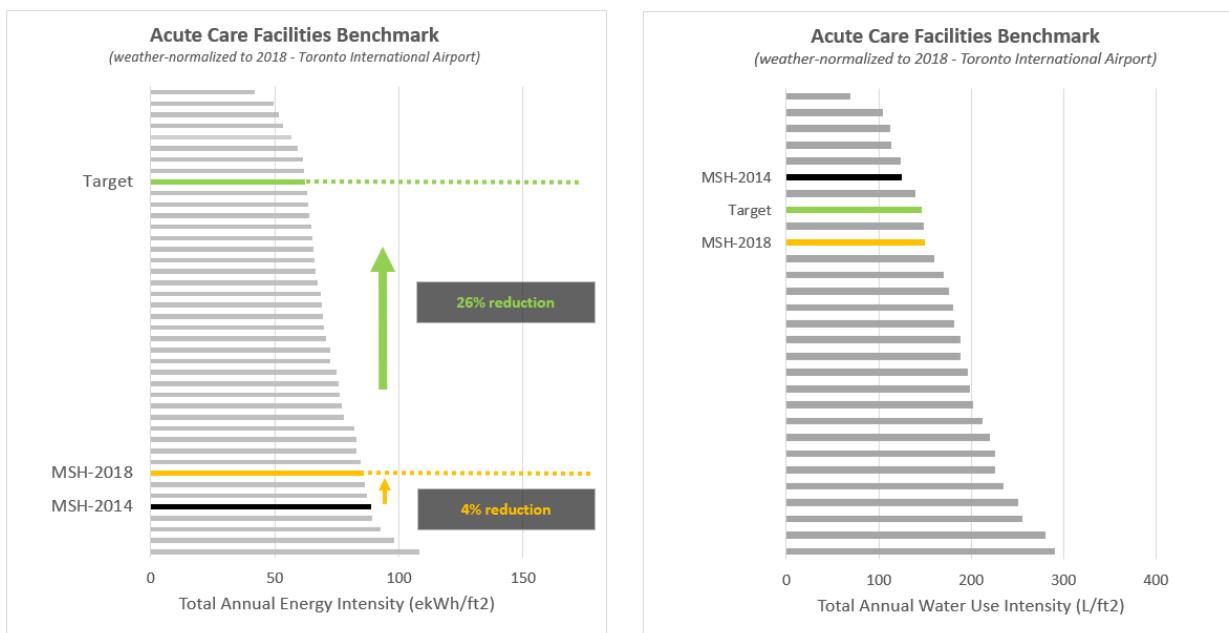
	Energy Usage Intensity (ekWh/ft2)		Target Savings vs 2018	
	Actual	Target	%	\$
Base Electricity	24.4	21.4	12%	\$324,582
Electric Cooling	3.6	2.9	22%	\$84,055
Base Thermal	30.0	21.2	29%	\$135,980
Heating Thermal	26.3	16.6	37%	\$149,857
Water (liters/ft2)	150.3	146.3	3%	\$11,181
Total	84.4	62.0	26.4%	\$705,655

Table 8 Uxbridge site preliminary energy target

	2017 Energy Usage Intensity (ekWh/ft2)		Target Savings vs 2017	
	Actual	Target	%	\$
Electricity	31.0	18.7	40%	\$47,001
Gas	29.7	25.6	14%	\$3,361
Total	60.8	44.3	27%	\$50,362

Greening Health Care sets good practice energy and water targets for its member hospitals based on top-quartile performance of comparable facilities in the Greening Health Care database and adjusted for weather and material site specific variables. The Plan has identified 64% of the electricity savings, 79% of natural gas and 100% of the water savings potential from the 2018 Greening Health Care targets. Other measures are expected to be uncovered over the course of the Plan which will account for the remaining savings potential, and can be considered by MSH for implementation at the appropriate time.

Figure 9 shows MSH positioning in 2014, 2018 and at the 2023 performance level which is the goal for the Plan.

Figure 9 2018 total energy and water use intensity benchmark charts

3 Energy efficiency measures

Table 9 summarizes the required retrofit projects and other measures together with their costs and savings, payback, and estimated GHG emissions reduction.

Table 9 Energy and water efficiency projects summary

#	Measures	Description (<i>Note 1</i>)	Estimated Measure Life (years)	Budget Costs	Savings \$/year	Incentives	Paybacks (with incentives)	GHG Emissions Reduction (tonnes CO2e)
1	Ventilation re-balancing and scheduling	Analysis of air test reports, re-balance to CSA, retrofits to allow zone control and reduce static pressure losses, adjust schedules	5	\$880,000	\$357,006	\$211,607	1.9	1,036
2	Re-programming controls	Automated supply temperature and SP reset, fan and pump speed controls	5	\$350,000	\$261,353	\$91,961	1.0	1,067
3	Lighting retrofit and controls	LED retrofit of patient room and CFL lighting, fully operationalize controls	10	\$350,000	\$31,926	\$21,284	10.3	4
4	Building envelope	Install white roofs, conduct thermographic scans, re-point brickwork, local draft-proofing and re-insulation	20	\$525,000	\$38,425	\$17,038	13.2	326
5	Renewable energy	Consider solar thermal air intakes, local photo-voltaics	20	\$115,000	\$5,764	\$2,556	19.5	49
6	Water conservation	Continue conversion to CHW cooling, implement autoclave water savers, toilet replacements	15	\$105,000	\$11,181	-	9.4	0.03
7	Uxbridge energy audit and plan	Conduct testing and analysis, prepare 5-year plan	5	\$15,000	-	-	-	
8	Contingency		N/A	\$200,000	-		-	
Total				\$2,540,000	\$705,655	\$344,445	Note 2	2,483

Note 1: Some measures are interrelated and cannot be implemented independently

Note 2: Overall simple payback affected by program management costs discussed in Section 4. These costs are included in Figure 2 cash flow model

3.1 Ventilation re-balancing and scheduling

- Scheduling air supplies based on occupancy
 - Fine-tune Building A schedules in consultation with departments
 - Implement Building B OR System scheduling, monitor and verify performance
 - Re-program/retrofit airflow control boxes to allow zone controls
- Testing and Re-balancing

- Analyze Building B test reports and Building A AHU replacement specifications, verify airflows against CSA requirements and supply/return/exhaust balance
- Correct over-pressurization in Building B
- Analyze static pressures, specify retrofits including silencer removal, system refurbishment
- Building A Patient Room Pods induction units
 - Test systems and implement immediate system and control improvements
 - Plan for replacement when funding available

3.2 Re-programming controls

- Analyze trend logs and implement hospital-wide supply air temperature and static pressure reset strategy through collaboration between operators and Honeywell
- As the new Building A air handling units and controls are installed, implement heating and cooling pump controls to maintain supply/return temperature differentials
- Evaluate and fine-tune summer steam system shutdown strategy

3.3 Lighting retrofit and controls

- Source and implement Building A patient room LED fixture retrofit
- Source and implement CFL fixture conversions to LED
- Operationalize hospital-wide lighting control system

3.4 Building Envelope

- Continue white roof replacements
- Conduct thermographic scan of building exteriors to identify high heat loss locations. Implement local draft-proofing and re-insulation as necessary

3.5 Renewable energy

- There are no existing renewable or geothermal installations at this facility. Consideration will be given to solar thermal installations on major ventilation air intakes and small-scale photovoltaics.

3.6 Water conservation

- Complete conversions from domestic water to chilled water cooling
- Implement autoclave water savers
- Replace old, inefficient toilets

3.7 Uxbridge Energy Plan

- Undertake audit, system testing and analysis to develop 5-year plan.

4 Management and organizational alignment

Key to MSH's success to date has been the strong corporate culture which is supportive of energy efficiency and sustainability along with engagement and active involvement of its facility operations team. An energy position was added to the team in 2018 to provide the capacity needed to support ongoing project implementation and development of the management systems necessary to achieve and sustain high performance over time. The following management and organizational developments form an essential part of the Plan to enable and support high levels of efficiency.

4.1 Strategic alignment

Explicit reference to energy and environmental performance in MSH's quality improvement and other strategic reporting will be considered to further reinforce with stakeholders its importance to the hospital.

4.2 Energy management and reporting

We will make full use of our investment in building automation, systems' monitoring and sub-metering capabilities by implementing an integrated performance reporting system. Enhanced transparency and motivation will be achieved through regular communication of actual savings results to all stakeholders, in particular facility operations staff, beginning with monthly savings and progressing towards weekly and real-time reporting. Regular team meetings will review results, identify solutions and brainstorm new ideas, document action items and follow up on implementation.

4.3 Integrated Building Performance Team

We will fully integrate our powerful building automation system into facility operations and maintenance through a team-based approach to optimizing and verifying control strategies, fine-tuning operations and responding to comfort and operational issues through our closed-loop work order system.

4.4 Staff training and support

Enhancing staff capability in energy management and building automation will be achieved by defining job-specific expectations, providing on-the-job training opportunities and working with service providers to provide necessary training and support.

We will make greater use of our membership in Greening Health Care by incorporating case studies into our in-house training, exposing more of our staff to the networking, workshops and webinars, earning recognition for our achievements and continuing to participate in the program's applied research into areas of opportunity for MSH.

4.5 Facility renovations and operating standards

We will put in place and reinforce design and operational standards to ensure renovations consistently deliver high-performance, and that HVAC service levels and user guidelines (such as use of solar blinds) are communicated and followed.

4.6 Energy management support

MSH created a new energy position in 2018 which will support successful implementation of projects, help ensure that renovations, equipment replacements and new-builds achieve high performance standards and work towards implementation of necessary management systems. The scope of responsibility includes:

- arranging integrated design and building performance team meetings
- concept and design development, budgeting, procurement, implementation and commissioning of energy and water efficiency projects
- business case development
- incentives management
- documentation
- outcomes-based service contracts

4.7 Occupant engagement and communications

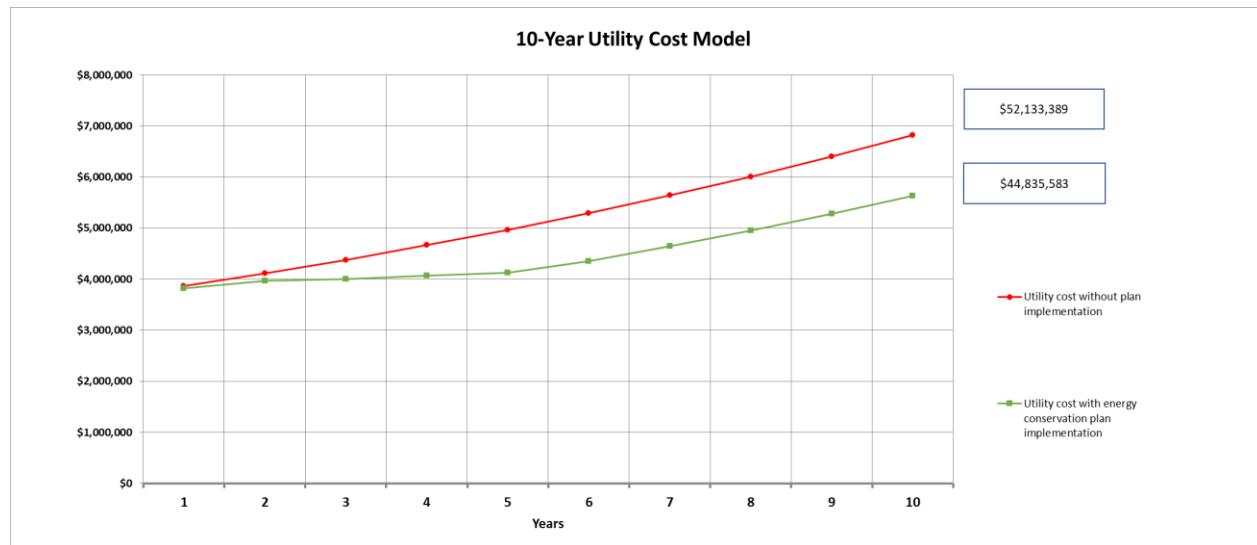
We will continue to encourage departmental input into operating schedules and project development and to communicate results achieved together with how occupants can help with further energy and water efficiency improvements.

5 Project timelines and financial forecast

5.1 Utility cost forecast

Figure 10 shows the 10-year annual utility cost forecast for MSH, with and without implementation of the project.

Figure 10 Utility cost forecast over the next 10 years



With current utility price escalation forecasts, the hospital's annual utility costs (electricity, natural gas and water) can be expected to rise from \$3.86 million in 2018 to \$6.8 million in 2028, for a ten-year total spend of over \$52 million. Implementation of the ECDM Plan is projected to lower that expenditure by \$2 million over the 5-year period of the Plan, while maintaining those savings over 10 years will provide cumulative savings of \$7.3 million due to implementation of the measures. These utility cost savings will fully repay the total investment in energy and water efficiency improvements and provide a positive net cash flow to hospital operations.

5.2 Phasing of work and annual capital expenditures

Table 10 below summarizes project completion % in each year, while Table 11 shows annual project and ECDM program management costs (accounting for inflation). The program management costs include the energy position established in 2018 along with additional needs identified by MSH to build organizational capacity in terms of training, reporting and communication.

Table 10 Project phasing

Measure	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Ventilation scheduling, rebalancing and upgrades	30%	50%	75%	100%						
Re-programming controls	30%	50%	75%	100%						
Lighting retrofit and controls	20%	40%	50%	75%	100%					

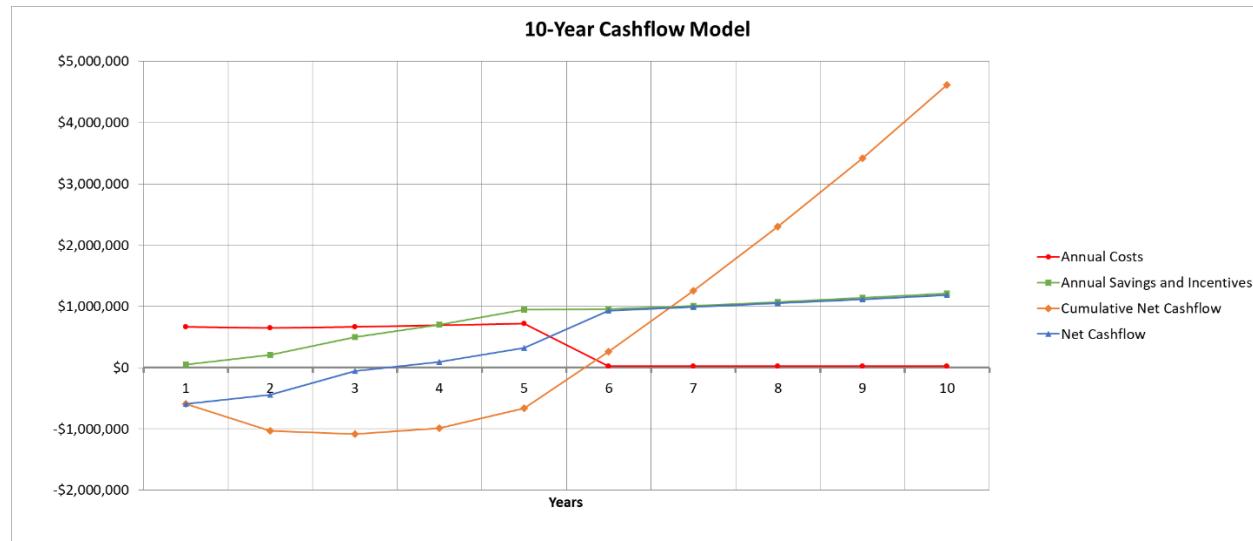
Measure	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Building envelope	10%	30%	50%	50%	100%					
Renewable energy	0%	0%	0%	0%	100%					
Water conservation	10%	40%	60%	100%						
Uxbridge energy audit and plan	40%	100%								
Contingency	5%	25%	40%	75%	100%					

Table 11 Annual costs

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Project cost	\$527,000	\$504,813	\$523,737	\$545,984	\$568,464	-	-	-	-	-
Program cost	\$140,000	\$143,500	\$147,088	\$150,765	\$154,534	\$22,628	\$23,194	\$23,774	\$24,368	\$24,977
Total cost	\$667,000	\$648,313	\$670,824	\$696,748	\$722,997	\$22,628	\$23,194	\$23,774	\$24,368	\$24,977

5.3 Cash flow and Internal Rate of Return

The cash flow model in Figure 11 and Table 12 below includes input from project cost, energy savings and utility incentives, and ECDM program management costs. The current model has an internal rate of return of 32% and payback period of 4.5 years.

Figure 11 Cashflow Model

The 10-year costs, savings, and incentives as well as key assumptions are summarized below.

Table 12 Cashflow model

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Total
Total cost	\$667,000	\$648,313	\$670,824	\$696,748	\$722,997	\$22,628	\$23,194	\$23,774	\$24,368	\$24,977	\$3,524,823
Incentives	\$19,859	\$59,576	\$115,319	\$93,545	\$95,033	-	-	-	-	-	\$383,332
Savings	\$34,995	\$148,630	\$386,689	\$607,673	\$856,308	\$952,790	\$1,012,016	\$1,075,012	\$1,142,024	\$1,213,314	\$7,429,451
Total incentives + savings	\$54,853	\$208,206	\$502,009	\$701,218	\$951,341	\$952,790	\$1,012,016	\$1,075,012	\$1,142,024	\$1,213,314	\$7,812,783
Net cashflow	-\$592,288	-\$1,032,395	-\$1,085,890	-\$987,876	-\$664,499	\$265,663	\$1,254,485	\$2,305,723	\$3,423,380	\$4,611,716	
Cumulative net cashflow	-\$592,288	-\$440,106	-\$53,496	\$98,014	\$323,377	\$930,162	\$988,822	\$1,051,238	\$1,117,656	\$1,188,336	

Assumptions

Inflation	2.5%	Elec. rate at 1st year (\$/kWh)	\$0.15
Electricity escalation rate	6.9%	Gas rate at the 1st year(\$/M3)	\$0.23
Demand escalation rate	6.9%	Water rate at 1st year (\$/M3)	\$3.99
Gas escalation rate	5%	Electricity incentives (\$/kWh)*	\$0.10
Water escalation rate	8%	Gas incentives (\$/M3)*	\$0.20

*Rates are based on current utility company incentive program structure, subject to change.

Management sign-off

I confirm that Markham Stouffville Hospital's senior management has reviewed and approved this 2019 - 2023 Energy and Conservation and Demand Management Plan.

Signature: Maria Pavone

Date: June 24, 2019

Name: Maria Pavone

Title: Director, Facilities and Corporate Services