NORTH YORK GENERAL

Making a World of Difference

North York General Hospital 2019-2023 Energy Conservation and Demand Management Plan

JUNE 20, 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

North York General Hospital (NYGH) 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 since the previous plan was posted in 2014, 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.

It should be noted that the hospital's ability to fully implement the Plan is dependent upon levels of annual funding received from the Ministry.

The Plan is aligned with the NYGH long-term Master Plan, laying directional foundations for energy- and water-efficient building systems' integration in the future expanded hospital. The Plan also forms an integral part of the Hospital's public reporting.

In the previously approved ECDM plan posted July 1, 2014, NYGH set a goal to reduce total energy (electricity and natural gas) intensity by 10% compared to a 2013 baseline over the plan's 5-year term. Water use was not addressed in the 2014 plan.

Table 1 presents actual results achieved, 6% energy savings were recorded in 2018 compared to our 2013 weather-normalized baseline, lowering utility costs by $252,369 (the 2014 ECDM plan was based on 2012 utility data baseline which has a minor 0.5% increase from 2012 in total energy usage). Cumulative savings over the five-year period total $741,751. Further details on the measures implemented can be found in Part 3 of the Plan.

Table 1 Energy and GHG emissions savings

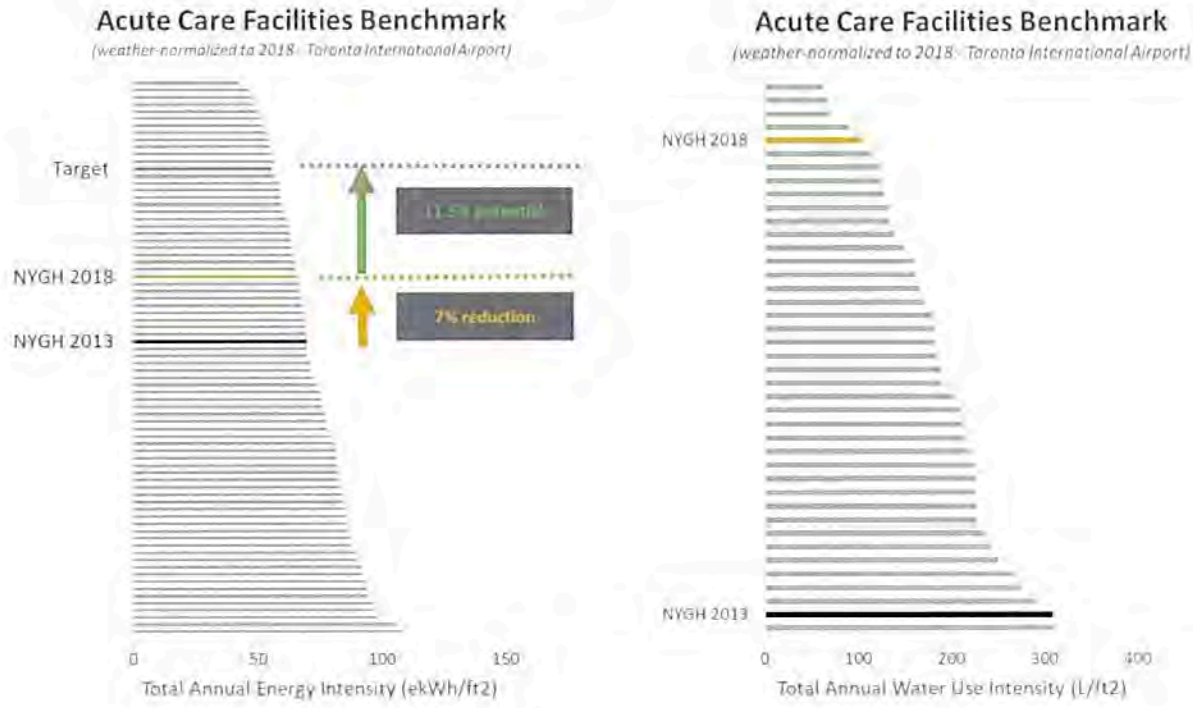
	2018 (2013 baseline)			
	2013 Target		**2018 Actual**	
Electricity Reduction (kWh)	1,873,013	10%	1,604,393	8%
Natural Gas Reduction (m3)	273,983	10%	107,981	4%
Total Energy Reduction (ekWh)	4,708,738	10%	2,721,995	6%
Total Cost Reduction ($)	$371,366	10%	$252,369	7%
GHG Reduction (tonnes CO2e)	600	10%	271	5%

Building on the savings achieved, 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 through training, information and engagement. NYGH has done well in engaging building operators, in reviewing renovation projects to ensure high energy efficiency standards and in responding quickly to government funding. We have been recognized by Building

Owners and Managers Association (BOMA) and Greening Health Care[1] for our achievements. Community-based events have been successful in spreading the word. We will continue involving hospital departments, staff and the patient community to build a learning organization with an integrated and dynamic team focused on energy and water efficiency and sustainability. Champions and key personnel will be identified, and a long-term capacity building framework established. 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 next five years (2019 to 2023) is to further reduce energy use by 11.5% (9.5% electricity and 12.8% natural gas) measured against the new 2018 baselines. These improvements will move NYGH into the top quartile of the benchmark chart of top performers as shown in Figure 1 below.

Figure 1 NYGH energy and water benchmarks for 2013, 2018, and 2023 target



The planned improvements prioritize operational efficiencies and management systems for long-term maintenance of savings, along with targeted investments in high-savings potential energy and water efficiency projects as described in Part 3. Capital renewal projects, including new builds and renovations, will be aligned with the building systems' vision of the Master Plan and will incorporate design standards to establish and achieve high-performance energy efficiency targets. Where practical, Health

[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.

Infrastructure Renewal Fund capital will be directed to projects which can deliver energy and water savings as well as replacement and upgrading of end-of-life building equipment and systems.

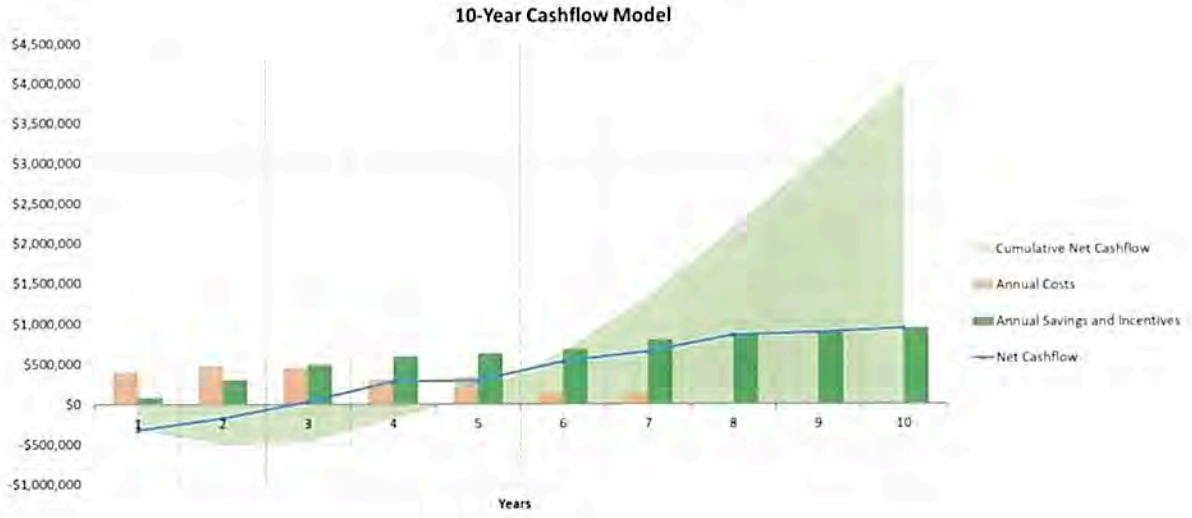
Table 2 below summarizes the energy and water efficiency improvements included in the scope of the Plan. Manageable work packages will be prioritized and scheduled over the ECDM plan period based on capital availability and project management capacity. Implemented measures are projected to bring in $240,000 of utility company incentives and yield electricity, natural gas, and water savings worth $519,000 per year at current utility rates. The associated GHG emissions reduction is 12.6% or 670 tonnes CO2e per 661 year.

Table 2 Energy and water efficiency projects summary

Measure	Description	Payback (Years)	Project Cost ($)	Total Savings ($)	Total Incentives ($)	GHG Emissions Reduction (tonnes CO2e)
Compressors replacement	Replace the current 2 air compressors to more efficient, variable-frequency systems with right-sized motor HP.			$14,793	$9,802	2
Water conservation	Convert existing water-cooled units and connect them to the main chilled water loop if necessary; Maximize free cooling; Upgrade water fixtures to more efficient types	0.4	$79,180	$159,708	$8,005	0.5
AHU optimization phase 1 (VFD adjustment)	Three systems in each phase: test to fix air leakage and high pressure drop components; balance supply and return to satisfy CSA standards; install zone dampers to enable scheduling of areas where possible; improve supply and return fan sequence to optimize SAT reset, thermal wheel controls, flow reduction and static pressure reduction.	1.3	$32,000	$15,961	$10,481	15
AHU optimization phase 2 (first 4 AHUs)		1.6	$128,000	$55,865	$36,685	51
AHU optimization phase 3 (next 4 AHUs)		2.6	$128,000	$39,903	$26,204	36
AHU optimization phase 4 (next 4 AHUs)		3.4	$128,000	$31,923	$20,963	29
Heating plant optimization	Following chiller optimization, reduce summer reheat usage and simultaneous heating and cooling. Investigate heating load and optimize main plant efficiency as well as reducing distribution losses.	1.4	$200,000	$98,923	$60,737	501
Lighting retrofit and controls	Convert current T-8s to LEDs and add occupancy/scheduling controls.	5.1	$555,918	$96,856	$64,065	13
Kitchen Hood Control	Install control system on kitchen hood to reduce hours of operation.	4.2	$25,000	$5,155	$3,297	14
Total			**$1,276,098**	**$519,087**	**$240,239**	**661**

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 incentive receipts, phased in over the 5-year period and accounting for inflation as well as current utility cost escalation forecasts. Cumulative net cash inflow is shaded green with breakeven in year 4. Net positive cash is $295,696 at the end of 5 years. Continuing, escalating savings yield a total cumulative net cashflow of $4,002,271 at the end of 10 years after payment of all implementation costs.

Figure 2 Cashflow model



The rationale for this investment is that this money is going to be spent anyway. NYGH is choosing to invest it on upgrading building systems, organizational capacity-building and long-term savings rather than excessive payments to utility companies due to inefficient energy and water consumption.

Part 1: Introduction

1 About NYGH

The Plan focuses primarily on the main hospital at 4001 Leslie Street. Energy and water targets and measures are provided for the main site only. Energy use for the hospital's other sites can be found in Part 3, Section 1.

Table 3 Sites in NYGH

Site	Address	Building Area (ft2)	Description	Status in ECDM Plan
North York General Main Hospital	4001 Leslie St	677,691	Acute care services	Primary focus
Seniors' Health	2 Buchan Ct	111,989	Long-term care	Not included: Major redevelopment planned
Medical Building	4000 Leslie St	12,075	Medical and other administrative offices	Not included
Phillips House	10 Buchan Ct	16,013	Ambulatory and transitional mental health services centre	Not included: Under major renovation, not yet operational
Branson Site	555 Finch Ave W	336,214	Former ambulatory care	Not included: NYGH will be moving out in 2020

NYGH main hospital is an acute-care facility originally built in 1964. A southeast wing was added in 2001 and various renovations and redevelopment have taken place throughout its operation. Major development and renovation projects in the past five years are outlined below.

- Complete renovation of previously empty floors 7 and 8 in the main hospital Southeast tower opened in 2017, adding 40 beds to the hospital capacity.
- Hospital Energy Efficiency Program (HEEP) projects in 2018 including VFD installations on 17 air handling units, Operating Room ventilation optimization, and chiller replacement project.

Future development projects are outlined below.

- The Paediatrics unit, Heart and Chemo clinics in the main hospital will be renovated and construction will start within this timeframe.
- The retail area renovation of the main hospital is under planning.
- The long-term Master Plan to construct an extension of the main hospital on the existing parking lot is under development.
- Seniors Health site is to be re-developed or retrofitted within the timeframe of this plan, however the detailed plan has not been finalized.
- Phillips House site is being fully renovated and will open within the timeframe of the Plan.

NYGH 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 of capital projects. Funding is made

available for energy and water conservation initiatives and the savings generated have been shown to repay these investments.

2 Planning horizon and scope

The planning horizon is the 5-year period from 2019 to 2023 with projects and organizational improvements which are manageable within this timeframe. We will also be following trends in technology, in particular building automation and low-carbon heating energy sources, in order to be well-prepared for future planning periods.

3 Other goals

NYGH aims to be a leader in energy efficiency and corporate sustainability among our peers. NYGH will continue engagement in community events such as Earth Day to solidify a strong community team of sustainability champions.

Part 2: Results from the past 5 years (2014-2018)

1 Energy and water progress compared to targets

In the previously approved ECDM plan posted July 1, 2014, NYGH set a goal to reduce total energy intensity (electricity and natural gas) by 10% over the plan's 5-year term.

Table 4 presents actual results achieved. A total 6% energy reduction were recorded in 2018 compared to our 2013 weather-normalized baseline, lowering 2018 utility costs by $252,369 with an associated reduction of 271 tonnes CO2e of greenhouse gas emissions. Cumulative savings over the five-year period total $741,751.

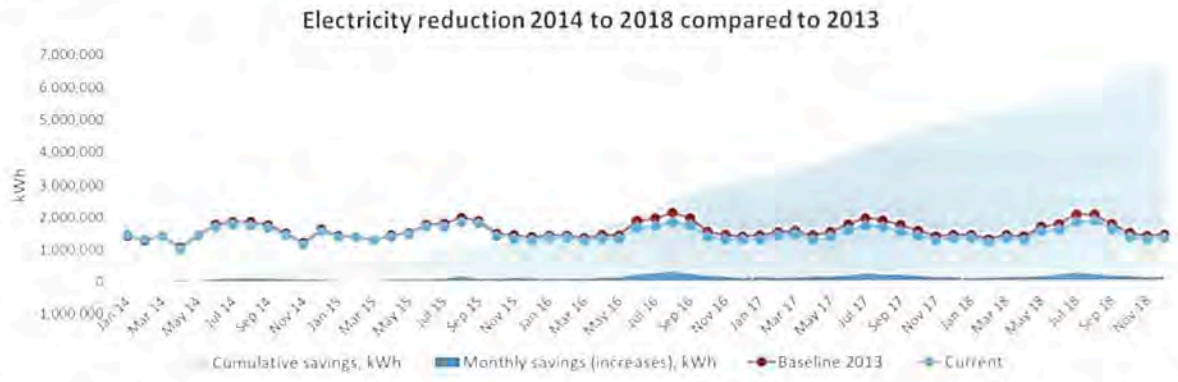
Table 4 Energy and GHG emissions savings

	2018 (2013 baseline)			
	2013 Target		**2018 Actual**	
Electricity Reduction (kWh)	1,873,013	10%	1,604,393	8%
Natural Gas Reduction (m3)	273,983	10%	107,981	4%
Total Energy Reduction (ekWh)	4,708,738	10%	2,721,995	6%
Water Reduction (m3) *	-	0%	141,847	68%
Total Cost Reduction ($)	$371,366	10%	$252,369	7%
GHG Reduction (tonnes CO2e)	600	10%	271	5%

*See note under Figure 6.

The weather-normalized energy consumption trends shown in Figure 3, Figure 4, and Figure 5 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 2013 baselines. Blue points below the red points signify real savings.

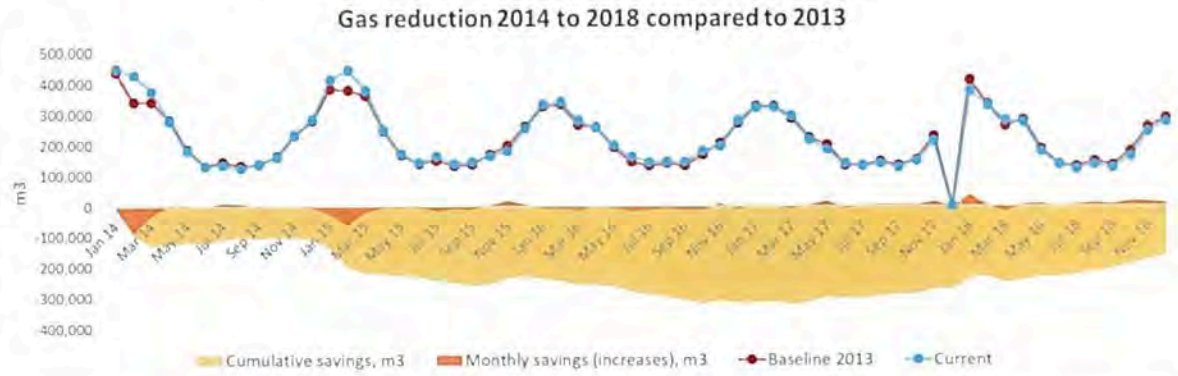
Figure 3 Electricity usage (kWh) 2014 to 2018 compared to 2013 baseline



Electricity use has been improving visibly since late 2014 with the Phase 1 and Phase 2 ventilation projects and some lighting retrofits.

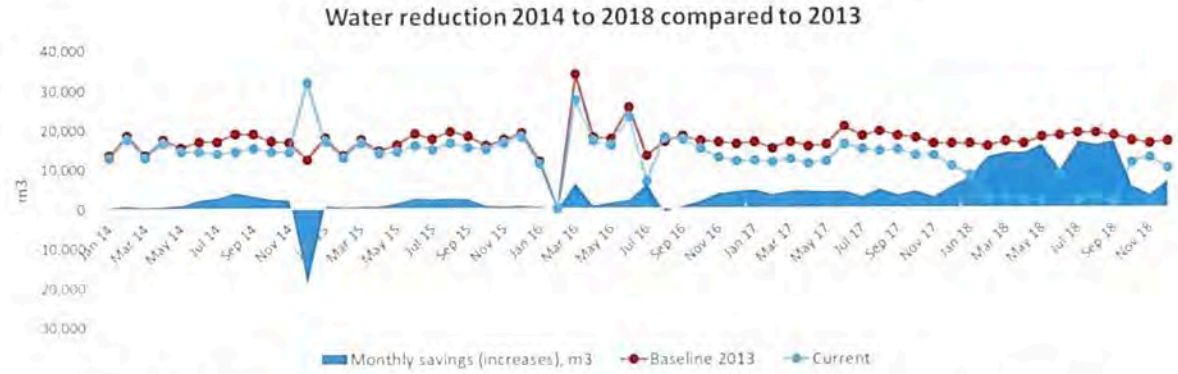
Figure 4 Electricity demand (kW) 2014 to 2018 compared to 2013 baseline

Figure 5 Gas usage (m3) 2014 to 2018 compared to 2013 baseline



The natural gas trend over the last five years shows significant setbacks during the beginning of 2014 and 2015. Improvements started in 2017 and continued through 2018.

Figure 6 Water usage (m3) 2014 to 2018 compared to 2013 baseline



Water use showed savings in the past five years except in January 2015 when city water had to be used as back-up to the cooling system and caused a spike. The water meter had an issue since 2017, resulting in significant reduction in registered water use.

2 Measures implemented between 2014-2018

Phase 1 and Phase 2 ventilation retrofit projects have made the biggest contribution to energy savings, which implemented variable frequency drives (VFDs) and scheduling for the hospital's highest-potential air handling units.

The following summarizes all measures implemented during the period of the 2014 ECDM Plan:

2.1 Ventilation systems optimization

- Phase 1 and 2 ventilation projects installed VFDs on major air handling units and enabled scheduling on these systems in 2014 and 2016
- Occupancy sensors were installed to control both the lighting and ventilation on the administrative areas on floors 7 and 8 in 2017
- An additional 18 VFDs were installed on air handling units in 2018
- An operating room ventilation project was completed in 2018 which added occupancy sensors, airflow stations and static pressure sensors to enable night setback on the air handling system
- The old induction unit air handling systems are being progressively removed and replaced

2.2 LED lighting conversion

NYGH has been working on LED lighting conversions since 2014.

- LED lighting and occupancy sensors were installed as part of renovations in SE tower 7th & 8th floors, 3rd & 4th floors, ¼ of emergency department.
- Complete LED retrofit was completed in the parking area in 2017
- LED is specified in all new renovations
- Overall less than 10% of hospital has so far been retrofitted to LED.

2.3 Chiller replacement

Three out of the four existing chillers have been replaced in 2018 and 2019.

- Chillers were replaced with efficient magnetic bearing type machines
- VFDs were installed on main chilled water pumps.

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 future. These lessons have informed the development of the Plan, and are summarized as follows:

1. Operator training:
   - The hospital has identified needs for four levels of operating staff training: 1) How to troubleshoot typical issues (standardized steps and procedures, user communication strategy, documenting changes made on the BAS with notification to facility management); 2) Just-in-

time training for new renovations; 3) Regular team meetings to review savings reports and operational issues; 4) annual staff training.

- We can make greater use of our membership in Greening Health Care to help with identifying the best measures, sharing experience with other hospitals, supporting staff training and reporting and being recognized for our accomplishments.

2. Continuous monitoring:
   - OR ventilation control drifted since October 2018, affecting energy use (but not health and safety). Continuous monitoring of system operation is critical as efficient operation can be overridden and affect savings and performance.
   - Regular energy management meetings with operators and service providers will review BAS reports and energy savings trends.
3. Communication with users:
   - The OR ventilation project would have benefited from communication with surgical staff and cleaning staff to more fully address their needs and how they use the space (signal lights, cleaning practices, door opening, rooms needed for standby mode). Communication with end users will be integral to future energy retrofits, beginning with a user group meeting to explain goals and get feedback on existing comfort and other concerns for inclusion in design.
4. Design considerations:
   - Building system retrofits will be designed with a focus on facilitating balancing along with ongoing operation and control. Adjacent zones need to be considered when resetting airflows to maintain overall relative static pressures.
   - Breaking down large projects into manageable work packages and sequencing them in logical steps are key to tackling ventilation and heating plant optimization.
   - Engaging building operators, contractors, engineers and facility management in integrated building performance team meetings proved very effective and empowering in uncovering the best measures and ensuring effective implementation.
5. Long-term planning:
   - Long-term and advance planning of projects is important to secure funding and resources, and also to be prepared with "shovel-ready" projects when provincial or federal funding becomes available, generally at short notice.
   - The building systems' design vision contained in the hospital's master plan, in particular transitioning to low-carbon heating energy sources, will be considered in every future capital project.

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

NYGH is working towards top-quartile positioning in the Greening Health Care energy efficiency benchmark charts through further reduction of 11.5% in total energy by 2023 compared with the 2018 baseline. The projects and management/organizational measures described below are together designed to achieve this goal along with utility cost savings worth over $500,000 per year at 2018 rates and GHG emissions reduction of 661 tonnes CO2e/year.

1 2018 energy and water use

Table 5 and Table 6 present 2018 energy and water use, costs and emissions for NYGH's main site and the two sites for which data are available.

Table 5 NYGH main hospital's 2018 energy and water use

	2018 Consumption	2018 Cost	GHG Emissions (tonnes CO2e)
Electricity (kWh)	17,562,315	$2,634,347	351
Gas (m3)	2,545,736	$840,093	4,875
Water (m3)	76,991	$307,195	0.9
Total		$3,781,635	5,227

Table 6 Other NYGH sites' 2018 energy use

Building	Building area (ft2)	2018 Electricity usage		2018 Gas usage		Total energy cost	GHG Emissions
		kWh	$	m3	$	$	tonnes CO2e
North York - 4000 Leslie	12,075	244,510	$36,677	21,278	$7,022	$43,698	46
North York Seniors Health	111,989	2,333,704	$350,056	221,398	$73,061	$423,117	471

2 Benchmark positioning and targets

Greening Health Care sets good practice energy and water targets for its 65 member hospitals based on top-quartile performance of comparable buildings in the Greening Health Care database and adjusted for weather and material site specific variables. Figure 7 shows NYGH positioning in 2013, 2018 and at the performance level which is the goal for the Plan.

Figure 7 2018 total energy and water use intensity benchmark charts

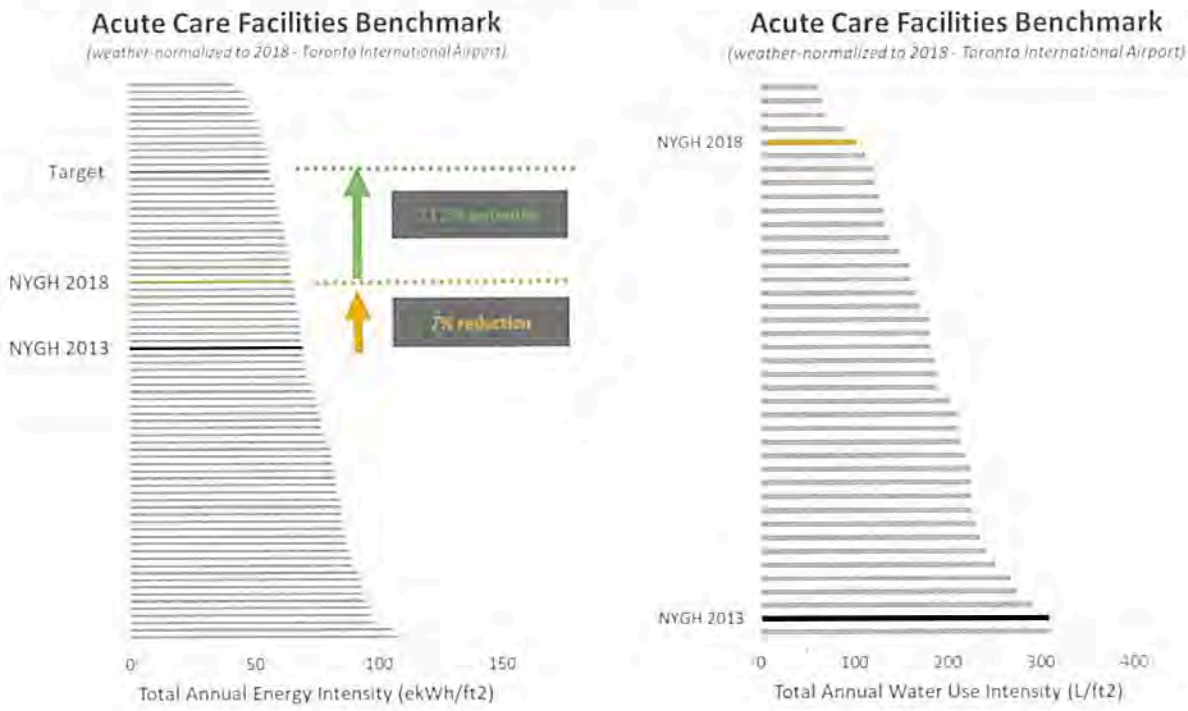


Table 7 presents 2018 actual energy intensities and energy intensity targets with overall savings potential of 12%. Achievement of these targets will result in $450,589 in annual utility cost savings. Water target was not specified due to utility meter issue, however water-saving measures are detailed using a bottom-up approach in the next section.

The targeted savings potential is further separated by energy components, which help direct efforts to the building systems with the biggest opportunities:

- Base electricity systems are fans, pumps, equipment and lighting and show significant savings potential;
- Electric cooling systems are chiller plants and local AC units with modest further savings potential;
- Base thermal systems are reheat in ventilation systems, domestic hot water, sterilizers and kitchens and show big savings potential;
- Heating thermal systems are space and ventilation heating and humidification with significant savings potential.

Table 7 Hospital energy and water targets

	Energy Usage Intensity (ekWh/ft2)		Target Savings vs 2018	
	Actual	Target	%	$

Base Electricity	23.1	20.1	13%	$305,512
Electric Cooling	2.8	2.7	5%	$15,660
Base Thermal	23.0	19.0	17%	$85,988
Heating Thermal	15.9	13.9	13%	$43,429
Total Energy	**64.8**	**55.6**	**12%**	**$450,589**
Water (liters/ft2)	113.6	113.6	0%	$0
Total				**$450,589**

3 Retrofit projects

Table 8 below summarizes the proposed measures together with their costs and savings, payback, and estimated GHG emissions reduction.

Table 8 Energy and water efficiency projects summary

Measure	Description	Payback (Years)	Project Cost ($)	Total Savings ($)	Total Incentives ($)	GHG Emissions Reduction (tonnes CO2e)
Compressors replacement	Replace the current 2 air compressors to more efficient, variable-frequency systems with right-sized motor HP.			$14,793	$9,802	2
Water conservation	Convert existing water-cooled units and connect them to the main chilled water loop if necessary; Maximize free cooling; Upgrade water fixtures to more efficient types	0.4	$79,180	$159,708	$8,005	0.5
AHU optimization phase 1 (VFD adjustment)	Three systems in each phase: test to fix air leakage and high pressure drop components; balance supply and return to satisfy CSA standards; install zone dampers to enable scheduling of areas where possible; improve supply and return fan sequence to optimize SAT reset, thermal wheel controls, flow reduction and static pressure reduction.	1.3	$32,000	$15,961	$10,481	15
AHU optimization phase 2 (first 4 AHUs)		1.6	$128,000	$55,865	$36,685	51
AHU optimization phase 3 (next 4 AHUs)		2.6	$128,000	$39,903	$26,204	36
AHU optimization phase 4 (next 4 AHUs)		3.4	$128,000	$31,923	$20,963	29
Heating plant optimization	Following chiller optimization, reduce summer reheat usage and simultaneous heating and cooling. Investigate heating load and optimize main plant efficiency as well as reducing distribution losses.	1.4	$200,000	$98,923	$60,737	501
Lighting retrofit and controls	Convert current T-8s to LEDs and add occupancy/scheduling controls.	5.1	$555,918	$96,856	$64,065	13
Kitchen Hood Control	Install control system on kitchen hood to reduce hours of operation.	4.2	$25,000	$5,155	$3,297	14
Total			**$1,276,098**	**$519,087**	**$240,239**	**661**

*Includes savings from water conservation measures. The water savings were not presented in the top-quartile targeting approach in Table 5 as recorded water usage was inaccurate due to meter issues.

3.1 Compressor replacement (estimated measure life 25 years)

The existing two air compressors serving the pneumatic components for the base building equipment were old and inefficient, operating at full capacity most of the time. They are being replaced with more efficient, staged units with smaller compressor motors.

3.2 Water conservation (estimated measure life 5-10 years)

The hospital uses a significantly higher amount of water compared to its target. A recent water audit revealed opportunities to reduce water consumption by converting existing city water-cooled units to main chilled water loop and maximize free cooling. Water fixtures could also be converted to low-flow types. The water audit was only able to identify 59% of the water usage, and it is recommended that further analysis using hourly AMR meter data combined with flow monitoring would be able to reveal additional usage and help identify savings opportunities due to leaks and losses.

3.3 Air Handling Units optimization (estimated measure life 5 year to re-testing, 10 years to re-engineering)

A comprehensive optimization of ventilation systems includes testing systems for high pressure drop components, air leakage, electrical performance and air flow rates. The areas served by the AHUs will be re-balanced to CSA requirements. Block or zone dampers will be added to branches that are unoccupied during after hours to enable zone scheduling. The supply and return fan sequences will be optimized with considerations for supply air temperature reset, free cooling, thermal wheel controls optimization, flow reduction and static pressure reduction.

The project will be completed in four stages. The first stage performs the testing and re-balancing on the top-five potential air handling units. The second stage involves zoning and further scheduling to reduce airflow during unoccupied periods. Main system optimization and controls sequences will also be completed. The third and fourth stages will repeat the same process for the next five high potential units.

3.4 Heating system optimization (estimated measure life 5-10 years)

Gas consumption profile shows that the base thermal component is high in the summer, and most of it goes into reheat in ventilation systems. The simultaneous heating and cooling is equivalent to the full load of one chiller (320 tons). By reducing reheat in the summer through improved controls, the facility can also reduce chiller operation saving significant electric cooling energy.

3.5 Lighting retrofit and controls upgrade (estimated measure life for retrofitted fixtures 15 years)

The hospital has undergone a complete retrofit from T12s to T8s. The current lighting density compared to achievable target is still high and a comprehensive lighting audit will determine the most cost-effective retrofit and controls solutions.

3.6 VFD installation on heating and cooling pumps 9long payback measure to be considered after higher ROI projects completed)

Most pumps in the hospital currently don't have VFDs, and most are also throttled presenting good opportunity to reduce flow by using VFDs and save significant pump power.

3.7 Kitchen hood control (estimated measure life 5-10 years)

The kitchen hood for Thai Express in the food court is manually controlled. Automatic control using infrared/heat sensors will reduce the amount of conditioned air being unnecessarily exhausted.

3.8 Induction system retrofit and control (estimated measure life 5-10 years until funding available to replace these units)

The two induction unit air handling systems are original building systems from 1968 and at the end of their service lives. The coils are serviced to the best of the building operators' ability. However, as time wears on the systems become plugged up and inefficient. The operators also commented that the valves are manually adjusted to satisfy space temperature requirements and there are numerous too hot/cold complaints in areas served by the systems. Until they can be fully replaced, the proposed solution is to convert the manual valves into automatic Belimo valves, connecting them as well as local thermostats to the BAS and controlling centrally. The coils will also be cleaned to improve heat exchange efficiency.

3.9 Building automation system (BAS) (estimated measure life 10-15 years)

There are a few zones in the hospital that are still not connected to the hospital's modern BAS. The hospital plans to upgrade these areas to integrate their controls.

3.10 Renewable energy

There are no existing renewable or geothermal installations at this facility, and none are planned for the term of this ECDM Plan.

4 Management and organizational alignment

Key to NYGH's success to date has been the engagement and active involvement of its facility operations team. Further management and organizational development form an essential part of the Plan to enable and support conservation project delivery and continuous efficiency improvement, and to sustain savings over time.

4.1 Strategic alignment

In order to make clear to internal and external stakeholders the importance of efficiency and sustainability to the hospital, specific reference to energy and environmental performance will be incorporated as appropriate in NYGH's master plan, quality improvement and other strategic reporting. This ECDM Plan will be formally presented to the QI team to obtain their input to and alignment with the broader goals of the hospital.

4.2 Energy management, reporting and team-building

An integrated energy performance reporting system will be put in place to provide transparency and motivation through regular communication to all stakeholders of actual savings results. The reporting to facility operations staff will be built upon the existing Greening Health Care online system and will be designed to improve knowledge and team-building through regular review and analysis of actual savings achieved. The reporting will begin with monthly meetings and progress towards weekly email reporting with formal feedback. Quarterly team meetings with management, operators and external service

providers will review results, identify solutions, brainstorm new ideas, document action items and follow up on implementation, providing the overall ongoing direction to Plan implementation.

Quarterly reporting will be provided to senior management to keep them informed of progress towards the established targets.

4.3 Staff training and support

Staff training to enhance individual and team competency, particularly in energy management and building automation, will be developed through the quarterly meetings by defining expectations and working with service providers to provide necessary training and support. We will make greater use of our membership in Greening Health Care by engaging more of our staff in the networking, best practices and recognition which the program offers through its workshops, webinars and technical support.

4.4 Facility renewal and renovations

High performance design and operational standards will be put in place to ensure that all equipment replacements and facility renovations meet required performance targets through an integrated design, review and M&V process. The ECDM Plan will be formally reviewed with Planning and Redevelopment to ensure that appropriate processes are put in place and adhered to.

4.5 Occupant engagement and communications

Integrating the culture of conservation throughout the organization requires regular feedback and reinforcement that NYGH is focused, serious and committed to achieving and sustaining high performance. We will engage fully with Corporate Communications to plan events such as Earth Day and provide regular messaging to help engage and assist all occupants in becoming active players in the energy performance of the hospital.

4.6 Project and program management and support

A dedicated Energy Manager is needed to handle the wide range of technical and human challenges involved in successfully implementing the projects, ensuring that renovations, equipment replacements and new-builds meet the required standards and directing the ongoing development of organizational capacity-building and management systems. This position is included in the cash flow forecast presented in the Plan, and includes the following responsibilities:

- management of the overall ECDM Plan, budget, financial reporting and timelines
- project coordination of suppliers, contractors and hospital departments
- incentives management
- concept, design and business case development
- verification of actual savings achieved and initiating remedial action where necessary
- serving as the hospital's Energy Champion with input into all energy-related aspects of hospital operations
- communicating energy efficiency goals and results to senior management, hospital staff and external stakeholders

Expert external technical support and advice are also needed through the implementation of the Plan and are included in the cash flow forecast. This energy advisory service will be used on an as-needed basis to fill resourcing and knowledge gaps related to:

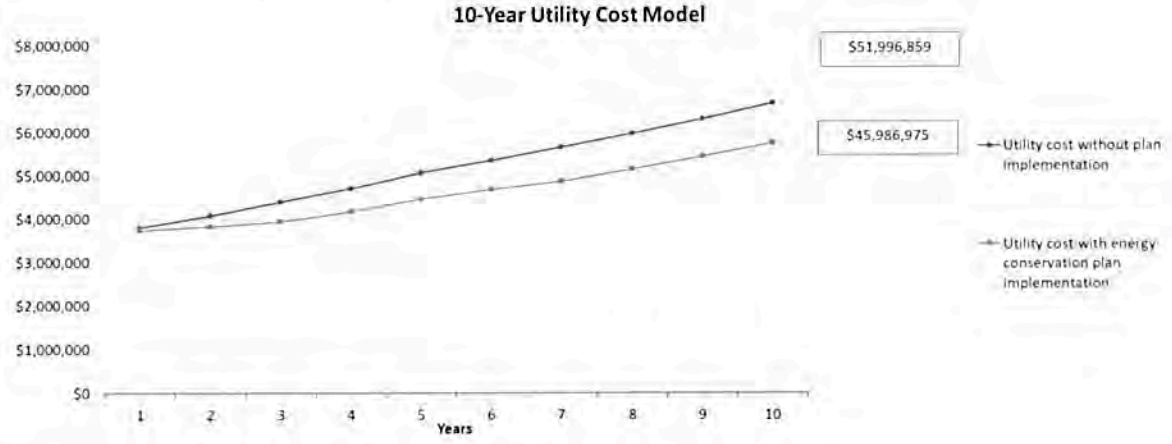
- project definition and design briefs
- energy reporting system development and management
- team-building and meeting facilitation
- internal and external communications
- development of best-practice standards

5 Project timelines and financial forecast

5.1 Utility cost forecast

Figure 8 shows the 10-year annual utility cost forecast for the NYGH main hospital, with and without implementation of the project.

Figure 8 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 $3.8 million in 2018 to $6.7 million in 2028, for a ten-year total spend of $52 million. Implementation of the ECDM Plan is projected to lower that expenditure by $1.9 million over the 5-year period of the Plan, while maintaining those savings over 10 years will provide cumulative savings of over $6 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 implementation costs

Table 9 below summarizes project completion % in each year, while Table 10 shows annual project and ECDM program management costs (accounting for inflation). The program management costs include the additional cost identified by NYGH to build organizational capacity in terms of training, reporting and communication.

Table 9 Project phasing

Measure	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Compressors replacement	100%									
Water conservation		100%								
AHU optimization phase 1 (VFD adjustment)	100%									
AHU optimization phase 2 (first 4 AHUs)	100%									
AHU optimization phase 3 (next 4 AHUs)		10%	100%							
AHU optimization phase 4 (next 4 AHUs)						10%	100%			
Heating plant optimization	20%	80%	100%							
Lighting retrofit and controls	5%	20%	40%	60%	80%	100%				
Kitchen Hood Control				10%	100%					

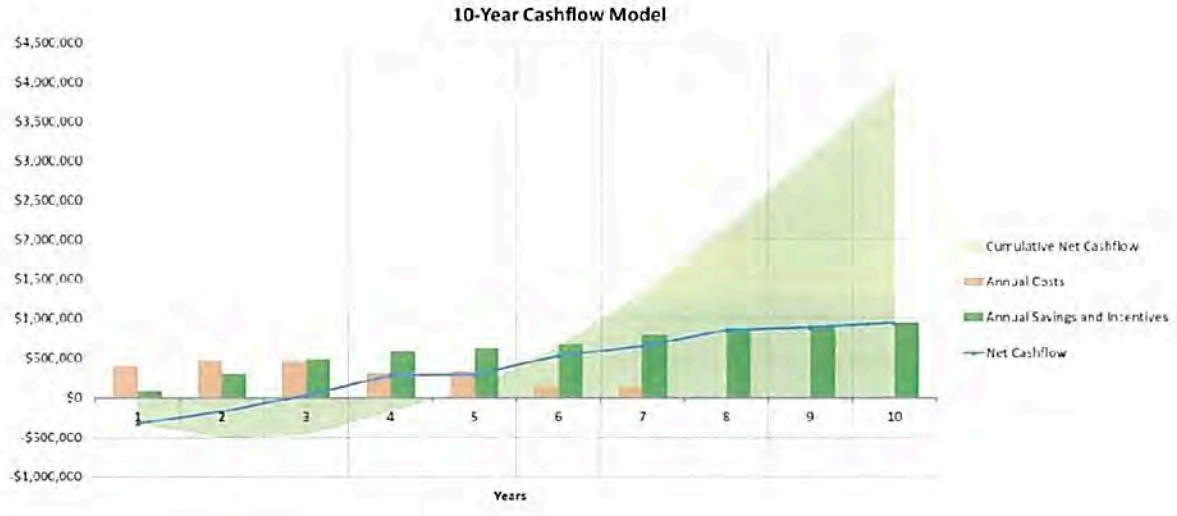
Table 10 Annual costs

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Total
Project cost (with inflation)	$227,796	$302,752	$279,869	$122,425	$147,562	$140,276	$133,597	$0	$0	$0	$1,354,277
Program cost (with inflation)	$170,000	$174,250	$178,606	$183,071	$187,648	$0	$0	$0	$0	$0	$893,576
Total cost	**$397,796**	**$477,002**	**$458,476**	**$305,496**	**$335,210**	**$140,276**	**$133,597**	**$0**	**$0**	**$0**	**$2,247,853**

5.3 Cash flow and Internal Rate of Return

The cashflow model in Figure 9 and Table 11 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 47% and payback period of 4.8 years.

Figure 9 Cashflow model



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

Table 11 Cashflow model

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Total
Total cost	$397,796	$477,002	$458,476	$305,496	$335,210	$140,276	$133,597	$0	$0	$0	**$2,247,853**
Incentives	$12,818	$42,510	$48,803	$54,672	$25,566	$11,588	$16,825	$23,789	$3,668	$0	**$240,239**
Savings	$64,964	$259,102	$441,522	$538,622	$605,340	$663,660	$774,626	$834,630	$886,179	$941,237	**$6,009,884**
Total incentives + savings	$77,782	$301,611	$490,325	$593,294	$630,906	$675,248	$791,451	$858,419	$889,848	$941,237	**$6,250,123**
Cumulative net cashflow	-$320,014	-$495,404	-$463,554	-$175,756	$119,940	$654,912	$1,312,766	$2,171,186	$3,061,033	$4,002,271	
Net cashflow	-$320,014	-$175,391	$31,850	$287,798	$295,696	$534,972	$657,855	$858,419	$889,848	$941,237	

Assumptions

Inflation	2.5%	Elec. rate at 1st year ($/kWh)	$0.15
Electricity escalation rate	6.5%	Gas rate at the 1st year($/M3)	$0.33
Demand escalation rate	6.5%	Water rate at 1st year ($/M3)	$3.99
Gas escalation rate for years 1-5	10%	Electricity incentives ($/kWh)*	$0.10
Gas escalation rate for years 6-10	2.5%	Gas incentives ($/M3)*	$0.20
Water escalation rate	8%		

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

6 Immediate next steps

6.1 VFD speeds reduction

Test and reduce new VFD speeds to 90-95%, beginning with AHU 40 and 19, trending/testing end-of-line static pressures and damper positions first. AHU 40 losses to be found and fixed.

Prioritize fans with new VFDs for air balancing, unoccupied period reset, considering adjacent systems being done together.

6.2 Induction system

Analyze old induction systems to determine the extent to which induction units have been replaced and the budget cost for completing full replacement.

6.3 Thermal wheel controls

The thermal wheel optimization in air handling units can also be completed in stages. The first step is to adjust the temperature setting on the BAS to reduce preheat temperature in the supply air entering the wheel. This will minimize fuel heat and maximize heat recovery. A pilot will be conducted to determine the optimum preheat temperature and avoid frost. Thermal wheel temperature setpoint adjustment alone can reduce total gas usage in the hospital by 10%, additional savings will be realized by optimizing supply air temperatures in the next step.

Management sign-off

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

Signature: _____ & _____

Name: Bessy Leung & Rudy Dahdal Date: Jun 28, 2019

Title: VP Information & Corp. Services, CFO & VP Planning, Facilities & Support Servic.