

Hôpital Montfort

2019-2023 Conservation and Demand Management Plan

Presented to:

Hôpital Montfort

Prepared by:



Copyright

Copyright © 2013/01/01 by FNX Enerpro, a Canadian Corporation. All rights reserved. No part of the contents of this document may be reproduced or transmitted, in any form, by parties other than those employed or engaged by the Client, by any means, without written permission of FNX Enerpro.

Confidentiality & Privacy

This document contains confidential material solely for the usage of FNX Enerpro. All reasonable precautionary methods in handling the document and the information contained herein should be taken to prevent any third party from obtaining access. FNX Enerpro does not divulge client information to any third party without authorization from the client. Some data may be used in a generic sense to refine or update energy performance indices and other similar generic materials. In any such case, data is normalized and consolidated with other relevant material to remove any connection or identity with the original user.

Terms & Limitations

This Conservation and Demand Management Plan is based on information made available by the client, such as, if applicable, information from the Building Management System (BMS), energy invoices, available mechanical and electrical systems drawings, on-site visits, shop drawings, and current building norms and standards. Building equipment location and operation can differ from what is found in the drawings and in the BMS. It might introduce distortions in the calculations. Furthermore, the results are estimated and can differ from the reality. If any significant differences are found between real building operation and the assumptions made in this Conservation and Demand Management Plan, the plan will be revised accordingly.

Table of Contents

Unit list, abbreviations and acronyms	4
Executive Summary.....	1
1 Introduction.....	2
1.1 General Facility Information	2
1.1.1 A-Wing.....	2
1.1.2 B-Wing.....	2
1.1.3 C-Wing.....	2
1.1.4 D-Wing.....	2
1.1.5 E-Wing E and Power Plant	3
2 Energy Consumption.....	4
2.1 Baseline	4
2.1.1 Energy Consumption.....	4
2.1.2 Electricity.....	4
2.1.3 Natural gas consumption	5
2.1.4 Global Energy Intensity	7
2.2 Energy Conservation Measures.....	8
2.2.1 Past Energy Conservation Measures.....	8
2.2.2 Proposed Energy Conservation Measures	9
3 Summary.....	11
3.1 Previous ECDM Goals.....	11
3.2 Current ECDM Goals.....	11

Unit list, abbreviations and acronyms

AHU	Air Handling Unit	
BHP	Brake horsepower	Pure horsepower that considers the loss of speed due to various auxiliary components of the motor
BMS	Building Management System	
BTU	British thermal unit	A unit of measurement of heat content/energy consumption
°C	Degree Celsius	A unit of measurement of temperature
CDE	Carbon dioxide equivalent	A unit of measurement of greenhouse gas emissions
CFM	Cubic feet per minute	A unit of measurement of air flow rate
°F	Degree Fahrenheit	A unit of measurement of temperature
Ft²	Square feet	A unit of measurement of surface area
GHG	Greenhouse gas	
h	Hours	
HP	Horsepower	A unit of measurement of power output
HRC	Heat Recovery Chiller	
HVAC	Heating, ventilation and air conditioning	
klbs	kilopounds	A unit of measurement of steam consumption
kPa	kilopascals	A unit of measurement of pressure
kW	kilowatt	A unit of measurement of electrical power demand
kWh	kilowatt-hours	A unit of measurement of electrical consumption
ekWh	Equivalent kilowatt-hours	A unit of measurement of energy consumption
LED	Light-emitting diode	LED lamps have considerably better lifespan and electrical efficiency than typical incandescent lamps and fluorescent lamps
M²	Square meters	A unit of measurement of surface area
MTCDE	Metric tons of CDE	A unit of measurement of greenhouse gas emissions commonly used in the industry
PSI	Pounds per square inch	A unit of measurement of pressure
Ton.h	Tons of refrigeration - hours	A unit of measurement of chilled water consumption
T	Tons of refrigeration	1 T = 12,000 BTU/h; 1 T = 3.517 kW, a unit of measurement of cooling capacity
USGPM	US gallons per minute	A unit of measurement of water flow rate
VAV	Variable air volume	A type of air distribution system
VFD	Variable frequency drive	A device that controls the speed of a motor
\$	Canadian dollars	

Executive Summary

The Ontario Provincial Government has committed to help public agencies better understand and manage their energy consumption. As part of this commitment, Ontario Regulation 507/18 under the Electricity Act requires public agencies, including municipalities, municipal service boards, school boards, universities, colleges and hospitals to report on their energy consumption and greenhouse gas (GHG) emissions annually, to develop and implement an Energy Conservation and Demand Management (ECDM) Plan, and to update their ECDM Plan every five years.

Hôpital Montfort (HM) is committed to developing and executing on strategies to reduce environmental impact and ensure regulatory compliance, in accordance with Ontario Regulation 507/18. The 2014-2018 Energy Conservation and Demand Management Plan had a goal to reduce overall energy consumption by 6-8% of 2011 levels by 2018.

Table 1 compares the target and total electricity and natural gas consumption. HM was able to **exceed** this goal.

Table 1: Hôpital Montfort 2014-2018 Goal Summary

		2011 Baseline	8% Reduction Target	2018 Total	% Under 2011 Baseline
Electricity Consumption	(kWh)	22 135 706	20 364 850	18 443 786	17%
Natural Gas Consumption	(m3)	3 204 723	2 948 345	2 983 569	7%

Table 2 summarizes the results from the Ministry of Energy’s 2016 Energy Consumption and Greenhouse Gas Emissions Template. Public agencies report energy and natural gas usage two years prior to the current year (i.e. the report for 2016 energy consumption was submitted in 2018). This data forms the energy consumption benchmark for the latest CDM plan.

Table 2: Hôpital Montfort 2016 Baseline Energy Consumption Summary

Facility	Address	Total Floor Area (m2)	Electricity (kWh)	Natural Gas (m3)
Hôpital Montfort	713 Montreal Road	67 355	19 309 426	3 116 136
Portobello Clinic	1968 Portobello Drive	193	421 040	14 989

HM’s goal for the 2019-2023 Energy Conservation and Demand Management Plan is to reduce electricity consumption by 21% (4,172,527 kWh) and natural gas consumption by 20% (642 223 m3) by 2023, based on 2016 consumption. This is expected to require an estimated investment of over \$15M.

The electricity consumption and GHG emissions reduction goals HM will achieve by 2023 are summarized in Table XX.

1 Introduction

HM worked collaboratively with FNX Enerpro to develop the 2019-2023 ECDM plan. The plan meets the requirements of Ontario Regulation 507/18 and is separated into sections to provide information on:

- General facility information;
- Historical energy consumption;
- The results of the energy conservation measures of the 2014-2018 ECDM plan; and,
- The planned energy conservation measures of the 2019-2023 ECDM plan.

1.1 General Facility Information

HM is a 301-bed, multi-storey hospital that opened its doors in 1953 in Ottawa. At that time the now C-Wing was the original hospital, with the E-Wing added in 1954. The hospital has been added onto over time and now has a gross floor area of 68,934 m². In 1992, the A-Wing was added, followed by the B-Wing and D-Wing in 2008.

HM also includes a satellite building, the Portobello Clinic, located at 1968 Portobello Drive in Orleans, ON. The satellite office offers diagnostic imaging, physiotherapy, and gynecology/urology physician offices.

1.1.1 A-Wing

A-Wing is a 4-storey structure built in 1992 with a gross floor area of 12,061 m². It houses different types of health care facilities such as operating rooms, emergency services, patient care rooms, pharmacy, sterilization

A-Wing has two mechanical rooms, located on the lower level and the third floor, respectively. These rooms are equipped with ten AHUs and their related equipment that preheat and supply the required air to the building. The heating needs for this wing are fulfilled by the perimeter heater and terminal units.

1.1.2 B-Wing

B-Wing is a 3-storey structure on the west side of the Montfort Hospital with a gross floor area of 16,836 m². This building houses a variety of services such as diagnostic imaging, intensive care rooms, nuclear medicine, etc.

B-wing has two mechanical rooms, located at the penthouse level and the basement, respectively. All the AHUs are located in the upper mechanical room to provide the ventilation air for the building. The heating for the building is provided from the steam/water heat exchangers in the lower level mechanical room, which supply the hot water to the perimeter zone heaters and the terminal units.

1.1.3 C-Wing

C-Wing, with a gross floor area of 18,621 m², is the original hospital building built in 1953. This wing has 6-storeys and provides services such as orthopedics, therapeutic services, pre-admission, and also houses administrative offices.

Ventilation air for the C-Wing is provided by four AHUs on the roof, two AHUs on the third floor, roof and one AHU in the lower level mechanical room. Heating coils in the AHUs, radiant heaters and terminal units provide the heating for this wing.

1.1.4 D-Wing

D-Wing was built in 2006 and the main occupant is the Department of National Defence. The gross floor area of the building is 16,890 m² and it includes six-storeys with various usage, such as general administration, dentistry, clinics, and therapeutic services.

The building has two mechanical rooms, which are located in the penthouse and the basement. Steam/water heat exchangers in the mechanical rooms supply the hot water for the AHUs, terminal units and perimeter zones to satisfy the building heating loads.

1.1.5 E-Wing E and Power Plant

E-Wing is a 2-storey building that includes the central heating and cooling plant in one section and general administration for the hospital and the University of Ottawa in the other

Five natural gas fired steam boilers, two centrifugal chillers, and two air-cooled chillers in the central heating and cooling plant provide the steam and chilled water for the entire hospital.

2 Energy Consumption

2.1 Baseline

2.1.1 Energy Consumption

This section provides the information on the energy consumption and the costs for HM for the recent years according to the billing information. Energy consumption is separated into two categories – electricity and natural gas. HM uses electricity, measured in kWh, provided by HydroOttawa and natural gas, measured in m³, provided by Enbridge.

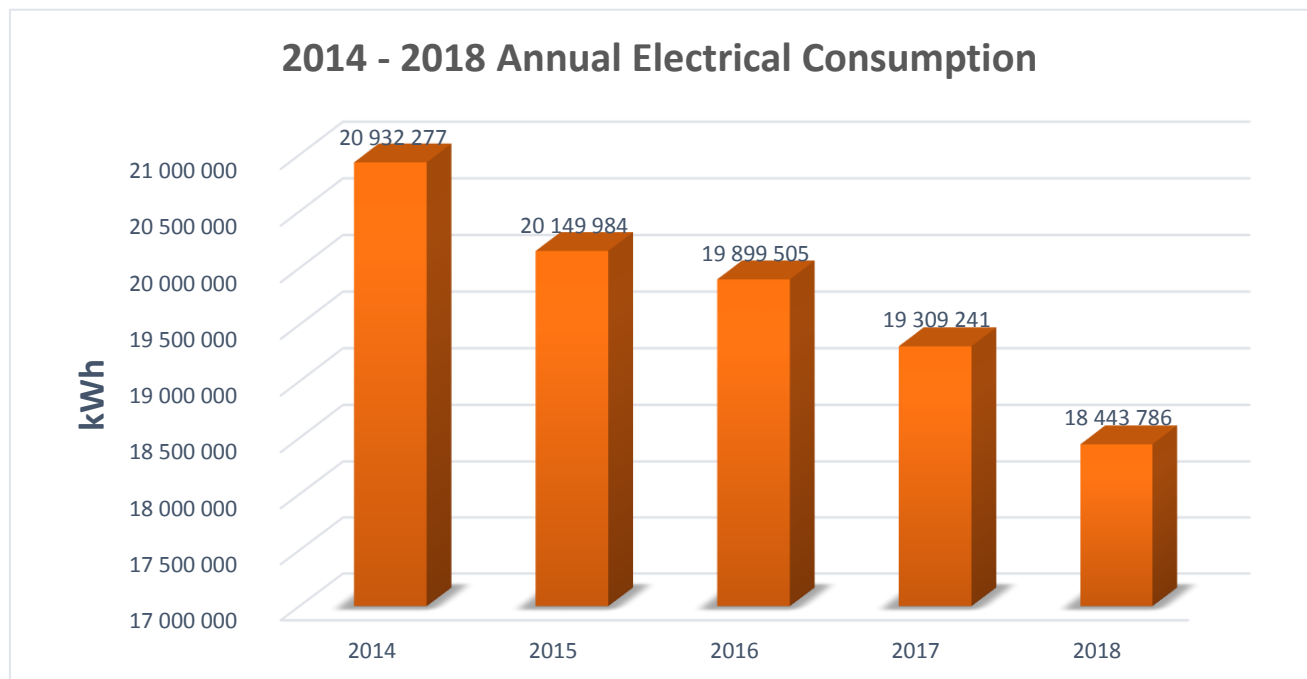
Electricity is used for all electrical requirement of the hospital including the production of chilled water, which is used throughout the hospital for cooling. The electricity invoices are composed of energy cost (\$/kWh), Global Adjustment cost (\$ per demand during peak provincial consumption periods), delivery and regulatory charges. The blended rate for electricity is 0.12 \$/kWh. Figure 1 summarizes HM’s annual electricity consumption from 2014-2018.

Natural gas is used in the power plant for steam production used in heating and humidification. The hospital is invoiced based on Rate 110 by Enbridge. Invoices are composed of a contract demand charge (18,500m³ in 2018), delivery charge, load balancing charge, transportation charge and cost adjustment charge. The blended rate for natural gas is 0.30 \$/m³. Figure 3 summarizes HM’s annual natural gas consumption from 2014-2018.

2.1.2 Electricity

The following chart shows the electrical consumption from 2014 to 2018.

Figure 1: Hôpital Montfort 2014-2018 Annual Electrical Consumption

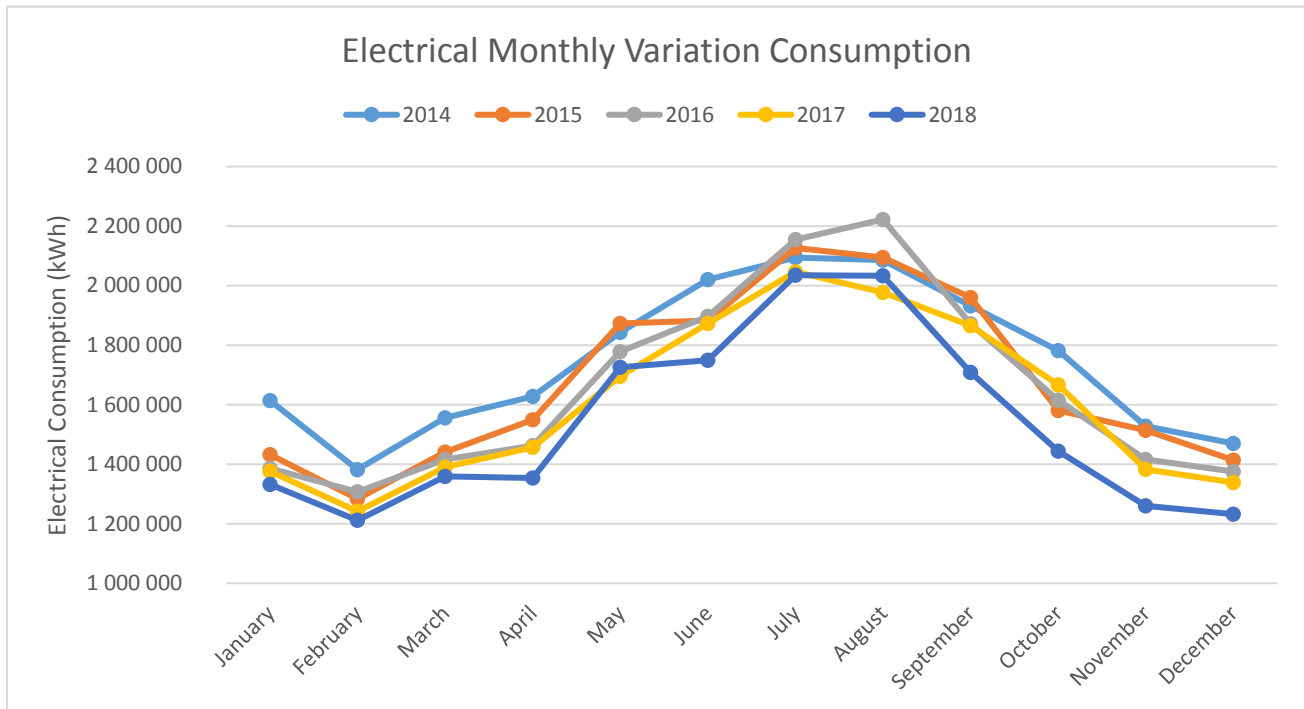


A total decrease of 12% in the electrical consumption can be seen during these last five years, However, this reduction should not be attributed entirely to the CDM plan established in 2014.

In 2018, the electricity consumption of the hospital was 18,443,786 kWh with a total cost of \$2,202,415. By analyzing the utilities invoices, 60% of the electrical cost is due to the Global Adjustment cost, which corresponds to the participation of the Hospital to the peak demand of the Ontario electrical grid. This Global Adjustment cost is directly linked to the electrical demand of the Hospital.

The following line diagram shows the monthly consumption variation between 2014 and 2018.

Figure 2: Hôpital Montfort 2014-2018 Monthly Electrical Consumption

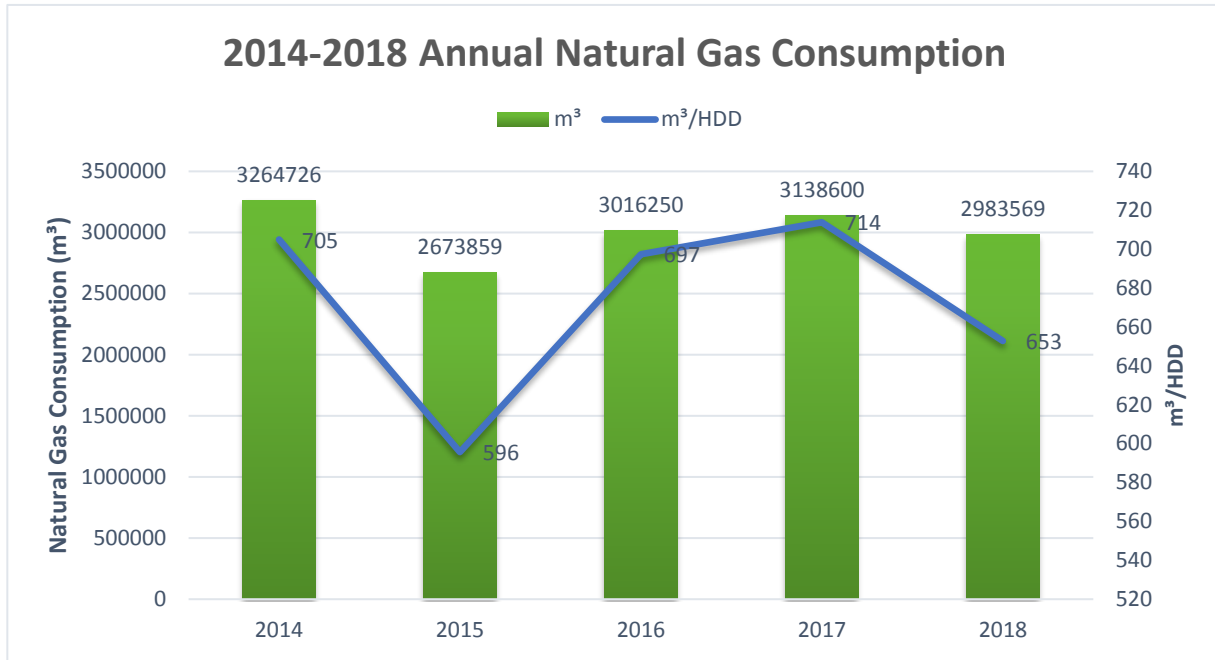


The highest power demand and electrical consumption are reached during summer months, as shown in the line diagram below. This is due to the increased production of chilled water in the power plant. Thus, any energy measures which will decrease the Hospital’s chilled water demand will have an important impact on the electrical cost.

2.1.3 Natural gas consumption

The following chart shows the volume of natural gas consumption from 2014 to 2018. The blue line of the graph shows the natural gas consumption divided by heating degree days.

Figure 3: Hôpital Montfort 2014-2018 Annual Natural Gas Consumption

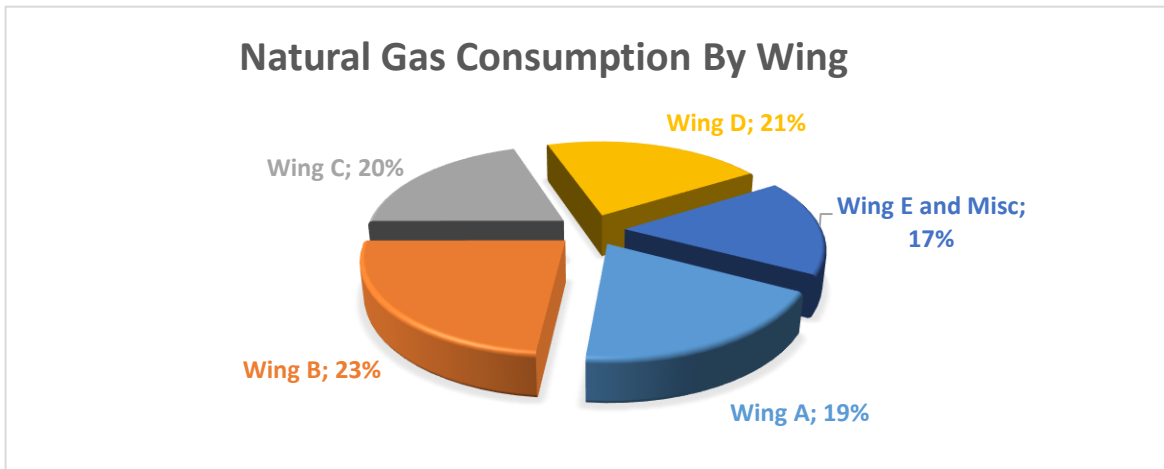


Note: Data for three winter months are missing for 2015, which explains the reduction of consumption during this year.

The total consumption of natural gas in 2018 was 2,983,569 m³ and the average consumption of 2014, 2016, 2017 and 2018 is 3,100,786 m³. These numbers include all usages and equipment.

By comparing the demand for different uses, the steam generated through the burning of natural gas is mainly used (more than 80%) for humidification, perimeter heating and terminal heating. Previous data provided by HM shows an end-use breakdown of natural gas by wing of the hospital. This analysis is shown in the chart below.

Figure 4: Hôpital Montfort 2014-2018 Annual Natural Gas Consumption



2.1.4 Global Energy Intensity

In 2018, HM had:

- a natural gas consumption of 2,983,569 m³, which is equivalent to 31,416,982 ekWh; and,
- an electrical consumption of 18,443,786 kWh.

The total energy consumption was therefore 49,860,768 ekWh. Based on a total building area of 67,355 m², this corresponds to a global energy intensity of 740 ekWh/m² or 69 ekWh/ft².

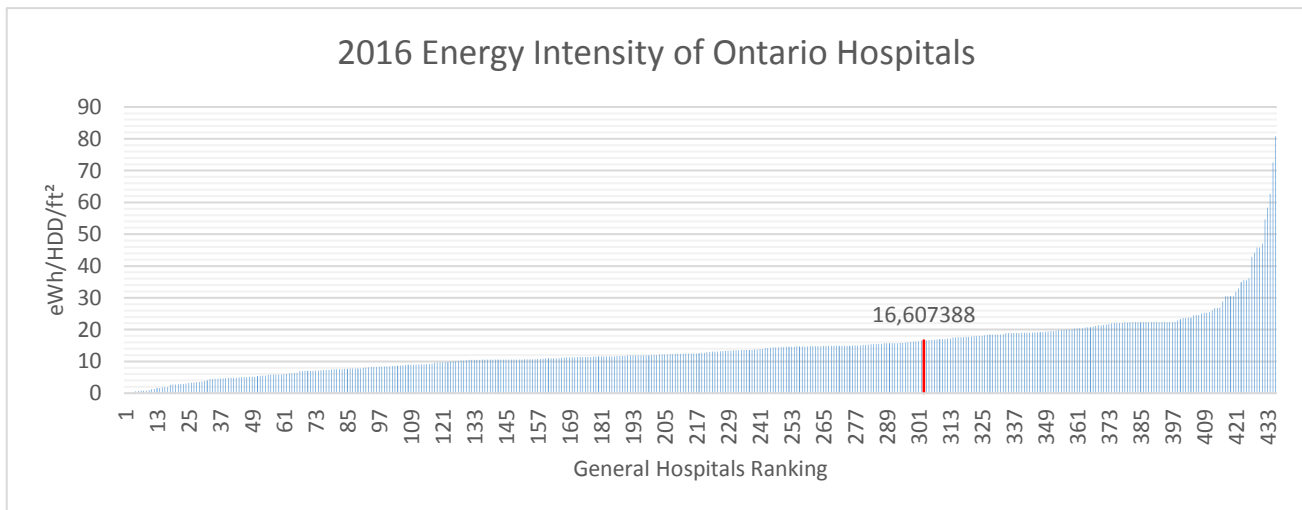
The energy intensity of each Ontario Hospital is published on an Open Data site. The energy intensity of each hospital is divided by the number of HDD in the subject year, in order that years can be compared against each other, independent of weather effects on consumption. Below is HM's energy intensity, normalized for temperature effects, between 2014 and 2018:

Table 3: Hôpital Montfort Energy Intensity 2014-2018

Year	Energy intensity (ekWh/HDD/ft ²)	Rank	# participating hospitals	Source
2018	15.1	Not available	Not available	Calculated
2017	16.4	Not available	Not available	Calculated
2016	16.6	303	438	www.ontario.ca
2015	16	308	431	www.ontario.ca
2014	16.39	324	426	

The following column chart is the energy intensity by HDD and square foot of 436 hospitals in the province of Ontario in 2016, when HM was ranked 303rd of 438 with an intensity of 16.6 ekWh/HDD/ft².

Figure 5: Hôpital Montfort Energy Intensity Rank



2.2 Energy Conservation Measures

Energy savings and capital costs were tracked for many of the energy conservation measures (ECMs) implemented and planned at HM. Some energy savings and capital cost values are missing as it was not possible to accurately quantify the values.

2.2.1 Past Energy Conservation Measures

HM published its first CDM plan in 2014. Since that time, HM has implemented several energy reduction measures, both within and outside the scope of the CDM 2014-2018, in an effort to meet the goals of the plan.

The primary reason for performing work outside the scope of the initial CDM plan is that the energy performance contract slated to be signed in 2014 was not signed until 2018. As a result of the delay, HM invested in operational measures, primarily implemented by staff, to reduce energy consumption.

A list of past ECMs is shown in the table below.

Table 4: ECMs completed between 2014 and 2018

Year	Facility	Measure	Annual Savings (kWh)
2014	Hôpital Montfort	Conduct an ASHRAE Level II Energy Audit Conduct an annual steam trap audit	Not applicable – studies.
2014	Hôpital Montfort	Participate with Hydro Ottawa in an energy saving booth Energy awareness training and seminars	Not applicable – educational.
2014	Hôpital Montfort	Implementation of an LED light replacement program	37 724
2014	Hôpital Montfort	Reduce runtime on several air handling systems from 24-7, to scheduled ON-OFF	515 408
2015	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable – study.
2015	Hôpital Montfort	Replacement and centralization of IT equipment	240 861
2016	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable – study.
2016	Hôpital Montfort	Replacement of emergency generator	Not applicable – resiliency.
2017	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable – study.
2017	Hôpital Montfort	Various Lighting Retrofits	528 180
2017	Hôpital Montfort	Replace 16x250W high bay luminaires with 56W LED	34 147
2018	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable – study.
2018	Hôpital Montfort	Sign an energy contract with Ameresco.	Not applicable.
2018	Hôpital Montfort	Reduce runtime on 93 fancoils from 24-7, using occupancy controls.	270 083
TOTAL			1 626 403

A number of other changes were made during the timespan that resulted in energy savings. These changes were done proactively by HM staff, but were not calculated prior to delivery, and included: behavioural changes, timers, programming, other lighting retrofits, etc.

2.2.2 Proposed Energy Conservation Measures

HM has developed a comprehensive CDM plan for the next five years. At the core of the plan is the implementation of a multi-year energy conservation and equipment renewal project, to be delivered by Ameresco. Not only will the project reduce annual utility consumption and operating costs, but it will significantly reduce greenhouse gas emissions, as well as increase equipment redundancy for operating room and sterilization ventilation systems.

The nearly \$15M program is fully funded by HM with an overall energy efficiency improvement of over 25%, based on 2014 baseline. Table 5 below show the ECMs proposed as part of the 2019-2023 ECDM Plan. At a high level, the project includes:

- Upgrade and expansion of the building automation system
- Retrofit of interior and exterior lighting
- Replacement of A-Wing and C-Wing Air Handling Units (9 systems)
- Replacement of two steam boilers and general heating plant improvements
- Cooling plant upgrades, including air-cooled chiller replacement and glycol-to-chilled water conversion

Table 5: ECMs proposed for 2019 through 2023

Year	Facility	Measure	Annual Savings (kWh)	Annual Savings (m3)
2019	Hôpital Montfort	A-Wing Controls Optimization	76 151	28 889
2019	Hôpital Montfort	B-Wing Controls Optimization	215 412	54 871
2019	Hôpital Montfort	D-Wing Controls Optimization	375 184	127 079
2019	Hôpital Montfort	Replace A-Wing Lighting with LED	164 039	
2019	Hôpital Montfort	Replace B-Wing Lighting with LED	200 066	
2019	Hôpital Montfort	Replace Parking Garage Lighting with LED	343 396	
2019	Hôpital Montfort	Replace Exterior Parking Lot Lighting with LED	106 155	
2019	Hôpital Montfort	Replacement of Exterior Lighting with LED	34 057	
2019	Hôpital Montfort	Replacement of AHU 1	57 714	19 292
2019	Hôpital Montfort	Chiller Replacement and Optimization	761 844	
2019	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable.	
2020	Hôpital Montfort	C-Wing Controls Optimization	81 224	53 740
2020	Hôpital Montfort	A-Wing CAV to VAV Conversion	54 000	
2020	Hôpital Montfort	Replace C-Wing Lighting with LED	181 917	
2020	Hôpital Montfort	Replace D-Wing Lighting with LED	239 077	
2020	Hôpital Montfort	Replacement of AHU 3 and 6	86 089	19 384
2020	Hôpital Montfort	Replacement of AHU 2	16 739	60 618
2020	Hôpital Montfort	Replacement of AHU 15, 16, 17	810 497	158 241
2020	Hôpital Montfort	Power Plant Improvement Measures	176 376	86 286
2020	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable.	
2021	Hôpital Montfort	Replacement of AHU 4	65 239	28 937

2021	Hôpital Montfort	Replacement of AHU 5	27 351	4 886
2021	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable.	
2022	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable.	
2023	Hôpital Montfort	Conduct an annual steam trap audit	Not applicable.	
TOTAL			4 172 527	642 223

In parallel with the multi-year renewal project, HM will identify and investigate complimentary measures to further reduce the costs and emissions related to utility consumption. This includes:

- Investigate installation of heat recovery chiller(s) to reduce natural gas consumption related to perimeter heating.
- Optimize chilled water loop optimization
- Optimize the operation of the domestic water booster pumps
- Investigate deaerator vent recovery
- Installation of insulation bags on steam traps
- Investigate installing condensing heat recovery or condensing boilers to improve heating plant efficiency.

3 Summary

3.1 Previous ECDM Goals

The previous ECDM plan had a goal of reducing overall energy consumption by 6-8% from 2011 levels by 2018. The table below demonstrates that HM **met** their goal by comparing the 2011 baseline consumption, 2018 target consumption, and 2018 actual consumption.

Table 6: Hôpital Montfort 2014-2018 Goal Summary

		2011 Baseline	8% Reduction Target	2018 Total	% Under 2011 Baseline
Electricity Consumption	(kWh)	22 135 706	20 364 850	18 443 786	17%
Natural Gas Consumption	(m3)	3 204 723	2 948 345	2 983 569	7%

3.2 Current ECDM Goals

HM's goal for the 2019-2023 Energy Conservation and Demand Management Plan is to reduce electricity consumption by 21% (4,172,527 kWh) and natural gas consumption by 20% (642 223 m3) by 2023, based on 2016 consumption. The utility consumption goals HM will achieve by 2023 are summarized in Table 7.

This is expected to require an estimated investment of over \$15M.

Table 7: Hôpital Montfort 2019-2023 Goal Summary

		2016 Baseline	2023 Target	% Reduction
Electricity Consumption	(kWh)	19 309 246	15 136 719	21%
Natural Gas Consumption	(m3)	3 116 136	2 473 912	20%

The implementation of the recommended energy efficiency measures will decrease by 21% the energy intensity of the Hospital from the 2016 published value of 16.6 ekWh/HDD/ft² to 13.1 ekWh/HDD/ft². This energy intensity decrease would have ranked HM 226th of 438 Ontario hospitals, compared to the initial ranking of 303rd of 438 Ontario hospitals.

