Toronto East Health Network

Energy Conservation and Demand Management Plan

2024 Update

June 2024

Contents

Energy Conservation and Demand Management Plan

1.0 Executive Summary

Ontario Regulation 25/23: Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans requires Broader Public Sector (BPS) organizations to develop an Energy Conservation and Demand Management (CDM) plan and update it every five years. We developed our updated CDM plan for 2025 to 2029 in compliance with the regulation.

Legacy MGH results

Toronto East Health Network (TEHN) has far surpassed its 2019 CDM plan conservation target to reduce the 2018 energy consumption of Michael Garron Hospital's legacy facilities (Legacy MGH) by 3% by the end of 2023.

During the period from 2019 through 2023, Legacy MGH reduced its total energy consumption by 20,414 MWh (7.9%), and its total GHG emissions by 3,482 t (10.6%), relative baseline 2018. By mid-2024, annual energy consumption was 13.9% below baseline 2018 and GHG emissions were down 15.9%.

Alignment with 2030 provincial GHG reduction target

The Legacy MGH results align with the provincial target to reduce levels of GHG emissions 30% from 2005 levels by 2030. In 2006, MGH entered a $9.5 million energy performance contract, which was substantially complete in 2009. As a result of this project and work in subsequent years, Legacy MGH reached and surpassed the provincial goal in 2019, with a 32.2% GHG reduction relative the 2005 baseline.

During the period from 2019 through 2023, Legacy MGH reduced its total energy consumption by 100,788 MWh (29.7%), and its total GHG emissions by 16,230 t (35.7%), relative baseline 2005. By mid-2024, annual energy consumption was 33.9% below baseline 2005 and GHG emissions were down 39.3%.

Redevelopment results

A major redevelopment of Michael Garron Hospital (MGH) has been underway since 2018. The new Ken and Marilyn Thomson Patient Care Centre opened to patients in early 2023. It replaces the hospital's oldest wings (A to F), most of which will be demolished.

Our 2019 CDM plan predicted that the energy and GHG intensity of the redeveloped site would be significantly less than that of the existing configuration, due to improvements in Legacy MGH and the energy efficient design of the new Ken and Marilyn Thomson Patient Care Centre, then

under construction. The result will be known once the planned demolitions have been completed, but the results to-date are encouraging, as discussed below.

The total energy intensity decreased 9.4% from 61.4 kWh/ft² in 2018 to 55.6 kWh/ft² in 2021, mainly due to the reduction in natural gas use of Legacy MGH, achieved by our facilities staff through optimized control of temperature and ventilation, while maintaining patient and staff comfort.

Construction of the Ken and Marilyn Thomson Patient Care Centre reached interim completion on 2022 July 31, after which MGH assumed responsibility for its energy consumption and cost. As a result, MGH's total energy intensity decreased to 52.3 kWh/ft² in 2022. Intensity rose in 2023 due to higher gas use, but by mid-2024 had reached an historic low of 51.5 kWh/ft² – 16.1% below the 2018 baseline.

By mid-2024, the total annual weather-normalized GHG intensity decreased 24.2% from 7.88 kg/ft² in 2018 to an historic low of 5.97 kg/ft².

2025-2029 Plan

TEHN plans to reduce the energy consumption of the expanded MGH 3%, relative 2023, by 2029.

2.0 TEHN 2023 Energy and GHG Report

The following table summarizes TEHN's 2023 energy and GHG report to the MOE.

Table 1
Toronto East Health Network
2023 Energy and GHG Report

	Area	Electricity	Natural Gas	GHG Emissions		Energy Intensity
Facility Name	ft²	kWh	m³	kg	%	ekWh/ft²
Michael Garron Hospital	1,196,110	25,923,245	3,349,844	7,223,666	97.3	51.57
Medical Arts Building (Mortimer)	59,998	937,557	0	27,218	0.4	15.63
Doctors' Offices	59,514	0	66,138	127,763	1.7	11.86
Withdrawal Management Centre	16,523	272,740	15,647	38,144	0.5	26.62
Community Outreach - Compass Team	4,327	45,411	2,888	6,897	0.1	17.62
TEHN Total	1,336,471	27,178,953	3,434,517	7,423,688	100.0	47.77

Michael Garron Hospital (MGH) accounted for 98 percent of TEHN's energy consumption and 97 percent of GHG emissions. The following sections report MGH's progress in reducing energy consumption and GHG emissions.

3.0 Legacy MGH results

3.1 Energy and GHG reductions since 2018

Table 2 summarizes the annual and total energy and GHG reduction of Michael Garron Hospital's (MGH) legacy facility (Legacy MGH) relative baseline 2018, for the years 2019 through 2023. Over this period, the legacy facility reduced total energy consumption by 20,414 MWh (7.9%), and total GHG emissions by 3,482 t (10.6%).

Table 2
Michael Garron Hospital: Legacy Facility
Annual Energy and GHG Reduction Relative Baseline 2018

	Electricity				Natural Gas				Total Energy			
	Energy		GHG		Energy		GHG		Energy		GHG	
Year	MWh	%	t	%	MWh	%	t	%	MWh	%	t	%
2019	-700	-3.9	-21	-3.9	2,323	6.5	413	6.5	1,623	3.0	392	5.7
2020	179	1.0	5	1.0	4,323	13.1	769	13.1	4,502	8.7	774	12.2
2021	42	0.2	1	0.2	5,639	17.2	1,025	17.2	5,681	11.1	1,026	15.8
2022	170	0.9	5	0.9	5,322	15.6	967	15.6	5,492	10.5	972	14.4
2023	1,628	8.9	47	8.9	1,489	4.7	271	4.7	3,117	6.2	318	5.0
Total	1,318	1.4	37	1.4	19,096	11.4	3,445	11.4	20,414	7.9	3,482	10.6

Update: by mid-2024, annual energy consumption was 13.9 % below baseline 2018 and GHG emissions were down 980 t (15.9%).

The effects of weather differences between 2018 and each reporting year have been accounted for by normalizing the 2018 consumption to the weather of the reporting year. The methodology has been described in Appendix A.1.

The GHG reduction is based on the electricity and natural gas carbon emission factors used by the MOE for BPS reporting in each year. Since 2022 and 2023 emission factors are not yet available, we have used the 2021 values for those years.

The 2019 and 2023 changes in electricity consumption and associated GHG emissions relative baseline 2018 were statistically significant at the 95% confidence level, i.e. there was less than a 5% probability that the reduction could be explained by the statistical variance of the baseline. Natural gas and its associated GHG reduction had the same level of statistical significance during 2020-2022.

3.2 Results align with 2030 provincial target

Our Legacy MGH results align with the provincial target to reduce levels of GHG emissions 30% from 2005 levels by 2030.

In 2006, MGH entered a $9.5 million energy performance contract, which was substantially complete in 2009. As a result of this project and work in subsequent years, Legacy MGH reached and surpassed the 2030 provincial goal in 2019, with a 32.2% GHG reduction relative the 2005 baseline. Table 3 summarizes the results for the years 2019 through 2023. Over this period, the legacy facility reduced total energy consumption by 100,788 MWh (29.7%), and total GHG emissions by 16,230 t (35.7%).

Table 3
Michael Garron Hospital: Legacy Facility
Annual Energy and GHG Reduction Relative Baseline 2005

	Electricity				Natural Gas				Total Energy			
	Energy		GHG		Energy		GHG		Energy		GHG	
Year	MWh	%	t	%	MWh	%	t	%	MWh	%	t	%
2019	1,546	7.6	47	7.6	17,023	33.9	3,028	33.9	18,569	26.3	3,075	32.2
2020	2,488	12.0	63	12.0	18,194	38.8	3,237	38.8	20,682	30.5	3,300	37.2
2021	2,369	11.4	69	11.4	18,960	41.2	3,446	41.2	21,329	31.9	3,515	39.2
2022	2,479	12.0	72	12.0	19,327	40.2	3,513	40.2	21,805	31.7	3,585	38.4
2023	3,864	18.8	112	18.8	14,538	32.3	2,642	32.3	18,402	28.1	2,755	31.4
Total	12,746	12.4	363	12.3	88,042	37.3	15,867	37.3	100,788	29.7	16,230	35.7

Update: by mid-2024, annual energy consumption was 33.9% below baseline 2005 and GHG emissions were down 3,363 t (39.3%).

The effects of weather differences between 2005 and each reporting year have been accounted for by normalizing the 2005 consumption to the weather of the reporting year. The methodology has been described in Appendix A.2.

The GHG reduction is based on the electricity and natural gas carbon emission factors used by the MOE for BPS reporting in each year. Since 2022 and 2023 emission factors are not yet available, we have used the 2021 values for those years.

In each year (2019-2023), the reduction in electricity and natural gas use and associated GHG emissions relative baseline 2005 has been statistically significant at the 95% confidence level, i.e. there was less than a 5% probability that the reduction could be explained by the statistical variance of the baseline.

4.0 Redevelopment results

A major redevelopment of Michael Garron Hospital (MGH) has been underway since 2018. The new Ken and Marilyn Thomson Patient Care Centre opened to patients in early 2023. It replaces the hospital's oldest wings (A to F), most of which will be demolished.

The redevelopment will increase the floor area of MGH 18.5% from 864,923 ft² to 1,025,099 ft². The following table displays the mean floor area in each year the period of the redevelopment.

Period	Mean Area, ft²	Events
Pre-2018	864,923	Original MGH (Wings A-K) prior to redevelopment
2018	851,036	E-Wing, F-Podium utilities cut off for demolition, Aug 2018
2019	831,593	
2020	831,593	
2021	831,593	
2022	994,007	Thomson Centre reached interim completion, Aug 2022
2023	1,196,110	F-Wing utilities cut off for demolition, May 2023
2024	1,187,684	
Final	1,025,099	Final MGH, following demolition of Wings A, B and C

Note: the area is the arithmetic mean of the area of the 12-months of the year.

Our 2019 CDM plan predicted that the energy and GHG intensity of the redeveloped site would be significantly less than that of the existing (2018) configuration, due to improvements in Legacy MGH and the energy efficient design of the new Ken and Marilyn Thomson Patient Care Centre, then under construction. The result will be known following the demolition of Wings A, B and C, but the results to-date are encouraging, as discussed below.

The energy and GHG intensity charts in this section depict progress on a weather-normalized basis, which facilitates reliable comparison, by controlling for annual variations in weather. The methodology is described in Appendix A.3.

The charts cover key years since 2005, which is the baseline of the provincial goal to reduce GHG emissions 30% by 2030. 2011 is included because it was the first year of mandatory reporting by the Broader Public Sector. 2018 is included because it is the baseline of our 2019 CDM plan.

Figure 1 reveals that total annual energy intensity decreased 9.4% from 61.4 kWh/ft² in 2018 to 55.6 kWh/ft² in 2021, mainly due to the reduction in natural gas use of Legacy MGH, achieved by our facilities staff through optimized control of temperature and ventilation, while maintaining patient and staff comfort.

Construction of the Ken and Marilyn Thomson Patient Care Centre reached interim completion on 2022 July 31, after which MGH assumed responsibility for its energy consumption and cost.

As a result, MGH's total energy intensity decreased to 52.3 kWh/ft² in 2022. Intensity rose in 2023 due to higher gas use, but by mid-2024 had reached an historic low of 51.5 kWh/ft² – 16.1% below the 61.4 kWh/ft² 2018 baseline, and 35% below the 79.2 kWh/ft² 2005 baseline.

Most of the improvement was due to reduced natural gas consumption, which was essential to achieving a large reduction in GHG emissions, because in Ontario gas combustion emits about 6 times the GHGs of grid electricity per unit energy. Figure 2 reveals that by mid-2024 the total annual weather-normalized GHG intensity had reached an historic low of 5.97 kg/ft² - a decrease of 24.2% from 7.88 kg/ft² in 2018, and 44.6% from 10.77 kg/ft² in 2005.

Figure 1
Michael Garron Hospital
Weather-normalized Annual Energy Intensity
CY'2005 – Mid-2024

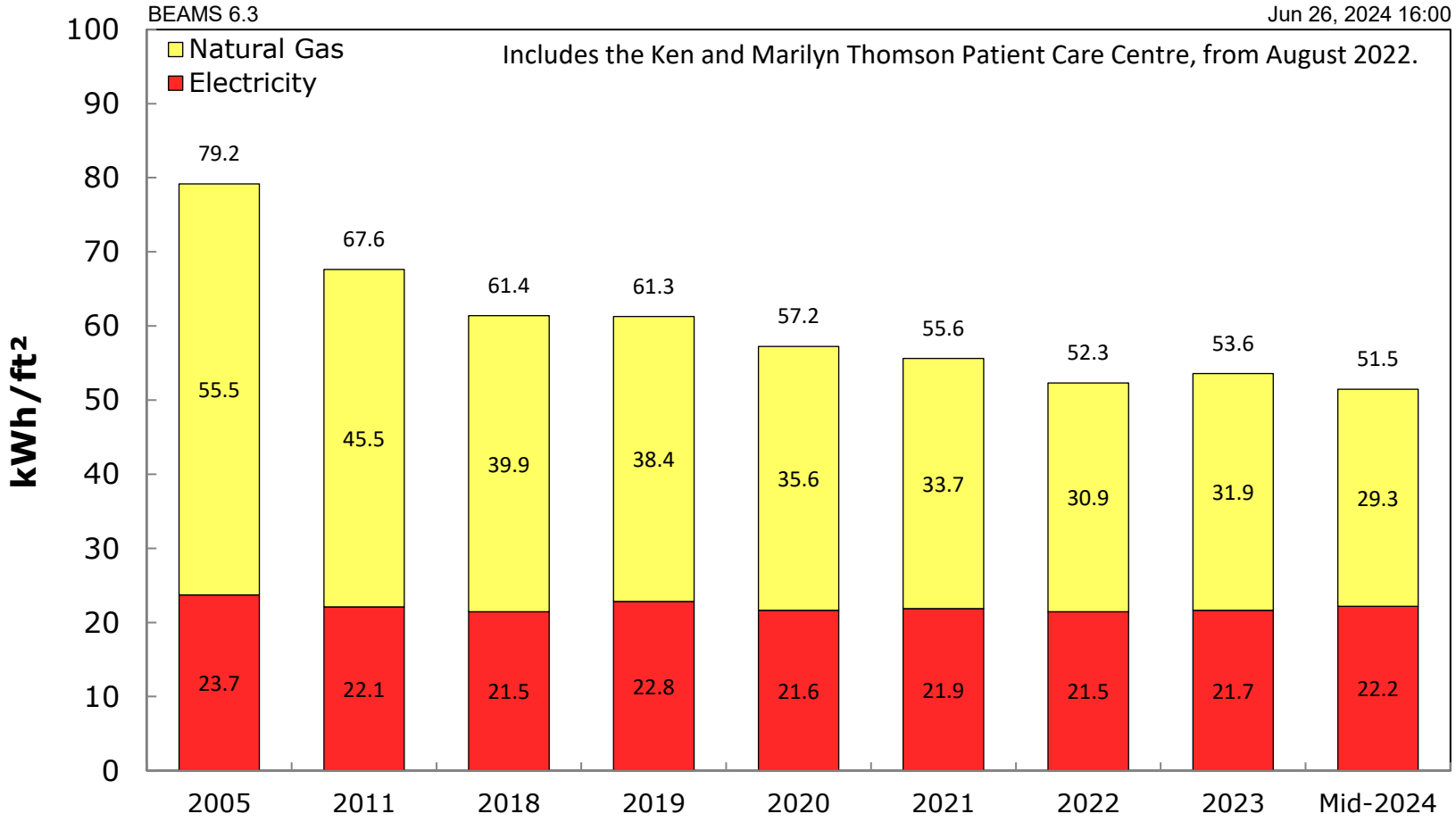
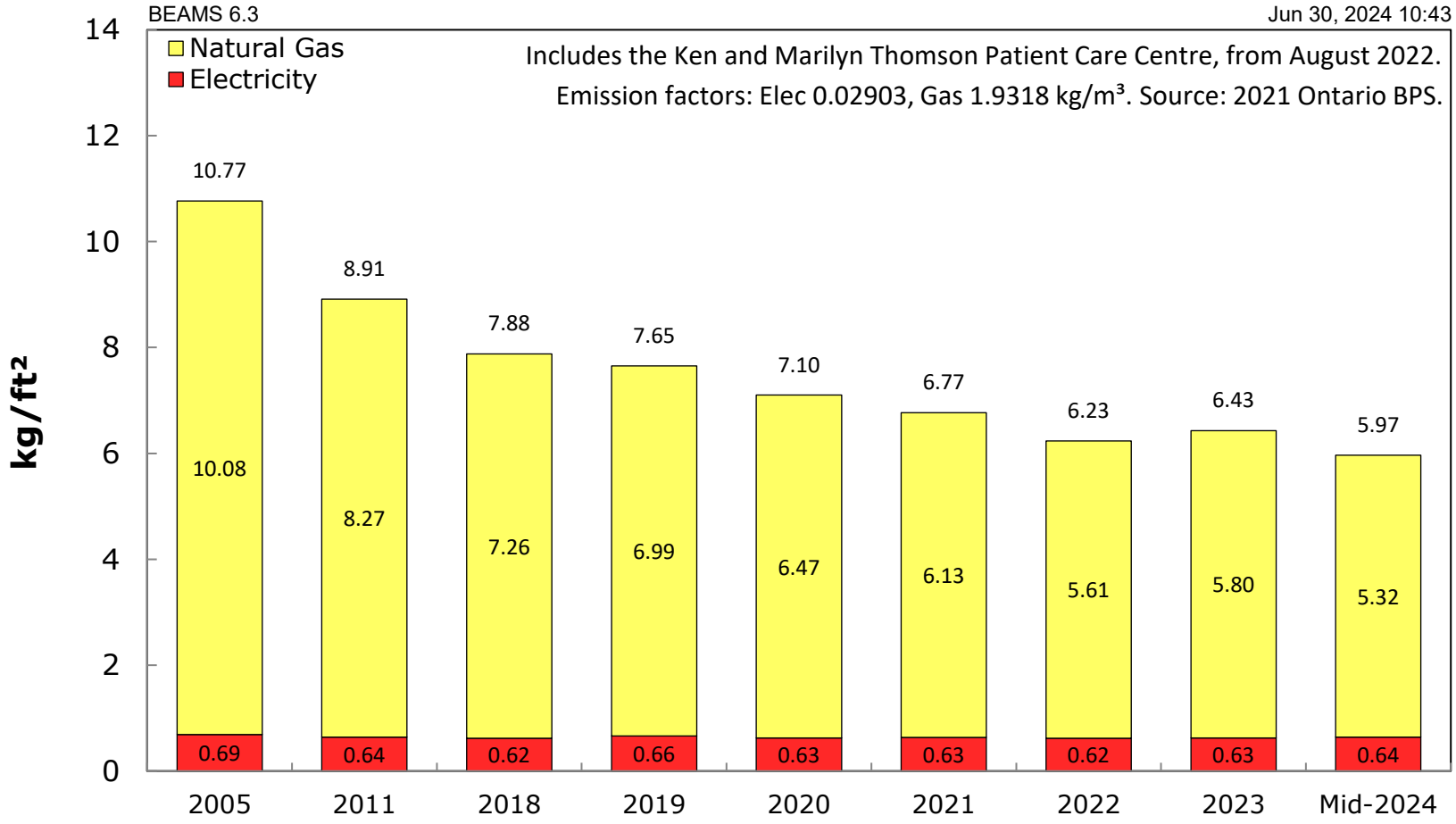


Figure 2
Michael Garron Hospital
Weather-normalized Annual GHG Intensity
CY'2005 – Mid-2024



5.0 Goals and objectives for conserving energy and managing demand

It is of critical importance to improve energy efficiency and reduce our operating costs. Equally important is displaying our commitment to the environment through the reduction of greenhouse gases, while improving our air quality. It is also important that these actions be carried out without adversely impacting operations. TEHN Staff will have an essential role in the success of this energy management plan. It will be the responsibility of the Energy Management Team to ensure that energy management measures are properly communicated and effectively implemented. An Energy Mandate for TEHN has been developed and is an integral component of this CDM Plan.

The primary objective of this plan is to improve the management of TEHN's energy consumption. Part of this objective is setting a conservation target that will see TEHN reduce the 2023 energy consumption of the expanded MGH 3% by the end of 2029.

5.1 Energy management team

Historically, TEHN addressed Energy Conservation and Demand Management on a project-by-project basis through the activities of Facility Services. Strategic directives have been provided by the Hospital Chief Executive Officer and the Senior Executive Team. A Sustainability Team and a Green Team have been active partners in the management of energy conservation at the Hospital.

5.2 Energy monitoring

TEHN closely monitors energy consumption and GHG emissions. Since 2015, TEHN has contracted with independent energy analyst Ted Molczan, to provide regular progress reports on energy performance, and to support its broader public sector reporting and CDM obligations. Ted produced the energy analyses in this report, using methodology described in Appendix A.

5.3 Management approval

The senior management of TEHN has approved this CDM plan.

6.0 Energy and GHG reduction measures

6.1 Past measures

Michael Garron Hospital completed the following energy and GHG reduction measures since the publication of the 2019 CDM plan.

LED lighting upgrade – >80% of the facility is now LED lighting
Installed 20 E.V Charging Ports
Installed VFD's on three 800-ton Chillers
Completed Roof Replacement of K-Wing
Roof replacement for J-Wing is in progress
Operating Rooms – Occupancy Fan Scheduling Project
Implemented a Fan Schedule reductions project
Decommissioned Oxygen Concentrator system to convert to Bulk Tank
Replaced six DHW tanks with instantaneous heaters. Reduced temperature 5 F deg.

6.2 Current and proposed measures

The following measures have been approved or are under consideration for the existing MGH.

LED Project – continue retrofit to 100%, with implementation of additional lighting controls system.
Investigating opportunities for solar power
Investigating heat recovery chiller to serve J-Wing

Appendix A: Energy Analysis Methodology

Energy and GHG reductions and benchmark plots have been prepared using Ted Molczan's proprietary software, BEAMS (Building Energy Analysis and Monitoring System). Now in its sixth generation, BEAMS has been in development and use continuously since 1991 and used to analyze hundreds of facilities in the commercial, institutional, residential, and industrial sectors.

Accurate weather normalization

Weather strongly influences the energy and water consumption of most buildings. Therefore, the effects of weather must be understood and accurately accounted for to confidently assess the success of cost-control and conservation efforts, detect unplanned increases in consumption, produce reliable budgets, and evaluate the feasibility of proposed projects.

The process of accounting for the effect of weather on energy and water use is called weather normalization. BEAMS enables weather-normalization by means of statistical models that express the empirical relationship between consumption and weather, as measured by heating degree-days and/or cooling degree-days.

Inherent in statistical models is uncertainty that must be accurately estimated and considered when interpreting results. For example, consider that the statistical uncertainty of modeled annual natural gas use typically is at least 5%, at the 95% confidence level. Therefore, a 3% change would not be considered statistically significant at that level of confidence.

Adherence to standards

At the heart of BEAMS is a powerful statistical modeling capability that adheres to current industry best practice, as defined by:

- ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers): Guideline 14-2023 - Measurement of Energy, Demand, and Water Savings
- The EVO (Energy Valuation Organization): International Performance Measurement and Verification Protocol (IPMVP) Core Concepts 2022, specifically for Option C (Whole Facility) applications.
- Bureau International des Poids et Mesures (BIPM)/ISO: Guide to the Expression of Uncertainty in Measurement (GUM).

Section A.1 describes how energy savings and GHG reductions relative 2018 were estimated.
Section A.2 describes how energy savings and GHG reductions relative 2005 were estimated.
Section A.3 describes how the data for the energy and GHG intensity plots was estimated.

A.1 Legacy MGH energy and GHG reduction relative 2018 baseline

A.1.1 Electricity

Differences in weather between baseline 2018 and the reporting period have been accounted for by means of weather-normalization. This was accomplished by creating a statistical model that relates the monthly energy use of the baseline year to heating degree-days and/or cooling degree-days.

Table A-1 displays the result of the BEAMS statistical analysis of Legacy MGH's 2018 electrical energy consumption. The Billing Period section reports the dates on which the meter was read, the number of days between readings, and the number of heating and cooling degree-days during this period. The Actual Use section lists the kWh of energy consumed.

To account for billing periods of different duration, actual use and degree-days have been normalized by dividing by the duration of the billing period for input into the linear regression calculation, as shown in the Regression Data section of Table A-1. A weighted least squares regression analysis was performed to find the linear equation relating consumption and degree-days that best fits the data. The energy and degree-day inputs have been weighted by the duration of the billing period, to minimize bias.

Energy consumption was found to correlate strongly with cooling degree-days relative a balance temperature of 13.5 C. The co-efficient of determination (r^2) was .978, which means that 97.8 percent of a change in consumption can be explained by a change in cooling degree-days. The degree-day coefficient is statistically significant at the 95% confidence level. The model predicts total annual baseline energy consumption with an uncertainty of about 2.4% at the 95% confidence level.

The linear regression equation is displayed beneath the regression data table, and reproduced here in a simpler form:

Baseline Use = 44397.816 X Days + 2101.079 X cdd

The Accounted section of Table A-1 displays the energy use computed by the above equation. The residuals section is the difference between the actual and accounted energy use. The total annual residual equals zero, which confirms the lack of bias – the model neither over-estimates nor under-estimates the annual baseline use.

Table A-1
Toronto East Health Network
Legacy Michael Garron Hospital
Electricity: Energy
Baseline Correlation With Degree-Days
Jan 2018 - Dec 2018

BEAMS 6.3 Jun 20, 2024 08:29

Billing Period					Actual Use	Regression Data				Accounted	Residuals	
Mon	Rdg Date	Days	hdd<13.5	cdd>13.5	kWh	kWh/d	hdd/d	cdd/d	Out	kWh	kWh	%
	2017 12 31											
Jan	2018 01 31	31	550.53	0.00	1,414,129	45,617	17.76	0.00		1,376,332	(37,797)	(2.7)
Feb	2018 02 28	28	390.04	0.00	1,278,860	45,674	13.93	0.00		1,243,139	(35,721)	(2.9)
Mar	2018 03 31	31	397.46	0.00	1,398,684	45,119	12.82	0.00		1,376,332	(22,352)	(1.6)
Apr	2018 04 30	30	277.63	0.00	1,335,031	44,501	9.25	0.00		1,331,934	(3,097)	(0.2)
May	2018 05 31	31	9.69	119.03	1,618,464	52,209	0.31	3.84		1,626,431	7,967	0.5
Jun	2018 06 30	30	0.67	185.05	1,686,652	56,222	0.02	6.17		1,720,739	34,087	2.0
Jul	2018 07 31	31	0.00	315.70	1,996,262	64,396	0.00	10.18		2,039,652	43,390	2.1
Aug	2018 08 31	31	0.00	308.41	2,065,728	66,636	0.00	9.95		2,024,331	(41,396)	(2.0)
Sep	2018 09 30	30	2.47	178.88	1,754,075	58,469	0.08	5.96		1,707,774	(46,301)	(2.7)
Oct	2018 10 31	31	138.70	24.02	1,420,104	45,810	4.47	0.77		1,426,793	6,689	0.5
Nov	2018 11 30	30	323.44	0.00	1,313,660	43,789	10.78	0.00		1,331,934	18,275	1.4
Dec	2018 12 31	31	383.53	0.00	1,300,077	41,938	12.37	0.00		1,376,332	76,255	5.5
Total		365	2474.16	1131.10	18,581,725					18,581,725	0	0.0

Weather Data: Environment Canada, Toronto City, Baseline Actual

Baseline Use = 44397.816 X Days + 2101.079 X (cdd>13.5) ($p < .05$); $r^2 = .978$

NDBE = 0.000%, CV(RMSE) = 2.61%, PI = ±2.37% ($p < .05$)

The baseline equation is used to estimate the change in energy use relative baseline in any past or future period. Table A-2 presents the energy change for the 12-months ended May 2024. Applying the baseline equation to the duration and heating and cooling degree-days of the billing period yields the baseline-equivalent use. Subtracting the actual use yields the change, which was a reduction of 1,735,669 kWh (9.5%). The GHG emission change is the product of the energy change and the emission factor for the year. The most recent available BPS emission factor was 0.0290 kg/kWh for 2021, which yielded a reduction of 50 t. The energy and GHG change of all other years were computed in the same manner.

The right-most columns report the prediction interval, which is an estimate of the uncertainty of the baseline-equivalent use at the 95% confidence level. The total energy reduction of 9.5% exceeded the annual prediction interval of 2.4%, which means that there was less than a 5% probability that it was due to the statistical variance of the baseline. Ten monthly reductions were also statistically significant at the 95% confidence level.

Table A-2
Legacy Michael Garron Hospital
Electrical Energy Change Relative Baseline 2018
Jun 2023 – May 2024

BEAMS 6.3 Jun 28, 2024 10:39

Billing Period				B.L. Equiv.	Actual Use	Change		+/- P.I.	
Mon	Rdg Date	Days	cdd>13.5	kWh	kWh	kWh	%	kWh	%
	2023 05 31								
Jun	2023 06 30	30	184.2	1,718,892	1,574,661	144,231	8.4	95,146	5.5
Jul	2023 07 31	31	279.7	1,963,969	1,808,212	155,757	7.9	102,967	5.2
Aug	2023 08 31	31	219.3	1,837,011	1,761,433	75,578	4.1	98,479	5.4
Sep	2023 09 30	30	161.9	1,672,117	1,479,295	192,822	11.5	94,228	5.6
Oct	2023 10 31	31	54.7	1,491,358	1,331,458	159,900	10.7	95,086	6.4
Nov	2023 11 30	30	0.0	1,331,934	1,217,586	114,348	8.6	95,229	7.1
Dec	2023 12 31	31	0.0	1,376,332	1,243,904	132,428	9.6	96,995	7.0
Jan	2024 01 31	31	0.0	1,376,332	1,294,256	82,076	6.0	96,995	7.0
Feb	2024 02 29	29	0.0	1,287,537	1,186,471	101,065	7.8	93,443	7.3
Mar	2024 03 31	31	0.0	1,376,332	1,179,821	196,511	14.3	96,995	7.0
Apr	2024 04 30	30	3.6	1,339,437	1,154,033	185,404	13.8	95,062	7.1
May	2024 05 31	31	98.1	1,582,431	1,386,883	195,547	12.4	94,648	6.0
Total		366	1001.4	18,353,683	16,618,013	1,735,669	9.5	442,824	2.4

Baseline Period: Jan 2018 - Dec 2018 2.23 t

Weather Data: Environment Canada, Toronto City 10.00 v

Baseline Use = 44397.816 X Days + 2101.079 X (cdd>13.5) ($p < .05$); $r^2 = .978$

NDBE = 0.000%, CV(RMSE) = 2.61%, PI = ±2.37% ($p < .05$)

A.1.2 Natural gas

The reduction in natural gas was estimated using the methodology for electrical energy, described in the previous section. Table A-3 displays the 2018 statistical correlation between Legacy MGH's natural gas use and heating degree-days.

Gas consumption was found to correlate strongly with heating degree-days below a balance temperature of 12.9 C. The co-efficient of determination (r^2) was .956, which means that 95.6 percent of a change in consumption can be explained by a change in heating degree-days. The degree-day coefficient is statistically significant at the 95% confidence level. The model predicts total baseline annual energy consumption with an uncertainty of about 9.8% at the 95% confidence level.

The linear regression equation is displayed beneath the regression data table, and reproduced here in a simpler form:

Baseline Use = 5017.820 X Days + 626.876 X hdd

The Accounted section of Table A-3 displays the natural gas use computed by the above equation. The residuals section is the difference between the actual and accounted energy use. The total annual residual equals zero, which confirms the lack of bias – the model neither over-estimates nor under-estimates the annual baseline use.

The baseline equation is used to estimate the change in energy use relative baseline in any past or future period. Table A-4 presents the natural gas change for the 12-months ended June 2024. Applying the baseline equation to the duration and heating degree-days of the billing period yields the baseline-equivalent use. Subtracting the actual use yields the change, which was a reduction of 481,323 m^3 (16.5%). The GHG emission change is the product of the energy change and the emission factor for the year. The most recent available BPS emission factor was 1.9318 kg/m^3 for 2021, which yielded a reduction of 930 t. The energy and GHG change of all other years were computed in the same manner.

The right-most columns of Table A-4 report the prediction interval, which is an estimate of the uncertainty of the baseline-equivalent use at the 95% confidence level. The total energy reduction of 16.5% exceeded the annual prediction interval of 11.5%, which means that there was less than a 5% probability that it was due to the statistical variance of the baseline.

Table A-3
Toronto East Health Network
Legacy Michael Garron Hospital
Natural Gas
Baseline Correlation With Degree-Days
Jan 2018 - Dec 2018

BEAMS 6.3 Jun 20, 2024 09:43

Billing Period				Actual Use	Regression Data			Accounted	Residuals	
Mon	Rdg Date	Days	hdd<12.9	m³	m³/d	hdd/d	Out	m³	m³	%
	2017 12 19									
Jan	2018 01 21	33	638.78	550,272	16,675	19.36		566,022	15,750	2.8
Feb	2018 02 20	30	452.97	460,670	15,356	15.10		434,494	(26,176)	(6.0)
Mar	2018 03 20	28	323.18	379,508	13,554	11.54		343,092	(36,416)	(10.6)
Apr	2018 04 19	30	333.08	396,097	13,203	11.10		359,333	(36,764)	(10.2)
May	2018 05 21	32	57.16	223,640	6,989	1.79		196,405	(27,235)	(13.9)
Jun	2018 06 20	30	0.00	156,267	5,209	0.00		150,535	(5,732)	(3.8)
Jul	2018 07 19	29	0.00	148,863	5,133	0.00		145,517	(3,346)	(2.3)
Aug	2018 08 21	33	0.00	158,341	4,798	0.00		165,588	7,247	4.4
Sep	2018 09 20	30	0.00	143,029	4,768	0.00		150,535	7,506	5.0
Oct	2018 10 21	31	52.08	175,495	5,661	1.68		188,200	12,705	6.8
Nov	2018 11 20	30	252.48	263,569	8,786	8.42		308,809	45,240	14.6
Dec	2018 12 19	29	347.24	315,970	10,896	11.97		363,192	47,222	13.0
Total		365	2456.97	3,371,721				3,371,721	0	0.0

Weather Data: Environment Canada, Toronto City, Baseline Actual

Baseline Use = 5017.820 X Days + 626.876 X (hdd<12.9) ($p < .05$); $r^2 = .956$

NDBE = 0.000%, CV(RMSE) = 10.64%, PI = ±9.80% ($p < .05$)

Table A-4
Legacy Michael Garron Hospital
Natural Gas Change Relative Baseline 2018
Jul 2023 -Jun 2024

BEAMS 6.3 Jun 26, 2024 12:50

Billing Period				B.L. Equiv.	Actual Use	Change		+/- P.I.	
Mon	Rdg Date	Days	hdd<12.9	m³	m³	m³	%	m³	%
	2023 06 20								
Jul	2023 07 21	31	0.0	155,552	118,452	37,100	23.9	73,639	47.3
Aug	2023 08 21	31	0.0	155,552	115,337	40,215	25.9	73,639	47.3
Sep	2023 09 20	30	0.0	150,535	106,797	43,738	29.1	72,272	48.0
Oct	2023 10 23	33	37.1	188,845	159,563	29,282	15.5	75,434	39.9
Nov	2023 11 20	28	152.4	236,005	223,787	12,218	5.2	67,233	28.5
Dec	2023 12 18	28	268.6	308,905	268,075	40,830	13.2	67,576	21.9
Jan	2024 01 21	34	452.4	454,197	367,471	86,726	19.1	77,519	17.1
Feb	2024 02 19	29	336.6	356,506	295,942	60,564	17.0	69,726	19.6
Mar	2024 03 19	29	237.9	294,664	258,836	35,828	12.2	68,541	23.3
Apr	2024 04 18	30	209.4	281,810	238,381	43,429	15.4	69,682	24.7
May	2024 05 21	33	49.7	196,716	182,768	13,948	7.1	75,165	38.2
Jun	2024 06 19	29	0.0	145,517	108,073	37,444	25.7	70,890	48.7
Total		365	1744.0	2,924,805	2,443,482	481,323	16.5	337,278	11.5

Baseline Period: Jan 2018 - Dec 2018 2.23 t

Weather Data: Environment Canada, Toronto City 10.00 v

Baseline Use = 5017.820 X Days + 626.876 X (hdd<12.9) ($p < .05$); $r^2 = .956$

NDBE = 0.000%, CV(RMSE) = 10.64%, PI = ±9.80% ($p < .05$)

A.2 Legacy MGH energy and GHG reduction relative 2005 baseline

A.2.1 Electricity

The provincial target to reduce GHG emissions is 30% from 2005 levels by 2030. Differences in weather between baseline 2005 and the reporting period have been accounted for by means of weather-normalization. This is accomplished by creating a statistical model that relates the monthly energy use of the baseline year to heating degree-days and/or cooling degree-days.

Table A-5 displays the result of the BEAMS statistical analysis of Legacy MGH's 2005 electrical energy consumption. The Billing Period section reports the dates on which the meter was read, the number of days between readings, and the number of heating and cooling degree-days during this period. The Actual Use section lists the kWh of energy consumed.

To account for billing periods of different duration, actual use and degree-days have been normalized by dividing by the duration of the billing period for input into the linear regression calculation, as shown in the Regression Data section of Table A-5. A weighted least squares regression analysis was performed to find the linear equation relating consumption and degree-days that best fits the data. The energy and degree-day inputs have been weighted by the duration of the billing period, to minimize bias.

Energy consumption was found to correlate strongly with heating and cooling degree-days relative a balance temperature of 13.6 C. The co-efficient of determination (r^2) was .993, which means that 99.3 percent of a change in consumption can be explained by a change in heating and/or cooling degree-days. Both degree-day coefficients are statistically significant at the 95% confidence level. The model predicts total annual baseline energy consumption with an uncertainty of about 1.7% at the 95% confidence level.

The linear regression equation is displayed beneath the regression data table, and reproduced here in a simpler form:

Baseline Use = 47682.556 X Days + 160.550 X hdd + 2859.528 X cdd

The Accounted section of Table A-5 displays the energy use computed by the above equation. The residuals section is the difference between the actual and accounted energy use. The total annual residual equals zero, which confirms the lack of bias – the model neither over-estimates nor under-estimates the annual baseline use.

Table A-5
Toronto East Health Network
Legacy Michael Garron Hospital
Electricity: Energy
Baseline Correlation With Degree-Days
Jan 2005 - Dec 2005

BEAMS 6.3 Jun 20, 2024 08:29

Billing Period					Actual Use	Regression Data				Accounted	Residuals	
Mon	Rdg Date	Days	hdd<13.6	cdd>13.6	kWh	kWh/d	hdd/d	cdd/d	Out	kWh	kWh	%
	2004 12 23											
Jan	2005 01 23	31	556.33	0.00	1,538,806	49,639	17.95	0.00		1,567,477	28,671	1.8
Feb	2005 02 23	31	518.30	0.00	1,569,618	50,633	16.72	0.00		1,561,373	(8,245)	(0.5)
Mar	2005 03 23	28	449.21	0.00	1,423,490	50,839	16.04	0.00		1,407,232	(16,259)	(1.2)
Apr	2005 04 23	31	179.63	3.67	1,522,862	49,125	5.79	0.12		1,517,507	(5,355)	(0.4)
May	2005 05 23	30	106.35	12.47	1,456,987	48,566	3.54	0.42		1,483,211	26,224	1.8
Jun	2005 06 23	31	0.95	205.40	2,003,075	64,615	0.03	6.63		2,065,659	62,585	3.0
Jul	2005 07 23	30	0.00	345.33	2,399,548	79,985	0.00	11.51		2,417,955	18,407	0.8
Aug	2005 08 23	31	0.00	293.97	2,342,904	75,578	0.00	9.48		2,318,789	(24,115)	(1.0)
Sep	2005 09 23	31	0.00	227.53	2,179,136	70,295	0.00	7.34		2,128,785	(50,351)	(2.4)
Oct	2005 10 23	30	47.45	50.13	1,604,539	53,485	1.58	1.67		1,581,440	(23,099)	(1.5)
Nov	2005 11 23	31	192.81	0.47	1,509,170	48,683	6.22	0.02		1,510,473	1,303	0.1
Dec	2005 12 23	30	464.68	0.00	1,514,846	50,495	15.49	0.00		1,505,081	(9,766)	(0.6)
Total		365	2515.71	1138.98	21,064,983					21,064,983	0	0.0

Weather Data: Environment Canada, Toronto City, Baseline Actual

Baseline Use = 47682.556 X Days + 160.550 X (hdd<13.6) ($p < .05$) + 2859.528 X (cdd>13.6) ($p < .05$); $r^2 = .993$

NDBE = 0.000%, CV(RMSE) = 1.89%, PI = ±1.73% ($p < .05$)

The baseline equation is used to estimate the change in energy use relative baseline in any past or future period. Table A-6 presents the energy change for the 12-months ended May 2024. Applying the baseline equation to the duration and heating and cooling degree-days of the billing period yields the baseline-equivalent use. Subtracting the actual use yields the change, which was a reduction of 3,953,940 kWh (19.2%). The GHG emission change is the product of the energy change and the emission factor for the year. The most recent available BPS emission factor was 0.0290 kg/kWh for 2021, which yielded a reduction of 115 t. The energy and GHG change of all other years were computed in the same manner.

The right-most columns report the prediction interval, which is an estimate of the uncertainty of the baseline-equivalent use at the 95% confidence level. The total energy reduction of 19.2% exceeded the annual prediction interval of 1.9%, which means that there was less than a 5% probability that it was due to the statistical variance of the baseline. The reduction in each month also was statistically significant at the 95% confidence level.

Table A-6
Legacy Michael Garron Hospital
Electrical Energy Change Relative Baseline 2005
Jun 2023 – May 2024

BEAMS 6.3 Jun 28, 2024 10:39

Billing Period					B.L. Equiv.	Actual Use	Change		+/- P.I.	
Mon	Rdg Date	Days	hdd<13.6	cdd>13.6	kWh	kWh	kWh	%	kWh	%
	2023 05 31									
Jun	2023 06 30	30	0.0	181.2	1,948,540	1,574,661	373,878	19.2	79,710	4.1
Jul	2023 07 31	31	0.0	276.6	2,269,057	1,808,212	460,845	20.3	84,122	3.7
Aug	2023 08 31	31	0.0	216.2	2,096,270	1,761,433	334,837	16.0	81,539	3.9
Sep	2023 09 30	30	0.0	158.9	1,884,879	1,479,295	405,585	21.5	79,874	4.2
Oct	2023 10 31	31	77.2	53.7	1,644,245	1,331,458	312,787	19.0	83,155	5.1
Nov	2023 11 30	30	260.2	0.0	1,472,252	1,217,586	254,666	17.3	79,094	5.4
Dec	2023 12 31	31	309.3	0.0	1,527,819	1,243,904	283,915	18.6	80,139	5.2
Jan	2024 01 31	31	461.5	0.0	1,552,248	1,294,256	257,992	16.6	82,186	5.3
Feb	2024 02 29	29	350.0	0.0	1,438,978	1,186,471	252,507	17.5	77,368	5.4
Mar	2024 03 31	31	282.8	0.0	1,523,565	1,179,821	343,744	22.6	80,374	5.3
Apr	2024 04 30	30	140.4	3.4	1,462,653	1,154,033	308,620	21.1	82,405	5.6
May	2024 05 31	31	4.4	95.3	1,751,447	1,386,883	364,564	20.8	83,912	4.8
Total		366	1885.7	985.3	20,571,954	16,618,013	3,953,940	19.2	385,236	1.9

Baseline Period: Jan 2005 - Dec 2005 2.26 t

Weather Data: Environment Canada, Toronto City 9.00 v

Baseline Use = 47682.556 X Days + 160.550 X (hdd<13.6) ($p < .05$) + 2859.528 X (cdd>13.6) ($p < .05$); $r^2 = .993$

NDBE = 0.000%, CV(RMSE) = 1.89%, PI = ±1.73% ($p < .05$)

A.2.2 Natural gas

The reduction in natural gas was estimated using the methodology for electrical energy, described in the previous section. Table A-7 displays the statistical correlation between Legacy MGH's natural gas use and heating degree-days.

Gas consumption was found to correlate strongly with heating degree-days below a balance temperature of 15.2 C. The co-efficient of determination (r^2) was .997, which means that 99.7 percent of a change in consumption can be explained by a change in heating degree-days. The degree-day coefficient is statistically significant at the 95% confidence level. The model predicts total baseline annual energy consumption with an uncertainty of about 2.7% at the 95% confidence level.

The linear regression equation is displayed beneath the regression data table, and reproduced here in a simpler form:

Baseline Use = 6221.820 X Days + 833.954 X hdd

The Accounted section of Table A-7 displays the natural gas use computed by the above equation. The residuals section is the difference between the actual and accounted energy use. The total annual residual equals zero, which confirms the lack of bias – the model neither over-estimates nor under-estimates the annual baseline use.

The baseline equation is used to estimate the change in energy use relative baseline in any past or future period. Table A-8 presents the natural gas change for the 12-months ended June 2024. Applying the baseline equation to the duration and heating degree-days of the billing period yields the baseline-equivalent use. Subtracting the actual use yields the change, which was a reduction of 1,681,380 m^3 (40.8%). The GHG emission change is the product of the energy change and the emission factor for the year. The most recent available BPS emission factor was 1.9318 kg/m^3 for 2021, which yielded a reduction of 3248 t. The energy and GHG change of all other years were computed in the same manner.

The right-most columns of Table A-8 report the prediction interval, which is an estimate of the uncertainty of the baseline-equivalent use at the 95% confidence level. The total energy reduction of 40.8% exceeded the annual prediction interval of 3.1%, which means that there was less than a 5% probability that it was due to the statistical variance of the baseline. The reduction in each month also was statistically significant at the 95% confidence level.

Table A-7
Toronto East Health Network
Legacy Michael Garron Hospital
Natural Gas
Baseline Correlation With Degree-Days
Jan 2005 - Dec 2005

BEAMS 6.3 Jun 19, 2024 11:47

Billing Period				Actual Use	Regression Data			Accounted	Residuals	
Mon	Rdg Date	Days	hdd<15.2	m³	m³/d	hdd/d	Out	m³	m³	%
	2004 12 20									
Jan	2005 01 20	31	562.10	671,927	21,675	18.13		661,646	(10,281)	(1.6)
Feb	2005 02 20	31	616.70	699,408	22,562	19.89		707,173	7,765	1.1
Mar	2005 03 20	28	508.86	600,796	21,457	18.17		598,579	(2,217)	(0.4)
Apr	2005 04 20	31	249.41	409,369	13,205	8.05		400,873	(8,496)	(2.1)
May	2005 05 20	30	163.58	318,358	10,612	5.45		323,074	4,716	1.5
Jun	2005 06 20	31	10.11	185,548	5,985	0.33		201,310	15,762	7.8
Jul	2005 07 20	30	0.00	172,834	5,761	0.00		186,655	13,821	7.4
Aug	2005 08 20	31	0.00	194,644	6,279	0.00		192,876	(1,768)	(0.9)
Sep	2005 09 20	31	0.00	213,718	6,894	0.00		192,876	(20,842)	(10.8)
Oct	2005 10 20	30	46.60	235,748	7,858	1.55		225,520	(10,228)	(4.5)
Nov	2005 11 20	31	224.62	372,689	12,022	7.25		380,200	7,511	2.0
Dec	2005 12 20	30	501.85	600,919	20,031	16.73		605,176	4,257	0.7
Total		365	2883.84	4,675,958				4,675,958	0	0.0

Weather Data: Environment Canada, Toronto City, Baseline Actual

Baseline Use = 6221.820 X Days + 833.954 X (hdd<15.2) ($p < .05$); $r^2 = .997$

NDBE = 0.000%, CV(RMSE) = 2.95%, PI = ±2.67% ($p < .05$)

Table A-8
Legacy Michael Garron Hospital
Natural Gas Change Relative Baseline 2005
Jul 2023 – Jun 2024

BEAMS 6.3 Jun 26, 2024 12:50

Billing Period				B.L. Equiv.	Actual Use	Change		+/- P.I.	
Mon	Rdg Date	Days	hdd<15.2	m³	m³	m³	%	m³	%
	2023 06 20								
Jul	2023 07 21	31	0.0	192,876	118,452	74,424	38.6	27,866	14.4
Aug	2023 08 21	31	0.0	192,876	115,337	77,539	40.2	27,866	14.4
Sep	2023 09 20	30	0.3	186,933	106,797	80,136	42.9	27,344	14.6
Oct	2023 10 23	33	74.4	267,366	159,563	107,803	40.3	28,321	10.6
Nov	2023 11 20	28	208.5	348,092	223,787	124,305	35.7	25,374	7.3
Dec	2023 12 18	28	333.0	451,954	268,075	183,879	40.7	25,609	5.7
Jan	2024 01 21	34	530.6	654,028	367,471	286,557	43.8	29,332	4.5
Feb	2024 02 19	29	403.3	516,744	295,942	220,802	42.7	26,417	5.1
Mar	2024 03 19	29	304.6	434,473	258,836	175,637	40.4	25,959	6.0
Apr	2024 04 18	30	276.7	417,420	238,381	179,039	42.9	26,357	6.3
May	2024 05 21	33	88.6	279,207	182,768	96,439	34.5	28,233	10.1
Jun	2024 06 19	29	2.9	182,893	108,073	74,820	40.9	26,799	14.7
Total		365	2223.0	4,124,862	2,443,482	1,681,380	40.8	126,534	3.1

Baseline Period: Jan 2005 - Dec 2005 2.23 t

Weather Data: Environment Canada, Toronto City 10.00 v

Baseline Use = 6221.820 X Days + 833.954 X (hdd<15.2) ($p < .05$); $r^2 = .997$

NDBE = 0.000%, CV(RMSE) = 2.95%, PI = ±2.67% ($p < .05$)

A.3 Weather-normalized energy and GHG benchmarks

Benchmarking is a popular method of tracking energy and GHG performance over time. The standard approach for commercial and institutional buildings is to plot intensity graphs - total energy consumption or GHG emissions, divided by gross floor area. However, annual variations in weather complicate interpretation. For example, a mild winter can make one year's fuel results appear better than those of another year. A cold winter can have the opposite effect. Weather-normalization addresses this concern.

The previous section described the use of weather-normalization to compare the energy use of two different years. In that case, the energy use of the baseline year was normalized to the weather of the reporting year. Since benchmarking typically compares more than two years, all years must be normalized to a common weather year. BEAMS employs a typical meteorological year (TMY), which best represents the average weather of each month and its variation. The TMY for TEHN has been derived from a statistical analysis of Environment Canada Toronto City weather station data for the years 2001-2020.

MGH's monthly electricity and natural gas consumption of each year has been statistically correlated with weather (heating and/or cooling degree-days), and the linear regression coefficients have been applied to the weather of the TMY. Below is a description of this process for 2018.

Appendix A.1.1 presented the statistically derived equation relating electrical energy use in 2018 with degree-days. Table A-9 displays MGH's weather-normalized 2018 energy consumption, based on applying this equation to the TMY. MGH would have consumed 18,256,058 kWh in a TMY. Dividing by the mean 2018 GFA of 851,036 ft² (from the table in Section 4) yields weather-normalized 2018 intensity of 21.45 kWh/ft².

Appendix A.1.2 presented the statistically derived equation relating natural gas use in 2018 with degree-days. Table A-10 displays MGH's weather-normalized 2018 gas consumption. MGH would have consumed 3,197,303 m³ in a TMY. Multiplying by the conversion factor 10.627777 kWh/m³ yields 33,980,223 kWh. Dividing by the mean 2018 GFA of 851,036 ft² yields intensity of 39.93 kWh/ft².

The above 2018 energy intensities and their sum, 61.38 kWh/ft², are displayed in Figure 1. The same method was used to derive the values of each year in Figure 1. On this basis, by mid-2024 the total annual energy intensity had been reduced from 61.4 kWh/ft² in 2018 to 51.5 kWh/ft² – a decrease of 16.1%.

The 2018 GHG intensity displayed in Figure 2 was obtained by multiplying the 2018 TMY electrical energy and natural gas use by their GHG emission factors. The emission factors have varied over

the period of Figure 2, especially that of electricity, which declined significantly, due to the permanent closure of Ontario's coal-fired generators, and the increased use of lower or zero carbon alternatives. This had the effect of reducing the carbon emissions of all consumers of electricity. To make clear the results of MGH's efforts, constant emission factor values have been applied to all years of the benchmark plot. The most recent available BPS emission factors were used, which were for 2021: 0.02903 kg/kWh of electricity and 1.9318 kg/m³ of natural gas.

Applying the electricity emissions factor of 0.02903 kg/kWh to the 2018 TMY electrical energy use of 18,256,058 kWh calculated above, yields emissions of 529,973 kg. Dividing by the mean 2018 GFA of 851,036 ft² (from the table in Section 4) yields intensity of 0.62 kg/ft².

Applying the natural gas emissions factor of 1.9318 kg/m³ to the 2018 TMY gas use of 3,197,303 m³ calculated above, yields emissions of 6,176,550 kg. Dividing by the mean 2018 GFA of 851,036 ft² yields intensity of 7.26 kg/ft².

The above 2018 GHG intensities and their sum, 7.88 kg/ft², are displayed in Figure 2. The same method was used to derive the values of each year in Figure 2. On this basis, by mid-2024 the total annual GHG intensity has been reduced from 7.88 kg/ft² in 2018 to 5.97 kg/ft² – a decrease of 24.2%.

Table A-9
Michael Garron Hospital
Weather-Normalized Electrical Energy Consumption
Baseline 2018 Applied to a TMY

Mon	Dur	cdd>13.5	kWh	+/- P.I.	%P.I.
Jan	31	0.0	1,376,332	96995	7.0
Feb	28	0.0	1,243,139	91635	7.4
Mar	31	0.0	1,376,332	96995	7.0
Apr	30	1.4	1,334,972	95229	7.1
May	31	59.4	1,501,145	94660	5.9
Jun	30	185.1	1,720,739	96106	5.5
Jul	31	280.8	1,966,324	105823	5.2
Aug	31	271.2	1,946,171	108009	5.2
Sep	30	146.0	1,638,701	95345	5.5
Oct	31	31.6	1,442,726	96118	6.8
Nov	30	0.6	1,333,143	95229	7.1
Dec	31	0.0	1,376,332	96995	7.0
Total	365	976.1	18,256,058	440983	2.4

Weather Data: Environment Canada, Toronto City, TMY

kWh= 44397.816 X Days + 2101.079 X cdd

Table A-10
Michael Garron Hospital
Weather-Normalized Natural Gas Consumption
Baseline 2018 Applied to a TMY

Mon	Dur	hdd<12.9	m³	+/- P.I.	%P.I.
Jan	31	520.9	482,095	80654	14.9
Feb	28	444.9	419,391	74585	15.8
Mar	31	352.2	376,307	75370	16.6
Apr	30	156.0	248,317	69695	26.1
May	31	24.8	171,115	72746	40.5
Jun	30	0.0	150,535	72249	47.8
Jul	31	0.0	155,552	73639	47.3
Aug	31	0.0	155,552	73639	47.3
Sep	30	1.7	151,585	72272	48.0
Oct	31	82.9	207,520	72127	36.1
Nov	30	209.8	282,025	70234	20.9
Dec	31	385.7	397,310	72521	18.8
Total	365	2178.7	3,197,303	330608	9.6

Weather Data: Environment Canada, Toronto City, TMY

$m^3 = 5017.82 \times Days + 626.876 \times hdd$