2019 5-YEAR ENERGY CONSERVATION AND DEMAND MANAGEMENT PLAN

BRANT COMMUNITY HEALTHCARE SYSTEM

June 27, 2019

Brant Community
HEALTHCARE SYSTEM

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Table of Contents

EXECUTIVE SUMMARY

The Ontario Government is committed to helping public agencies better understand and manage their energy consumption. As part of this commitment, Ontario Regulation 507/18 under the Electricity Act requires each public agency, including healthcare systems, to report energy consumption and greenhouse gas (GHG) emissions annually, to implement an Energy Conservation and Demand Management (ECDM) Plan, and to update its ECDM Plan every five years.

Brant Community Healthcare System is committed to the ECDM Plan outlined in this document to reduce its environmental impact. This ECDM Plan pertains to the Brantford General Hospital (BGH) and The Willett Hospital (TWH) at Brant Community Healthcare System and addresses the following objectives.

- **Baseline performance**: To document previous and current energy and GHG performance.
- **Energy conservation measures (ECMs)**: To document previous, current and proposed ECMs.
- **Energy and greenhouse gas (GHG) plan**: To establish 5-year energy and GHG performance targets and develop a road map to achieve those targets.

Table 1 summarizes the annual energy and GHG performance for the baseline year of 2018, and the 2023 performance targets established in this ECDM Plan. The 2023 targets reflect the performance expected upon implementing the ECMs identified in this Plan, as indicated in Figures 1 and 2.

The BGH targets are significantly influenced by the Cogeneration ECM, which involves the implementation of a natural gas fired electricity generator from which waste heat will be recovered to offset other heating loads at BGH. While the Cogeneration ECM is expected to increase natural gas consumption at BGH, an overall decrease in global energy consumption is expected because waste heat is not typically recovered in grid electricity generation processes.

Table 1: Summary of baseline energy and GHG performance and reduction targets

Category	Description	Unit	BGH	TWH
Electricity	2018 Baseline consumption	[kWh]	11,126,127	1,377,513
	2023 Target maximum consumption	[kWh]	1,338,359	1,071,284
	2023 Target consumption reduction	[kWh]	9,787,768	306,229
	2023 Target consumption reduction	[%]	88	22
Natural gas	2018 Baseline consumption	[m^3]	2,507,107	226,141
	2023 Target maximum consumption	[m^3]	3,542,365	158,948
	2023 Target consumption reduction	[m^3]	-1,035,258	67,193
	2023 Target consumption reduction	[%]	-41	30
GHG emissions	2018 Baseline emissions	[ton,CO_2,e]	5,212	486
	2018 Target maximum emissions	[ton,CO_2,e]	6,746	346
	2023 Target emission reduction	[ton,CO_2,e]	-1,534	140
	2023 Target emission reduction	[%]	-29	29

Figures 1 and 2 respectively outline ECM implementation road maps for BGH and TWH that are expected to achieve the above energy and GHG performance targets. These road maps reflect the following information.

- **ECMs**: A brief description of each ECM to be implemented as part of this ECDM Plan is superimposed over a timeline extending to 2023. The timeline indicates the in-service year for each ECM, which is the year by which the ECM is expected to be completely implemented and in service.
- **Capital costs**: The estimated capital costs of implementing the above ECMs are presented for each year until 2023. Capital costs are budgeted for the calendar year prior to the in-service year because that is the year during which most of the implementation is expected to take place. Capital costs for the year 2019 and for ECMs implemented under an Energy Savings Guarantee Contract (ESGC) are omitted from this Plan because they have already been budgeted for.

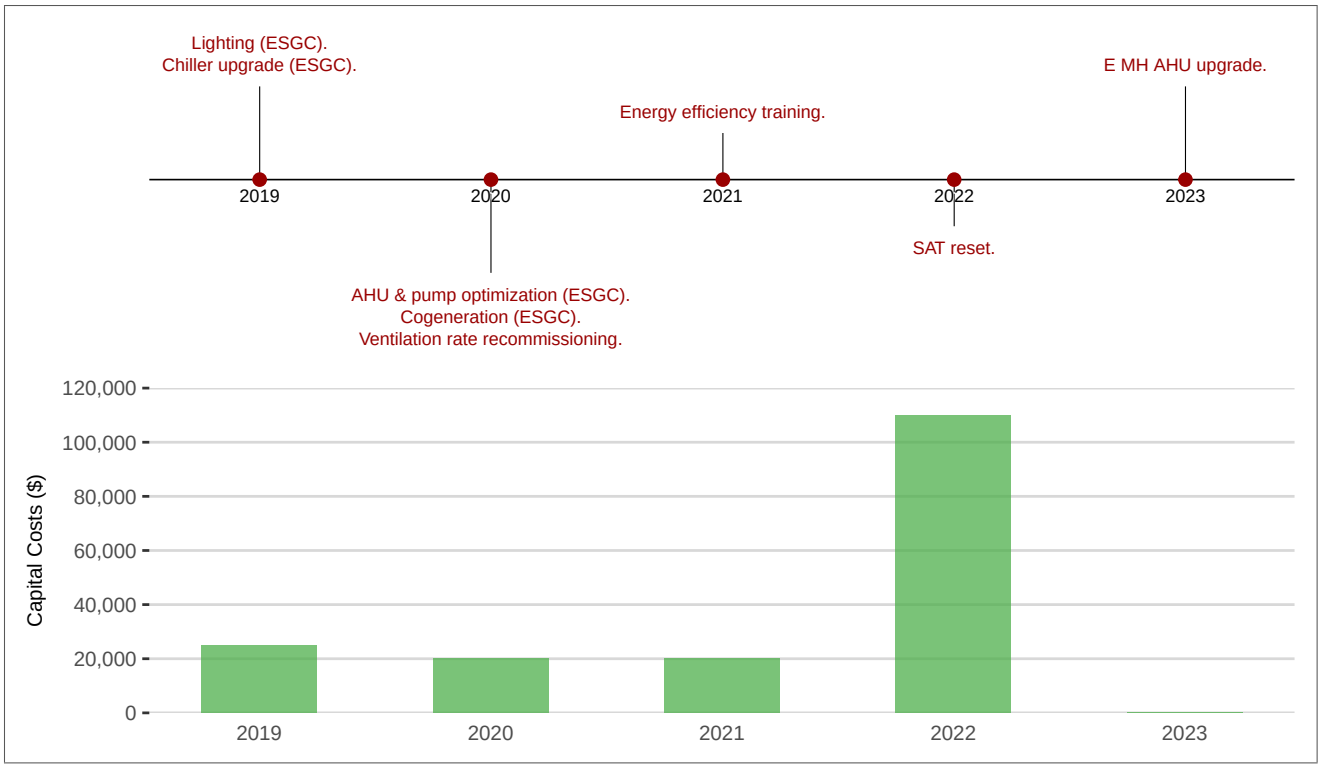

Figure 1: BGH ECM and capital cost summary

Figure 2: TWH ECM and capital cost summary

1 INTRODUCTION

1.1 Background

This is Brant Community Healthcare System's five-year Energy Conservation and Demand Management (ECDM) Plan, which has been developed in accordance with the requirements described in Ontario Regulation 507/18 under the Electricity Act. It pertains to the Brantford General Hospital (BGH) and the Willett Urgent Care Centre (AKA The Willett Hospital; TWH), which are depicted in Figures 3 and 4, respectively.

Figure 3: BGH


Figure 4: TWH

In 2014, Brant Community Healthcare System had completed an ECDM Plan in accordance with the same regulation (at the time, it was called Ontario Regulation 397/11). The 2014 ECDM Plan focused on implementing general principles and policies for improving energy efficiency, rather than achieving specific energy or GHG reduction targets.

Contextual highlights for both BGH and TWH are summarized as follows.

BGH contextual highlights

- BGH has an approximate gross floor area of 540,000 ft^2 and is located at 200 Terrace Hill Street, Brantford, Ontario.
- Brant Community Healthcare System has recently undertaken an Energy Savings Guarantee Contract (ESGC) with a third party to improve the energy performance at BGH.
- As part of the ESGC, a natural gas fired cogeneration generation plant is being implemented at BGH with a planned in-service year of 2020, which involves the implementation of a natural gas fired electricity generator from which waste heat will be recovered to offset other heating loads at BGH. The cogeneration plant is expected to increase natural gas consumption and GHG emissions at BGH, while resulting in an overall decrease in global energy consumption because waste heat is not typically recovered in grid electricity generation processes.

TWH contextual highlights

- TWH has an approximate gross floor area of 75,000 ft^2 and is located at 238 Grand River Street North, Paris, Ontario.
- TWH has been largely nonoperational in recent years, resulting in relatively low energy use intensity at the facility.
- During 2018, patient activity at TWH increased relative to previous years, while a significant portion of the building was still nonoperational.
- Planning for the future operations at TWH is ongoing and future operation expectations are not yet determined. This is an important factor in this ECDM Plan, because energy consumption at the facility is significantly influenced by its operations.

1.2 Objectives

In alignment with Ontario Regulation 507/18, the objectives of this ECDM Plan are as follows.

- **Baseline performance**: To document previous and current energy and GHG performance.
- **Energy conservation measures (ECMs)**: To document previous, current and proposed ECMs.
- **Energy and greenhouse gas (GHG) plan**: To establish 5-year energy and GHG performance targets and develop a road map to achieve those targets.

2 OVERALL

2.1 Baseline performance

2.1.1 Energy consumption

Figure 5 summarizes Brant Community Healthcare System annual electricity and natural gas consumption from 2014 - 2018.

Figure 6 compares Brant Community Healthcare System's facilities against other hospitals in Southern Ontario using 2016 data reported through the Broader Public Sectors (BPS) program. Data is used from the year 2016 because it is the most recent data available, as BPS data releases have a two year lag period.

The BGH facility is observed to operate at a higher energy use intensity (EUI) than the median facility for both electricity and natural gas. Thus, it is believed that there is opportunity to improve BGH energy performance through the energy conservation measures (ECMs) summarized in this Plan.

The TWH facility is observed to operate at a lower energy use intensity (EUI) than the median facility for both electricity and natural gas. This is attributed to its low operational levels throughout the 2014 to 2018 period.

Figure 5: Annual electricity and natural gas consumption

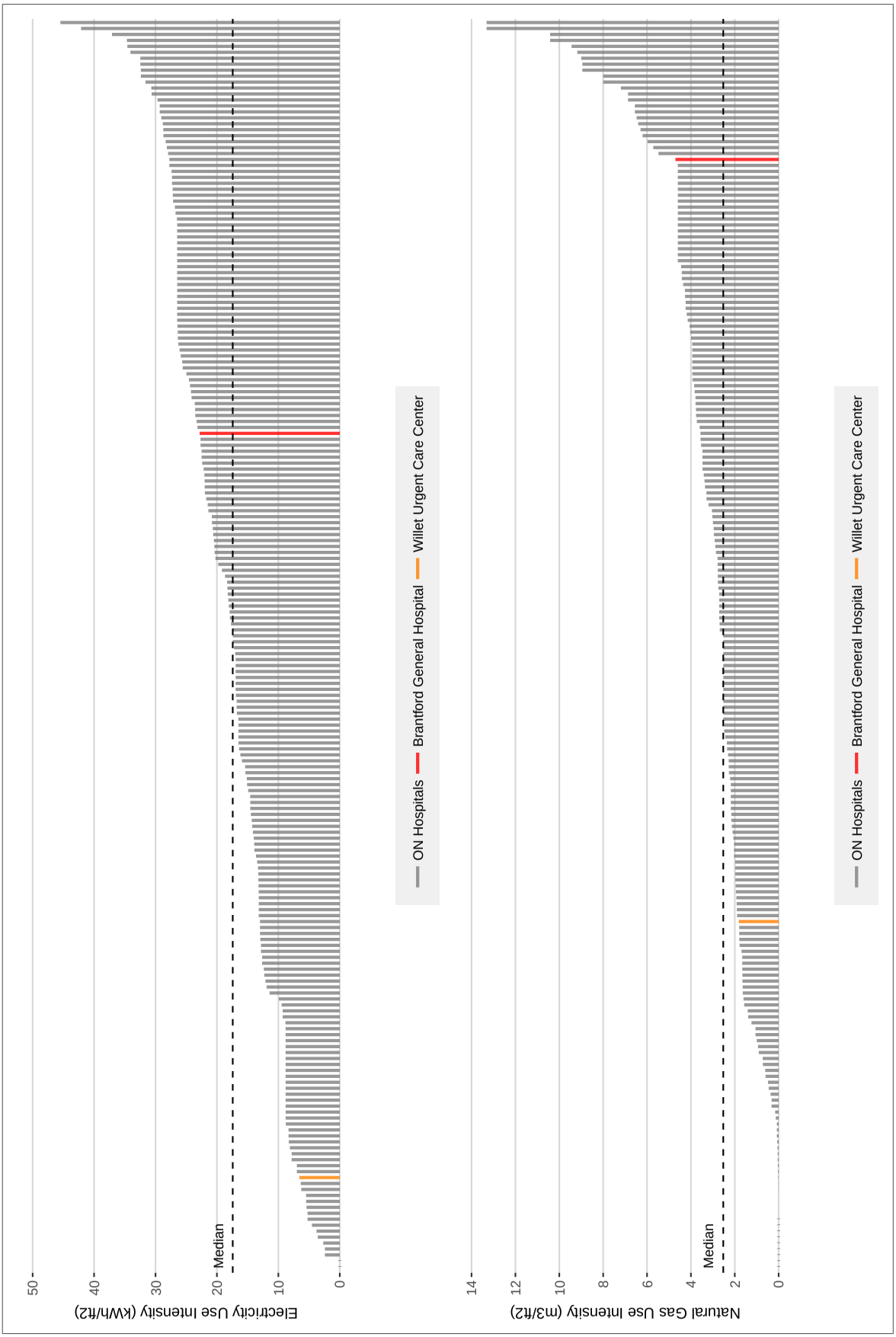

Figure 6: 2016 electricity and natural gas use intensity of Southern Ontario hospitals

2.1.2 GHG emissions

GHG emissions are typically measured in equivalent metric tonnes of carbon dioxide (mt,CO_2,e). To illustrate, a typical passenger vehicle emits approximately 4.6 mt,CO_2,e per year. GHG emissions can be broken down into three categories - Scope 1, Scope 2, and Scope 3.

Scope 1 emissions are defined as direct emissions from sources owned or controlled by the organization. An example of this would be the emissions from the burning of natural gas or propane by on-site equipment. This is typically the second largest contributor to a facility's GHG emissions.

Scope 2 emissions are defined as indirect emissions from sources owned or controlled by the organization. An example of this would be the downstream emissions from electricity purchased from the grid for use by on-site equipment. This is typically the smallest contributor to a facility's GHG emissions.

Scope 3 emissions are defined as emissions from sources not owned or directly controlled by the organization. An example of this would be emissions from vehicles used in employee travel and commuting. Scope 3 emissions were not included in this inventory as it is difficult to quantify, and data is not readily available. However, this would typically be the largest contributor to a facility's GHG emissions.

Scope 1 and 2 GHG emission factors used throughout this ECDM Plan are summarized in Table 2.

Table 2: GHG emission factors

Description	Unit	Value
Electricity (Scope 2) GHG emission factor	[g,$CO2e_2$/kWh]	43
Natural gas (Scope 1) GHG emission factor	[g,$CO2e_2$/m^3]	1,888

Figure 7 summarizes the Brant Community Healthcare System's GHG emissions from 2014 - 2018. It is separated by into Scope 1 and 2 emissions. Since this ECDM Plan focuses on the utility metered energy performance of the facilities, Scope 3 emissions are not considered.

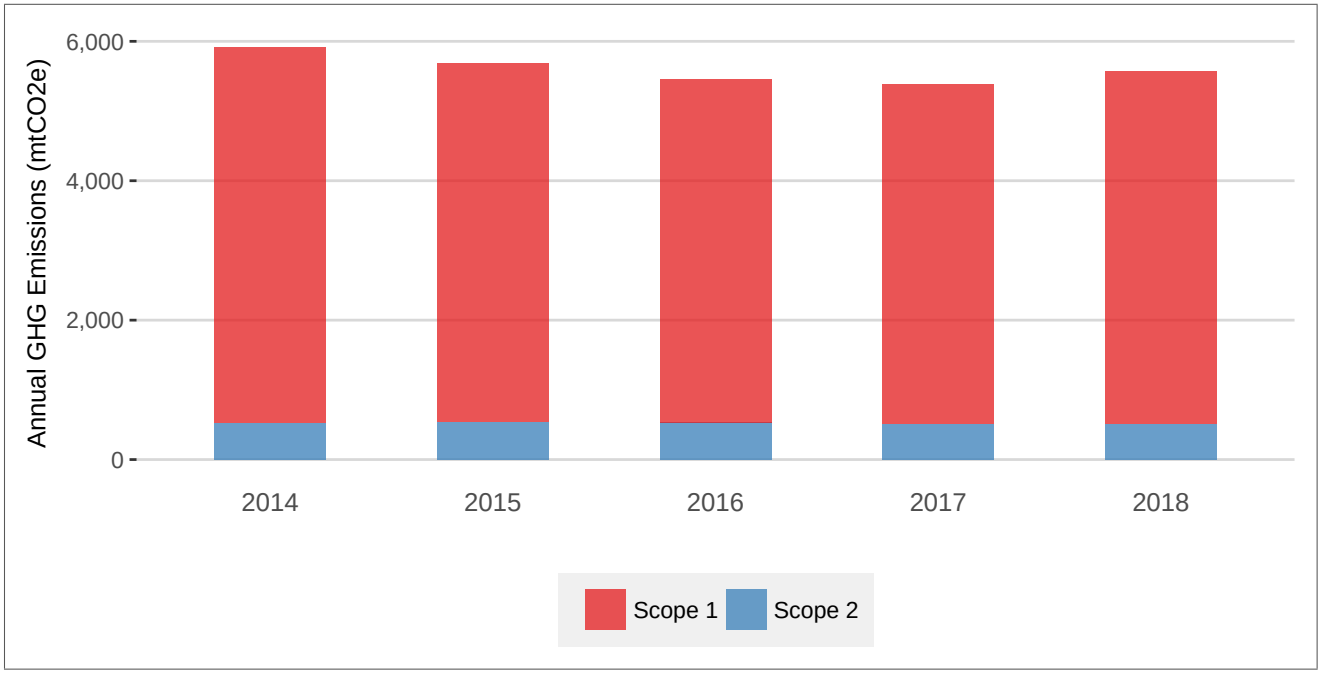

Figure 7: Annual GHG emissions

2.2 Energy conservation measures

2.2.1 Previous ECMs

Several ECMs were implemented between 2014 and 2018 in an effort to improve energy efficiency and GHG performance. These are summarized in Table 3.

Table 3: Previous ECMs summary table

Building	ECM	Year Completed
BGH	Compressor cooling water measure.	2018
BGH	Building envelope.	2018
TWH	C rooftop packaged RTU upgrade.	2018
TWH	C LED lighting upgrade.	2018
TWH	C roof upgrade.	2018

2.2.2 Current ECMs

Table 4 summarizes current ECMs that Brant Community Healthcare System had been considering implementing prior to the development of this revised ECDM Plan. In this ECDM Plan, only ECMs from Table 8 with expected simple payback periods of 30 years or less are planned for implementation between 2019 and 2023, as indicated by the planned in-service year. The only exception to this rule is the Boiler plant & fuel system upgrade ECM at TWH, which has a planned in-service year of 2021 because the existing plant is approaching the end of its useful life. The relatively long simple payback period of 30 years is used because these ECMs involve replacing aging infrastructure at BGH and TWH. In addition to the ECMs specified in Table 4, Brant Community Healthcare System is committed to considering energy performance in its purchasing, design and construction processes.

Table 4: Current ECMs summary table

Building	ECM	Planned In-Service Year	Electricity Savings [kWh]	Natural Gas Savings [m^3]	Capital Cost [$]	Simple Payback [Years]
BGH	AHU & pump optimization (ESGC).	2020	680,000	116,773	0	0
BGH	Chiller upgrade (ESGC).	2019	429,381	0	0	0
BGH	Cogeneration (ESGC).	2020	7,580,000	-1,315,000	0	0
BGH	E 5th floor RTU upgrade.	0	2,942	0	185,000	449
BGH	E auditorium AHU upgrade.	0	1,482	2,930	137,000	141
BGH	E MH AHU upgrade.	2023	23,669	2,142	110,000	28
BGH	F medical records RTU upgrade.	0	2,942	6,707	130,000	60
BGH	Lighting (ESGC).	2019	772,735	-40,680	0	0
BGH	Main kitchen dishwasher upgrade.	0	0	17,414	230,000	51
TWH	A & C 2nd floor window upgrade.	2020	6,462	2,530	0	0
TWH	A partial roof upgrade.	2020	22	148	0	0
TWH	Boiler plant & fuel system upgrade.	2021	0	18,980	562,000	114
TWH	B level 1 AHU upgrade.	2020	53,414	22,070	215,000	16
TWH	B partial roof upgrade.	0	73	680	190,000	1,017
TWH	C level 1 AHU upgrade.	2022	40,061	7,198	225,000	30
TWH	Pneumatic control system upgrade.	2022	64,618	15,671	287,000	22

Data for ECMs labelled "(ESGC)" is taken from an Energy Savings Guarantee Contract (ESGC), which Brant Community Healthcare System has undertaken with a third party to improve its energy efficiency. Since these

ECMs are to be implemented under an ESGC, capital costs and the simple payback periods associated with these ECMs are omitted from this ECDM Plan, as they have already been budgeted for.

Data for remaining ECMs is taken from investigations Brant Community Healthcare System had undertaken in 2018 regarding other potential energy-efficient capital upgrades. To account for interactive effects between these ECMs, energy savings for each ECM are assumed to be 80% of the values initially estimated in the 2018 investigations. Capital costs for each remaining ECM with a planned in-service year of 2020 (i.e. implementation during 2019) are also omitted from this ECDM Plan, as these ECMs have already been budgeted for.

2.2.3 Proposed ECMs

Table 5 summarizes additional ECMs proposed as part of this ECDM Plan. A planned in-service year of 0 indicates that the ECM is not planned for implementation between 2019 and 2023, which is decided based on the ECM analyses presented in Sections 3.2.3 and 4.2.3 for BGH and TWH, respectively.

Table 5: Proposed ECMs summary table

Building	**ECM**	**Planned In-Service Year**	**Electricity Savings** [kWh]	**Natural Gas Savings** [m^3]	**Capital Cost** [$]	**Simple Payback** [Years]
BGH	Energy efficiency training.	2021	278,153	62,678	20,000	0.4
BGH	Ventilation rate recommissioning.	2020	13,830	123,829	25,000	0.7
BGH	SAT reset.	2022	10,000	15,000	20,000	3.8
BGH	Solar PV electricity.	0	65,980	0	172,800	18.7
TWH	Energy efficiency training.	2021	17,479	4,272	8,000	2.2
TWH	Ventilation rate recommissioning.	0	11,525	103,191	50,000	1.8
TWH	Lighting upgrade.	2023	124,173	-3,676	200,000	12.2
TWH	Solar PV electricity.	0	33,530	0	90,000	19.2

3 BRANTFORD GENERAL HOSPITAL

3.1 Baseline performance

3.1.1 Energy consumption

Figure 8 summarizes the monthly electricity and natural gas consumption for BGH from 2014 to 2018. The trends it shows are typical: higher electricity consumption in the summer months due to increased cooling load and higher natural gas consumption in the winter months due to increased heating load.

Figure 8: BGH monthly electricity and natural gas consumption

Figure 9 summarizes the annual electricity and natural gas consumption for BGH from 2014 to 2018. Both annual electricity and natural gas consumption are observed to decrease slightly by 2018 relative to the 2014 performance.

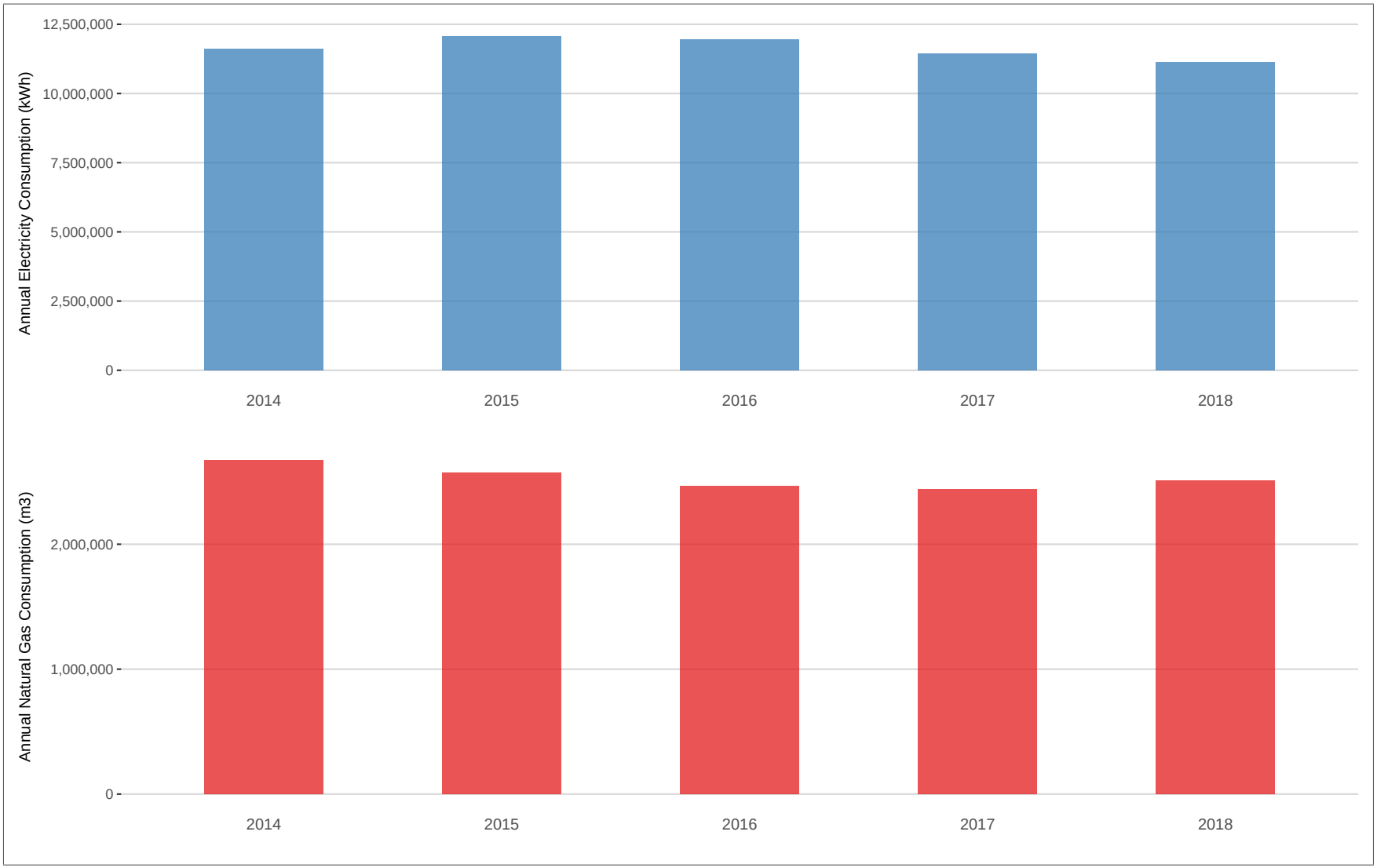

Figure 9: BGH annual electricity and natural gas consumption

3.1.2 GHG emissions

Figure 10 summarizes BGH's annual GHG emissions from 2014 to 2018, distinguishing between Scope 1 and 2 emissions. As described in Section 2.1.2, Scope 1 and 2 emissions are determined directly from the facility's natural gas and electricity consumption.

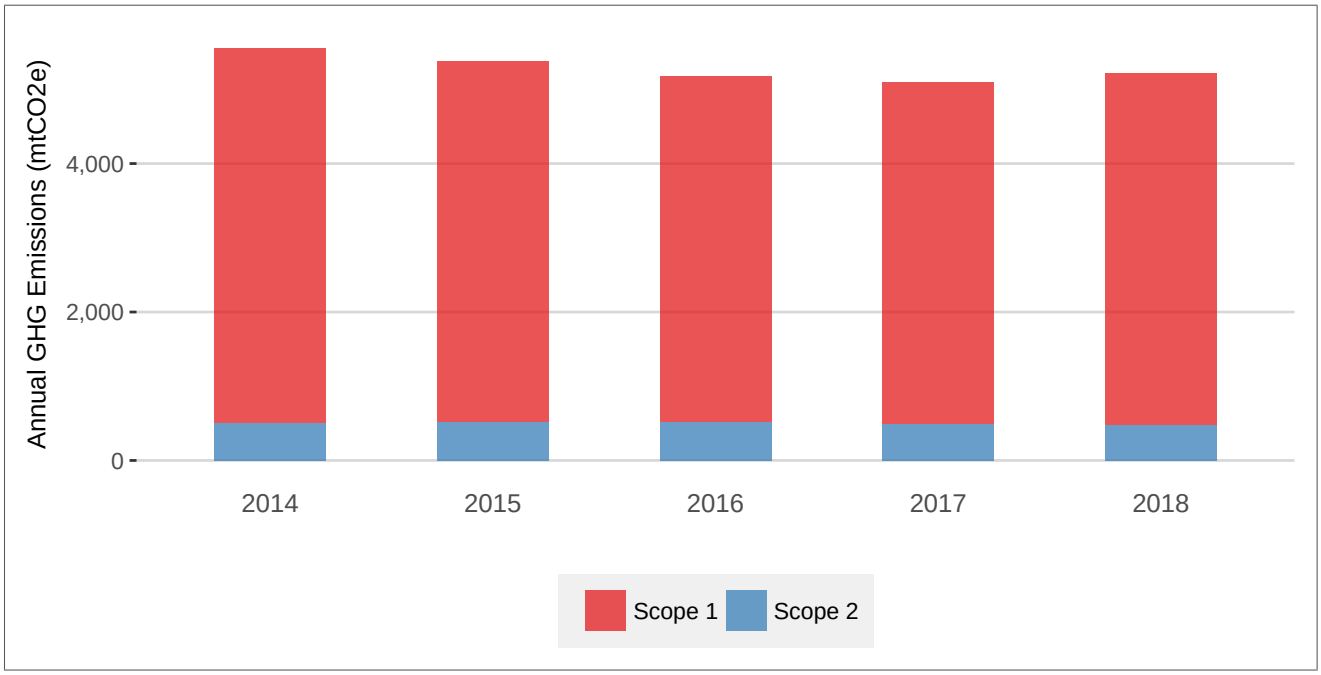

Figure 10: BGH annual GHG emissions

3.1.3 2018 baseline performance summary

Table 6 summarizes the energy and GHG performance of the 2018 baseline year.

Table 6: BGH energy and GHG performance summary for baseline year 2018

Category	Source	Description	Unit	2018 baseline
Energy	Electricity	Annual consumption EUI	[kWh] [ekWh/ft^2]	11,126,127 21
	Natural gas	Annual consumption Annual consumption EUI	[m^3] [ekWh] [ekWh/ft^2]	2,507,107 26,466,774 49
	Combined	Annual consumption EUI	[ekWh] [ekWh/ft^2]	37,592,901 70
GHG	Electricity (Scope 2)	Annual emissions GHGI	[mt,CO_2,e] [mt,CO_2,e/ft^2]	478 0.00089
	Natural gas (Scope 1)	Annual emissions GHGI	[mt,CO_2,e] [mt,CO_2,e/ft^2]	4,733 0.0088
	Combined	Annual emissions GHGI	[mt,CO_2,e] [mt,CO_2,e/ft^2]	5,212 0.0097

3.2 Energy conservation measures

3.2.1 Previous ECMs

Several ECMs were implemented between 2014 and 2018 in an effort to improve energy efficiency and GHG performance. These are summarized in Table 7.

Table 7: BGH previous ECMs summary table

Building	ECM	Year Completed
BGH	Compressor cooling water measure.	2018
BGH	Building envelope.	2018

3.2.2 Current ECMs

Table 8 summarizes current ECMs that Brant Community Healthcare System had been considering implementing prior to the development of this revised ECDM Plan. Note that certain ECMs are expected to reduce electricity consumption while increasing natural gas consumption. For example, the Cogeneration ECM involves the implementation of a natural gas fired electricity generator from which waste heat will be recovered to offset other heating loads at BGH. While the Cogeneration ECM is expected to increase natural gas consumption at BGH, an overall decrease in global energy consumption is expected because waste heat is not typically recovered in grid electricity generation processes. Also, the Lighting ECM is expected to increase natural gas consumption because the more energy-efficient lighting system will contribute less to space heating during the heating season.

In this ECDM Plan, only ECMs from Table 8 with expected simple payback periods of 30 years or less are planned for implementation between 2019 and 2023, as indicated by the planned in-service year. The relatively long simple payback period of 30 years is used because these ECMs involve replacing aging infrastructure at BGH. In addition to the ECMs specified in Table 8, Brant Community Healthcare System is committed to considering energy performance in its purchasing, design and construction processes.

Table 8: BGH current ECMs summary table

Building	ECM	Planned In-Service Year	Electricity Savings [kWh]	Natural Gas Savings [m^3]	Capital Cost [$]	Simple Payback [Years]
BGH	AHU & pump optimization (ESGC).	2020	680,000	116,773	0	0
BGH	Chiller upgrade (ESGC).	2019	429,381	0	0	0
BGH	Cogeneration (ESGC).	2020	7,580,000	-1,315,000	0	0
BGH	E 5th floor RTU upgrade.	0	2,942	0	185,000	449
BGH	E auditorium AHU upgrade.	0	1,482	2,930	137,000	141
BGH	E MH AHU upgrade.	2023	23,669	2,142	110,000	28
BGH	F medical records RTU upgrade.	0	2,942	6,707	130,000	60
BGH	Lighting (ESGC).	2019	772,735	-40,680	0	0
BGH	Main kitchen dishwasher upgrade.	0	0	17,414	230,000	51

Data for ECMs labelled "(ESGC)" is taken from an Energy Savings Guarantee Contract (ESGC), which Brant Community Healthcare System has undertaken with a third party to improve its energy efficiency. Since these ECMs are to be implemented under an ESGC, capital costs and the simple payback periods associated with these ECMs are assumed to be zero for the purpose of this ECDM Plan.

Data for remaining ECMs is taken from investigations Brant Community Healthcare System had undertaken in 2018 regarding other potential energy-efficient capital upgrades. To account for interactive effects between

these ECMs, energy savings for each ECM were assumed to be 80% of the values initially estimated in the 2018 investigations. Capital costs for each remaining ECM with a planned in-service year of 2020 (i.e. implementation during 2019) are also omitted from this ECDM Plan, as these ECMs have already been budgeted for.

3.2.3 Proposed ECMs

Additional ECMs are identified, evaluated and proposed as part of this ECDM Plan. These ECMs are elaborated in this section.

Energy efficiency training This ECM considers the effects of providing energy efficiency training to applicable staff at BGH. Human behaviour significantly influences energy performance. It is typical for such training to reduce energy consumption by 2.5 to 10%, depending on existing conditions and operations. Developing a sustained corporate culture in which energy efficiency is prioritized and continuously improved can result in significant long-term energy savings. The following strategies typically support an effective culture.

- Awareness - raising awareness of occupants as to their impact on and the importance of energy efficiency.
- Education - increasing the competency of occupants to make changes that improve energy efficiency.
- Empowerment - authorizing and encouraging occupants to make changes that improve energy efficiency.

Calculations are based on the following assumptions.

- Energy savings are calculated assuming a 2.5% reduction in both electricity and natural gas consumption.
- Training costs are assumed to be $20,000.

Table 9: Energy efficiency training ECM

Building	**ECM**	**Planned In-Service Year**	**Electricity Savings** [kWh]	**Natural Gas Savings** [m^3]	**Capital Cost** [$]	**Simple Payback** [Years]
BGH	Energy efficiency training.	2021	278,153	62,678	20,000	0.4

Ventilation rate recommissioning This ECM considers the recommissioning of the ventilation air flow rate in an air handling unit (AHUs) for a specific operating room at BGH. Under existing conditions, a natural gas fired direct exchange (DX) cooled AHU supplies ventilation air to this space at a ratio of 100%. It is permissible to supply ventilation air at a reduced ratio by recirculating return air under CSA ventilation standards. Reducing the ventilation air ratio is expected to reduce space heating and cooling energy consumption because less air will require conditioning from ambient temperature to room temperature. Calculations are based on the following assumptions.

- The total supply air flow rate from AHU serving the operating room is assumed to be 18,000 cfm.
- The AHU ventilation air ratio is assumed to be 100% in the baseline scenario and 33% in the proposed scenario.
- The AHU supply air temperature (SAT) is assumed to be 55°F on average.
- The SAT after reheat is assumed to be 62°F on average.
- Capital costs are assumed to be $25,000, to adjust return air ducting to enable recirculation.

Table 10: Ventilation rate recommissioning ECM

Building	ECM	Planned In-Service Year	Electricity Savings [kWh]	Natural Gas Savings [m^3]	Capital Cost [$]	Simple Payback [Years]
BGH	Ventilation rate recommissioning.	2020	13,830	123,829	25,000	0.7

Supply air temperature (SAT) reset This ECM considers the implementation of a SAT reset control strategy at BGH. Under existing conditions, AHUs supply air at a constant SAT (typically 55°F), which often exceeds the cooling requirements of the space. The air flows through space-specific reheat coils, where it is heated as required to maintain space condition setpoints. In the proposed scenario, return air temperature and humidity are measured, and the SAT is allowed to increase to match the space cooling requirements. For example, if a SAT of 60°F is sufficient to match the space cooling and humidity requirements, then rather than cooling the supply air down to 55°F and reheating it to 60°F, the SAT reset strategy only cools the supply air down to 60°F and avoids reheat. This saves both space cooling electricity and space heating natural gas consumption. Calculations are based on the following assumptions.

- An AHU with a supply air flow rate of 15,000 cfm was assumed for illustrative purposes.
- The AHU SAT is assumed to be fixed at 55°F in the baseline scenario and variable between 55 and 58°F in the proposed scenario.
- The AHU ventilation air ratio 33% in both scenarios.
- The SAT after reheat is assumed to be 62°F on average.
- Capital costs are assumed to be $25,000, to implement SAT reset controls on the AHU.

Table 11: SAT reset ECM

Building	ECM	Planned In-Service Year	Electricity Savings [kWh]	Natural Gas Savings [m^3]	Capital Cost [$]	Simple Payback [Years]
BGH	SAT reset.	2022	10,000	15,000	20,000	3.8

Solar photovoltaic (PV) electricity This ECM considers the implementation of a solar photovoltaic (PV) electricity generation system at BGH. A solar PV analysis was conducted for BGH using the HelioScope online modeling tool (see Figure 11). Calculations are based on the following assumptions.

- Electricity savings are taken from the Helioscope analysis.
- Capital costs are calculated assuming 3 $/ft^2 installed.

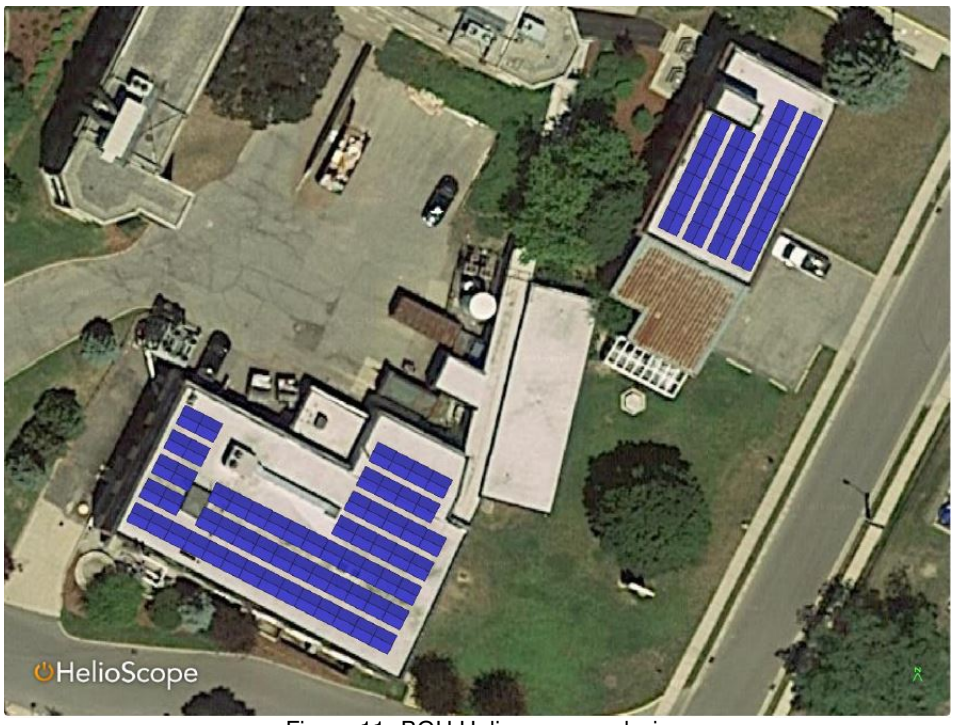

Figure 11: BGH Helioscope analysis

Table 12: Solar PV electricity ECM

Building	**ECM**	**Planned In-Service Year**	**Electricity Savings** [kWh]	**Natural Gas Savings** [m^3]	**Capital Cost** [$]	**Simple Payback** [Years]
BGH	Solar PV electricity.	0	65,980	0	172,800	18.7

Due to the relatively long simple payback period, the Solar PV electricity ECM is not planned for implementation between 2019 and 2023 at BGH. Brant Community Healthcare System will continue to reconsider ECMs strictly focused on energy efficiency (as opposed to capital upgrades) regularly based on financial performance.

Proposed ECM summary The proposed ECMs described above are summarized in Table 13. ECMs with a planned in-service year of 0 do not have planned implementations between 2019 and 2023.

Table 13: Proposed ECMs summary table

Building	**ECM**	**Planned In-Service Year**	**Electricity Savings** [kWh]	**Natural Gas Savings** [m^3]	**Capital Cost** [$]	**Simple Payback** [Years]
BGH	Energy efficiency training.	2021	278,153	62,678	20,000	0.4
BGH	Ventilation rate recommissioning.	2020	13,830	123,829	25,000	0.7
BGH	SAT reset.	2022	10,000	15,000	20,000	3.8
BGH	Solar PV electricity.	0	65,980	0	172,800	18.7

3.3 Energy and GHG plan

3.3.1 Energy and GHG performance targets

Energy and GHG performance targets are determined to reflect the annual energy and GHG performance expected upon implementing the current and proposed ECMs described in Section 3.2. These targets are summarized in Table 14.

The Cogeneration ECM (see Table 8) is expected to have a significant influence on electricity and natural gas consumption at BGH. As explained in Section 3.2.2, this ECM involves the implementation of a natural gas fired electricity generator from which waste heat will be recovered to offset other heating loads at BGH. While the Cogeneration ECM is expected to increase natural gas consumption at BGH, an overall decrease in global energy consumption is expected because waste heat is not typically recovered in grid electricity generation processes.

Table 14: BGH baseline energy and GHG performance and reduction targets

Category	Description	Unit	BGH
Electricity	2018 Baseline consumption	[kWh]	11,126,127
	2023 Target maximum consumption	[kWh]	1,338,359
	2023 Target consumption reduction	[kWh]	9,787,768
	2023 Target consumption reduction	[%]	88
Natural gas	2018 Baseline consumption	[m^3]	2,507,107
	2023 Target maximum consumption	[m^3]	3,542,365
	2023 Target consumption reduction	[m^3]	-1,035,258
	2023 Target consumption reduction	[%]	-41
GHG emissions	2018 Baseline emissions	[ton,CO_2,e]	5,212
	2018 target maximum emissions	[ton,CO_2,e]	6,746
	2023 Target emission reduction	[ton,CO_2,e]	-1,534
	2023 Target emission reduction	[%]	-29

To paraphrase Table 14, the 2023 energy and GHG performance targets for BGH are as follows.

- **Electricity**: To limit annual electricity consumption to 1,338,359 kWh.
- **Natural gas**: To limit annual natural gas consumption to 3,542,365 m^3.
- **GHG emissions**: To limit annual GHG emissions to 6,746 mt,CO_2,e.

3.3.2 Energy and GHG road map

To achieve the above energy and GHG performance targets at BGH, the road map depicted in Figure 12 is developed according to the following methodology.

1. Each current and proposed ECM (from Tables 8 and 13, respectively) with a planned in-service year between 2019 and 2023 is superimposed over the timeline in Figure 12 based on its planned in-service year, which is the year by which it is expected to be completely implemented and in service.
2. Capital costs associated with each ECM are taken from Tables 8 and 13. It is assumed that capital costs will be incurred during the calendar year prior to the in-service year for each ECM.
3. Changes in electricity, natural gas and GHG performance associated with each ECM are taken from Tables 8 and 13 and projected according to the same implementation timeline. Results are plotted in Figure 12.

For example, refer to Figure 12. The Cogeneration ECM has a planned in-service year of 2020, which means its implementation will be completed sometime during 2019. Since this ECM will be implemented under an ESGC, its capital cost has already been budget for and is intentionally omitted from the capital cost budget for 2019. The reduced electricity consumption, increased natural gas consumption and increased GHG emissions (7,580,000 kWh, -1,315,000 m^3 and -2,157 mt,CO_2,e, respectively) associated with this ECM are observed to take effect in the planned in-service year of 2020 and extend throughout the remainder of the 2019-2023 planning horizon.

Figure 12: BGH energy and GHG road map

4 THE WILLETT HOSPITAL

4.1 Baseline performance

4.1.1 Energy consumption

Figure 13 summarizes the monthly electricity and natural gas consumption for TWH from 2014 to 2018. The notable increase in both electricity and natural gas consumption in 2018 are due to an increase in patient activity in 2018 relative to previous years. Despite the 2018 increase in patient activity, TWH remains largely unoccupied, and energy consumption is believed to be relatively low as a result. Also, a sudden reduction in natural gas energy consumption is observed during the cooling season months. This is atypical for hospitals, which tend to consume natural gas for humidity controls year-round. Humidity is not actively controlled at TWH.

Figure 13: TWH monthly electricity and natural gas consumption

Figure 14 summarizes the annual electricity and natural gas consumption for TWH from 2014 to 2018. The notable increase in both electricity and natural gas consumption in 2018 are due to an increase in patient activity in 2018 relative to previous years. Despite the 2018 increase in patient activity, TWH remains largely unoccupied, and energy consumption is believed to be relatively low as a result.

Figure 14: TWH annual electricity and natural gas consumption

4.1.2 GHG emissions

Figure 15 summarizes TWH's annual GHG emissions from 2014 to 2018, distinguishing between Scope 1 and 2 emissions. As described in Section 2.1.2, Scope 1 and 2 emissions are determined directly from the facility's natural gas and electricity consumption, respectively.

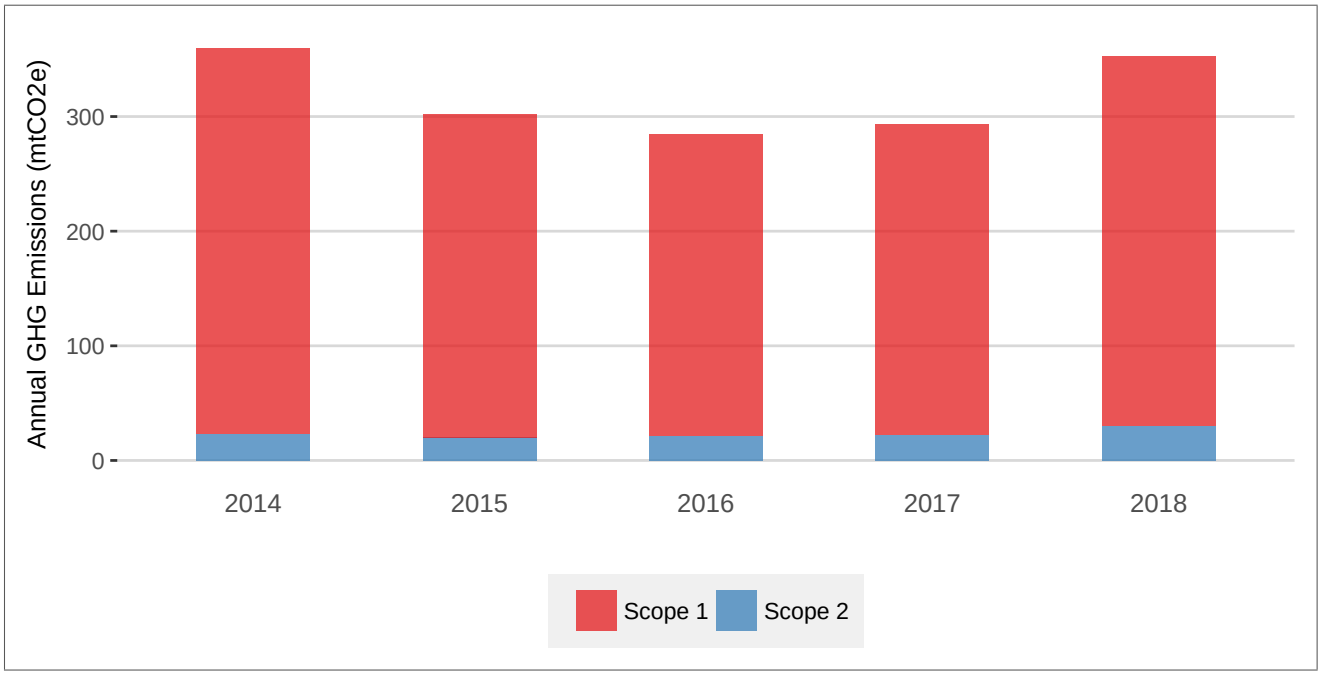

Figure 15: TWH annual GHG emissions

4.1.3 2018 baseline performance summary

As noted in the preceding sections, operation levels at TWH are low relative to its capacity. Planning for the future operations at TWH is ongoing and future operation expectations are not yet determined. On this basis, 2018 baseline energy and GHG performance at TWH is redefined as the performance expected under fully operational conditions according to the following methodology.

1. Baseline electricity performance is estimated as the product of the average electricity use intensity of all hospitals in the Broader Public Sector (BPS) database (refer to Figure 6) and the gross floor area at TWH.
2. Average electricity use intensity of all hospitals in the BPS database is calculated to be 18 kWh/ft^2.
3. The gross floor area at TWH is estimated to be 75,000 ft^2.
4. The baseline annual electricity consumption is thus estimated to be 1,377,513 kWh.
5. Baseline natural gas performance is estimated as the product of the average natural gas use intensity of all hospitals in the Broader Public Sector (BPS) database (refer to Figure 6) and the gross floor area at TWH.
6. Average natural gas use intensity of all hospitals in the BPS database is calculated to be 3.02 m^3/ft^2.
7. The baseline annual natural gas consumption is thus estimated to be 226,141 m^3.
8. The baseline annual GHG emissions is calculated by respectively multiplying the Scope 2 and Scope 1 GHG emissions factors listed in Table 2 by the baseline annual electricity and natural gas consumption values.

Table 15 summarizes the energy and GHG performance of the 2018 baseline year.

Table 15: TWH energy and GHG performance summary for baseline year 2018

Category	Source	Description	Unit	2018 baseline
Energy	Electricity	Annual consumption	[kWh]	1,377,513
		EUI	[ekWh/ft^2]	18
	Natural gas	Annual consumption	[m^3]	226,141
		Annual consumption	[ekWh]	2,387,305
		EUI	[ekWh/ft^2]	32
	Combined	Annual consumption	[ekWh]	3,764,818
		EUI	[ekWh/ft^2]	50
GHG	Electricity (Scope 2)	Annual emissions	[mt,CO_2,e]	59
		GHGI	[mt,CO_2,e/ft^2]	0.00079
	Natural gas (Scope 1)	Annual emissions	[mt,CO_2,e]	427
		GHGI	[mt,CO_2,e/ft^2]	0.0057
	Combined	Annual emissions	[mt,CO_2,e]	486
		GHGI	[mt,CO_2,e/ft^2]	0.0065

4.2 Energy conservation measures

4.2.1 Previous ECMs

Several ECMs were implemented between 2014 and 2018 in an effort to improve energy efficiency and GHG performance. These are summarized in Table 16.

Table 16: TWH previous ECMs summary table

Building	ECM	Year Completed
TWH	C rooftop packaged RTU upgrade.	2018
TWH	C LED lighting upgrade.	2018
TWH	C roof upgrade.	2018

4.2.2 Current ECMs

Table 17 summarizes current ECMs that Brant Community Healthcare System had been considering implementing prior to the development of this revised ECDM Plan. In this ECDM Plan, only ECMs from Table 17 with expected simple payback periods of 30 years or less are planned for implementation between 2019 and 2023, as indicated by the in-service year. The only exception to this rule is the Boiler plant & fuel system upgrade ECM, which has a planned in-service year of 2021 because the existing plant is approaching the end of its useful life. The relatively long simple payback period of 30 years is used because these ECMs involve replacing aging infrastructure at TWH. Also, capital costs for ECMs implemented in 2019 are omitted from this Plan, since budgeting for them is no longer necessary. In addition to the ECMs specified in Table 8, Brant Community Healthcare System is committed to considering energy performance in its purchasing, design and construction processes.

Table 17: TWH current ECMs summary table

Building	ECM	Planned In-Service Year	Electricity Savings [kWh]	Natural Gas Savings [m^3]	Capital Cost [$]	Simple Payback [Years]
TWH	A & C 2nd floor window upgrade.	2020	6,462	2,530	0	0
TWH	A partial roof upgrade.	2020	22	148	0	0
TWH	Boiler plant & fuel system upgrade.	2021	0	18,980	562,000	114
TWH	B level 1 AHU upgrade.	2020	53,414	22,070	215,000	16
TWH	B partial roof upgrade.	0	73	680	190,000	1,017
TWH	C level 1 AHU upgrade.	2022	40,061	7,198	225,000	30
TWH	Pneumatic control system upgrade.	2022	64,618	15,671	287,000	22

Data for these ECMs is taken from investigations Brant Community Healthcare System had undertaken in 2018 regarding other potential energy-efficient capital upgrades. To account for interactive effects between these ECMs, energy savings for each ECM are assumed to be 80% of the values initially estimated in the 2018 investigations. Capital costs for each ECM with a planned in-service year of 2020 (i.e. implementation during 2019) are omitted from this ECDM Plan, as these ECMs have already been budgeted for.

4.2.3 Proposed ECMs

Additional ECMs are identified, evaluated and proposed as part of this ECDM Plan. These ECMs are elaborated in this section.

Energy efficiency training This ECM considers the effects of providing energy efficiency training to applicable staff at TWH. Human behaviour significantly influences energy performance. It is typical for such training to reduce energy consumption by 2.5 to 10%, depending on existing conditions and operations. Developing a sustained corporate culture in which energy efficiency is prioritized and continuously improved can result in significant long-term energy savings. The following strategies typically support an effective culture.

- Awareness - raising awareness of occupants as to their impact on and the importance of energy efficiency.
- Education - increasing the competency of occupants to make changes that improve energy efficiency.
- Empowerment - authorizing and encouraging occupants to make changes that improve energy efficiency.

Calculations are based on the following assumptions.

- Energy savings are calculated assuming a 2.5% reduction in both electricity and natural gas consumption.
- Training costs are assumed to be $8,000.

Table 18: Energy efficiency training ECM

Building	ECM	Planned In-Service Year	Electricity Savings [kWh]	Natural Gas Savings [m^3]	Capital Cost [$]	Simple Payback [Years]
TWH	Energy efficiency training.	2021	17,479	4,272	8,000	2.2

Ventilation rate recommissioning This ECM considers the recommissioning of the ventilation air flow rate in the air handling units (AHUs) at TWH that serve level 1 of the C-wing. Under existing conditions, two natural gas fired AHUs with no cooling capabilities supply ventilation air to these spaces at a ratio of 100%. It is permissible to supply ventilation air at a reduced ratio by recirculating return air under CSA ventilation standards. Reducing the ventilation air ratio is expected to reduce space heating and cooling energy consumption because less air

will require conditioning from ambient temperature to room temperature. Calculations are based on the following assumptions.

- The C-wing level 1 total AHU supply air flow rate is assumed to be 15,000 cfm.
- The AHU ventilation air ratio is assumed to be 100% in the baseline scenario and 33% in the proposed scenario.
- The AHU supply air temperature (SAT) is assumed to be 55°F on average.
- The SAT after reheat is assumed to be 62°F on average.
- While the existing AHUs do not have cooling capabilities, the effects on space cooling energy consumption are also considered in this analysis for the purpose of illustration.
- Capital costs are assumed to be $50,000, to modify return air ducting to enable recirculation.

Table 19: Ventilation rate recommissioning ECM

Building	**ECM**	**Planned In-Service Year**	**Electricity Savings** [kWh]	**Natural Gas Savings** [m^3]	**Capital Cost** [$]	**Simple Payback** [Years]
TWH	Ventilation rate recommissioning.	0	11,525	103,191	50,000	1.8

Table 19 indicates a relatively short simple payback period of 1.8 years. While this is a financially feasible project that results in significant energy savings, it is not planned for implementation between 2019 and 2023. This is because other HVAC infrastructure upgrades to advance space conditioning controls have a higher priority at TWH. Brant Community Healthcare System will include this in its design criteria in future HVAC infrastructure upgrades.

Lighting upgrade Most lighting at TWH is provided by fluorescent fixtures. This ECM considers an upgrade to LED lighting fixtures throughout the facility. Calculations are based on the following assumptions.

- The gross floor area to which this ECM applies is 67,500 ft^2.
- Lights are assumed to be turned on 70% of the time.
- The lighting upgrade is assumed to reduce the lighting power density (LPD) by 0.3 W/ft^2 on average.
- The upgrade is assumed to cost approximately 3 $\$/ft^2$.
- Increased natural gas consumption is expected because the lights will contribute less to space heating during the heating season.

Table 20: Lighting upgrade ECM

Building	**ECM**	**Planned In-Service Year**	**Electricity Savings** [kWh]	**Natural Gas Savings** [m^3]	**Capital Cost** [$]	**Simple Payback** [Years]
TWH	Lighting upgrade.	2023	124,173	-3,676	200,000	12.2

Solar photovoltaic (PV) electricity This ECM considers the implementation of a solar photovoltaic (PV) electricity generation system at TWH. A solar PV analysis was conducted for TWH using the HelioScope online modeling tool (see Figure 16). Calculations are based on the following assumptions.

- Electricity savings are taken from the Helioscope analysis.
- Capital costs are calculated assuming 3 $\$/ft^2$ installed.

Figure 16: TWH Helioscope analysis

Table 21: Solar PV electricity ECM

Building	ECM	Planned In-Service Year	Electricity Savings [kWh]	Natural Gas Savings [m^3]	Capital Cost [$]	Simple Payback [Years]
TWH	Solar PV electricity.	0	33,530	0	90,000	19.2

Due to the relatively long simple payback period, the Solar PV electricity ECM is not planned for implementation between 2019 and 2023 at TWH. Brant Community Healthcare System will continue to reconsider ECMs strictly focused on energy efficiency (as opposed to capital upgrades) regularly based on financial performance.

Proposed ECM summary The proposed ECMs described above are summarized in Table 22. ECMs with a planned in-service year of 0 do not have planned implementations between 2019 and 2023.

Table 22: Proposed ECMs summary table

Building	ECM	Planned In-Service Year	Electricity Savings [kWh]	Natural Gas Savings [m^3]	Capital Cost [$]	Simple Payback [Years]
TWH	Energy efficiency training.	2021	17,479	4,272	8,000	2.2
TWH	Ventilation rate recommissioning.	0	11,525	103,191	50,000	1.8
TWH	Lighting upgrade.	2023	124,173	-3,676	200,000	12.2
TWH	Solar PV electricity.	0	33,530	0	90,000	19.2

4.3 Energy and GHG plan

4.3.1 Energy and GHG performance targets

Energy and GHG performance targets are determined to reflect the annual energy and GHG performance expected upon implementing the current and proposed ECMs described in Section 4.2. These targets are summarized in Table 23.

Table 23: TWH baseline energy and GHG performance and reduction targets

Category	Description	Unit	TWH
Electricity	2018 Baseline consumption	[kWh]	1,377,513
	2023 Target maximum consumption	[kWh]	1,071,284
	2023 Target consumption reduction	[kWh]	306,229
	2023 Target consumption reduction	[%]	22
Natural gas	2018 Baseline consumption	[m^3]	226,141
	2023 Target maximum consumption	[m^3]	158,948
	2023 Target consumption reduction	[m^3]	67,193
	2023 Target consumption reduction	[%]	30
GHG emissions	2018 Baseline emissions	[ton,CO_2,e]	486
	2018 target maximum emissions	[ton,CO_2,e]	346
	2023 Target emission reduction	[ton,CO_2,e]	140
	2023 Target emission reduction	[%]	29

To paraphrase Table 23, the 2023 energy and GHG performance targets for TWH are as follows.

- **Electricity**: To limit annual electricity consumption to 1,071,284 kWh.
- **Natural gas**: To limit annual natural gas consumption to 158,948 m^3.
- **GHG emissions**: To limit annual GHG emissions to 346 mt,CO_2,e.

4.3.2 Energy and GHG road map

To achieve the above energy and GHG performance targets at TWH, the road map depicted in Figure 17 is developed according to the following methodology.

1. Each current and proposed ECM (from Tables 17 and 22, respectively) with a planned in-service year between 2019 and 2023 is superimposed over the timeline in Figure 17 based on its planned in-service year, which is the year by which it is expected to be completely implemented and in service.
2. Capital costs associated with each ECM are taken from Tables 17 and 22. It is assumed that capital costs will be incurred during the calendar year prior to the in-service year for each ECM.
3. Changes in electricity, natural gas and GHG performance associated with each ECM are taken from Tables 17 and 22 and projected according to the same implementation timeline. Results are plotted in Figure 17.

For example, refer to Figure 17. The B level 1 AHU upgrade ECM has a planned in-service year of 2020, which means its implementation will be completed sometime during 2019. The estimated capital cost of this ECM is $215,000, which is budged for the year of its implementation (i.e. 2019). The reduced electricity consumption, natural gas consumption and GHG emissions (53,414 kWh, 22,070 m^3 and 44 mt,CO_2,e, respectively) associated with this ECM are observed to take effect in the planned in-service year of 2020 and extend throughout the remainder of the 2019-2023 planning horizon.

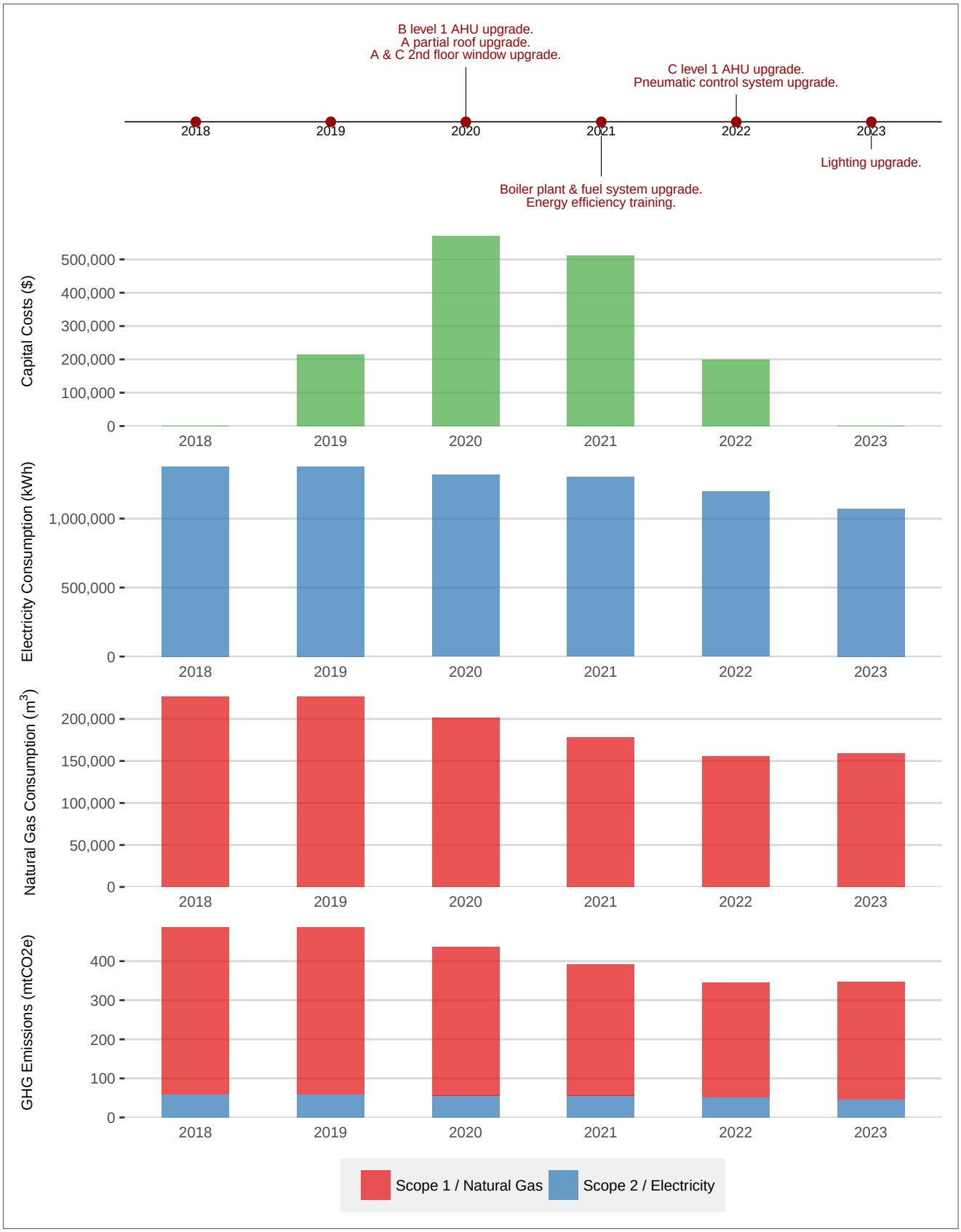

Figure 17: TWH energy and GHG road map

5 SUMMARY

This document summarizes Brant Community Healthcare System's 2019-2023 ECDM Plan, including a review the baseline energy and GHG performance, a review of previous, current and proposed ECMs, and an energy and GHG plan for BGH and TWH. Brant Community Healthcare System is committed to executing this ECDM Plan, with the intent of improving the energy-efficiency at these facilities, in alignment with Ontario Regulation 507/18 under the Electricity Act.

Baseline and target energy performance for each facility is summarized in Figure 18. Road maps to achieve these targets, indicating the planned ECM implementation timeline from 2019 to 2023, and the corresponding annual capital cost budget, are presented in Figures 19 and 20 for BGH and TWH, respectively. Capital costs for the year 2019 and for ECMs implemented under an Energy Savings Guarantee Contract (ESGC) are omitted from this Plan because they have already been budgeted for.

The BGH targets are significantly influenced by the Cogeneration ECM, which involves the implementation of a natural gas fired electricity generator from which waste heat will be recovered to offset other heating loads at BGH. While the Cogeneration ECM is expected to increase natural gas consumption at BGH, an overall decrease in global energy consumption is expected because waste heat is not typically recovered in grid electricity generation processes.

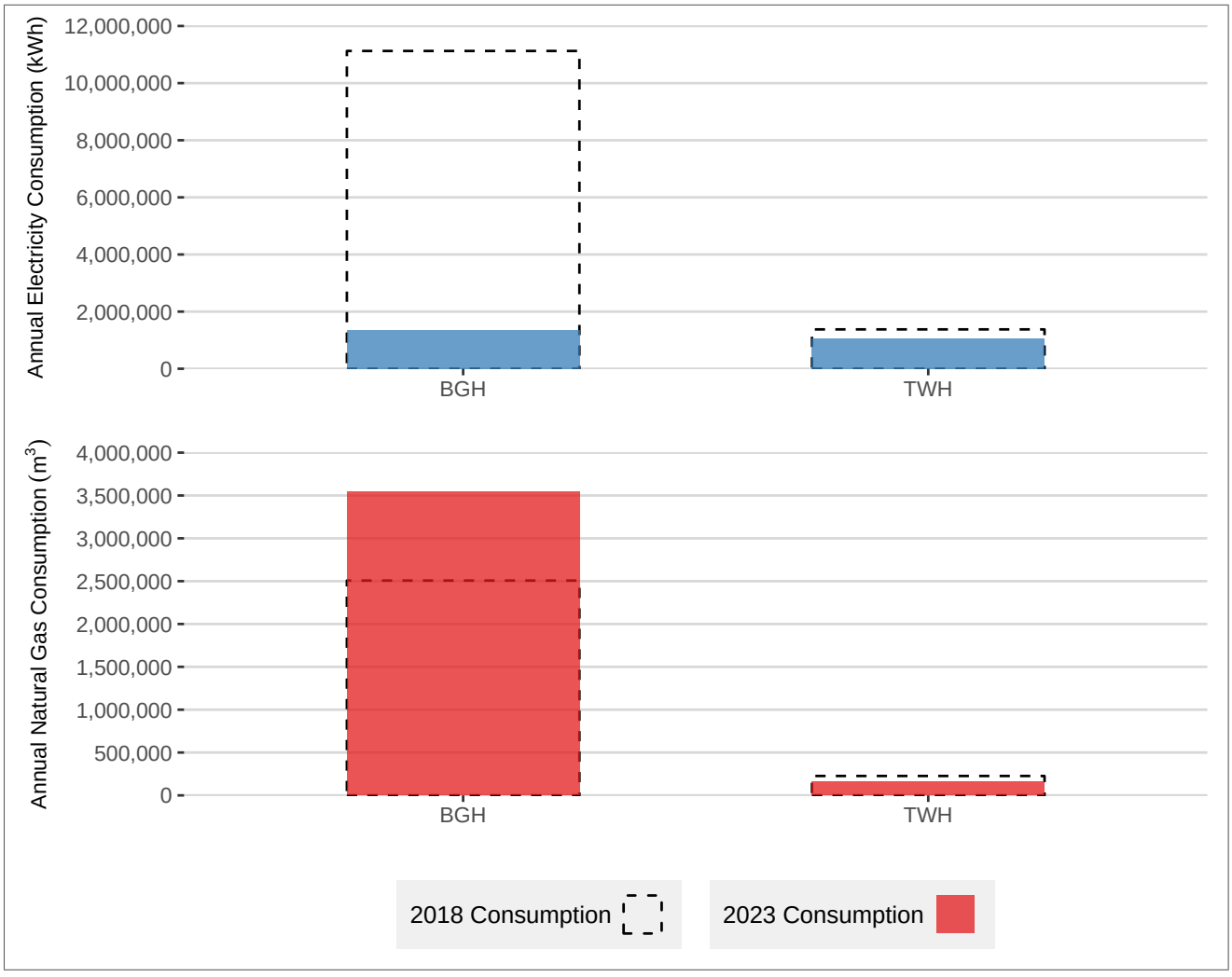

Figure 18: Baseline and target energy performance

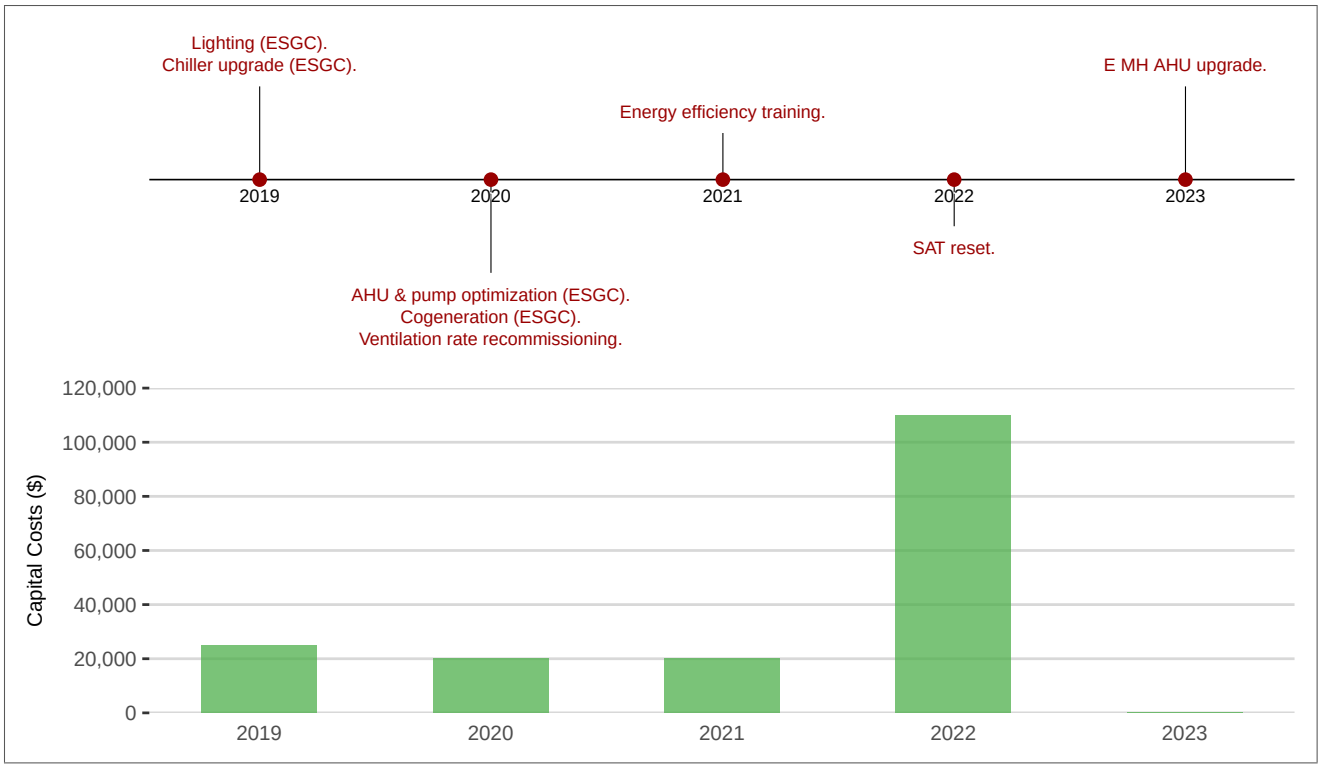

Figure 19: BGH ECM and capital cost summary

Figure 20: TWH ECM and capital cost summary