



## **Energy Conservation & Demand Management Plan**

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Prepared for:

SickKids Hospital

Prepared by:

Stantec Consulting Ltd.

Project #: 161012431



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### 1.0 INTRODUCTION

#### 1.1 CLIMATE CHANGE IS A GLOBAL PRIORITY

The relentless surge in greenhouse gas (GHG) emissions into Earth's atmosphere over the past century has set in motion profound and unprecedented climate changes. These shifts have resulted in catastrophic events, claiming lives, displacing tens of thousands from their homes, disrupting livelihoods, and dampening economic potential. The lingering impact on mental health and overall well-being is substantial, and the financial toll for recovery efforts has soared into the billions of dollars. These climate-induced transformations are already amplifying existing stressors, such as aging infrastructure, and revealing gaps in emergency preparedness and response systems. Hospitals and health care systems are at heightened risk due to the impacts and outcomes of climate change.

The Climate Projections for the National Capital Region<sup>1</sup> study forecasted that Ottawa will continue to become hotter, wetter, and experience more unpredictable extreme weather events over the coming decades. As the periods of extreme heat become more common, there is likely to be an increased severity of heat-related health and safety issues. This can place greater pressure on hospital staff due to the influx of people needing support. Additionally, there will be increased pressure on hospital heating, ventilation, and cooling (HVAC) systems, resulting in higher energy use and GHG emissions. Extreme events, such as tornadoes and flooding, can lead to power outages and damage to hospital facilities, affecting critical medical equipment, patient safety, and, at worst, resulting in evacuation. To avoid the most severe impacts of climate change, hospitals, health care systems and operations will need to incorporate climate resilience and redundancy measures into building assets and operational plans, adopting sustainable practices, and implement measures to reduce energy consumption and GHG emissions.

#### 1.2 ONTARIO REGULATION 507/18

The phenomenon of climate change and reducing GHG emissions has long been a priority for SickKids since its establishment of the 2030 Goals which commits SickKids to a socially responsible work environment that contributes to a safe, healthy, and ecologically efficient environment and sustainable low-carbon future. To safeguard the environment, reduce GHG emissions, and model responsible stewardship, SickKids has prepared this Energy Conservation and Demand Management (ECDM) Plan which outlines how SickKids will reduce overall energy consumption, operating costs and GHG emissions. This ECDM Plan is written in accordance with sections 4, 5, and 6 of the recently amended Electricity Act, 1998, O. Reg. 507/18.

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<sup>1</sup> [Climate Data in Action: City of Ottawa and National Capital Region — ClimateData.ca](https://www.climateaction.ca/en/ClimateData)

## ENERGY CONSERVATION & DEMAND MANAGEMENT PLAN

SickKids prepared its first ECDM Plan in 2014, and subsequently updated it in 2019, fulfilling regulatory obligations. This current 2024- 2029 ECDM Plan builds on the SickKids' previous plans developed and the experience gained in energy conservation over the last decade and contains:

- A description of current and proposed measures for conserving and otherwise reducing energy consumption and managing its demand for energy to reduce GHG emissions.
- A revised energy and GHG forecast of the expected results based on the current and proposed measures.
- A summary of the actual results achieved since the implementation of the 2019 ECDM Plan.
- A description of the updates made to energy and GHG related targets.

### 1.3 VISION & TARGETS TO CONSERVE ENERGY

The preparation of the ECDM Plan provided SickKids the opportunity to re-evaluate the status of corporate energy and GHG emissions and understand how corporate emissions have changed compared to the baseline, as well as provide a short-term and long-term business-as-usual forecast, with and without planned energy reduction initiatives, to compare to corporate targets. The implementation of this ECDM Plan will place SickKids on a trajectory towards its vision of becoming the most energy-efficient hospital by continuously reducing energy consumption and its GHG emissions through cost-effective, innovative, and integrated solutions. To achieve this vision, SickKids is:

- Investing in energy, water and infrastructure retrofits to reduce energy use, water use, and GHG emissions.
- Investing in alternative energy water sources and re-use, and renewable and clean energy technologies.
- Designing buildings and health-care services that are resilient to the impacts of climate change.
- Reducing the use of natural resources and toxic substances through continuous process improvement.
- Forming partnerships to promote a socially responsible work environment.
- Promoting socially responsible behavior through campaigns, training and departmental accountability.
- Participating in provincial, national and international environmental performance benchmarking, awards and challenges
- Participating in electrical demand management strategies

Aligned with *SickKids 2025* aspiration to mobilize a green-friendly organization, SickKids developed an Environmental Sustainability Strategy to set long-term goals including:

- GHG Net Zero by 2050
- GHG use intensity by 2040: Less than 40.09 kg CO<sub>2e</sub>/m<sup>2</sup>/yr
- Water use intensity by 2040: Less than 1.99 m<sup>3</sup>/m<sup>2</sup>/yr
- Waste diversion by 2040: Greater than 80%

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To move towards the 2030 vision, the following ECDM Plan targets are proposed in alignment with SickKids Environmental Sustainability Strategy long-term goals:

- In order to reduce GHG to Net Zero in year 2050, Sick Kids needs to:
  - Reduce energy consumption at Atrium and Annex by 1.5% averaged annually; reduce energy consumption at PGCRL 1% averaged annually; and reduce energy consumption at PSC 0.5% averaged annually
  - By reducing energy demand, and with utility provider to reduce GHG intensity simultaneously, we are expected to meet Net Zero by 2050
- Reduce water consumption to 1.99 m<sup>3</sup>/m<sup>2</sup> by 2040
- Continue to cultivate a culture of conservation across the organization through sustained behavior changes that reduce energy and water consumption.

### 1.4 SCOPE OF ECDM PLAN

SickKids energy and GHG emissions inventory has been prepared in accordance with the World Resource Institute (WRI) / World Business Council on Sustainable Development (WBCSD) Greenhouse Gas Protocol: Corporate Accounting and Reporting Standard (the Protocol)<sup>2</sup>, the GHG Protocol Scope 2 Guidance<sup>3</sup>, and ISO 14064-1-Specification With Guidance At The Organization Level For Quantification And Reporting Of Greenhouse Gas Emissions And Removals.<sup>4</sup>

Following the Protocol, SickKids energy and GHG boundary has been set following an “operational control” approach where SickKids should track energy and GHG emissions of an asset when:

- SickKids owns the asset, and
- SickKids is responsible for maintenance and capital upgrades to the asset.

Based on this assessment, the energy and GHG emissions from SickKids owned and existing buildings - Annex, Atrium and PGCRL are included in the ECDM Plan.

### 1.5 PLAN DEVELOPMENT

Energy and GHG emissions forecasting was based on corporate energy and GHG emissions available for the most representative year, 2023, and trends from 2013-2023 as well as anticipated growth to 2050. The identification of initiatives for in organization into the ECDM Plan was done through a combination of staff engagement, a best-in-class review of other hospitals and input from internal and external subject matter experts. The ECDM Plan covers a 5-year horizon from 2024 to 2029.

The ECDM Plan was reviewed by senior management prior to finalization.

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<sup>2</sup> [Companies and Organizations | Greenhouse Gas Protocol \(ghgprotocol.org\)](https://ghgprotocol.org/)

<sup>3</sup> [Scope 2 Guidance | Greenhouse Gas Protocol \(ghgprotocol.org\)](https://ghgprotocol.org/)

<sup>4</sup> [ISO - ISO 14064-1:2006 - Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals](https://www.iso.org/standard/68549.html)

## 2.0 CAMPUS DESCRIPTION

### 2.1 OVERVIEW

The Hospital for Sick Children (SickKids) is recognized as one of the world's foremost pediatric health-care institutions and is Canada's leading centre dedicated to advancing children's health through the integration of patient care, research, and education. Founded in 1875 and affiliated with the University of Toronto, SickKids is one of Canada's most research-intensive hospitals and has generated discoveries that have helped children globally.

SickKids owns multiple properties and facilities; however, most of the energy consumption and emissions are from three main facilities on the downtown campus. As such this study will focus on these three main facilities.

The main facilities are:

- Main Hospital which consists of multiple interconnected additions and renovations of various vintages. While there have been numerous smaller renovations and additions most of the clinical space is housed within:
  - Atrium, located at 170 Elizabeth Street, was constructed circa 1989 – 1993; and comprises of a gross floor area of approximately 953,000 sqft.
  - Annex, located at 555 University Avenue, is approximately 1,035,000 sqft. The Annex consists of:
    - University (Black Family) Wing constructed in 1949.
    - Gerrard (Roy C. Hill) Wing constructed in 1964.
    - Elm (Burton) Wing constructed in 1972.
- Patient Support Centre (PSC), located at 175 Elizabeth Street, is the newest addition to the campus in 2023. The PSC has area of approximately 523,000 sqft.
- Peter Gilgan Centre for Research and Learning (PGCRL) is the second newest building constructed in 2013. PGCRL has an approximate area of 898,000 sqft. Since opening PGCRL has not undergone any major renovations but has had upgrades to its plant systems. Most recently a dedicated process chiller was added to the Facility.

SickKids is currently in the process of completing a campus redevelopment project (Project Horizon) which will see the University (Black Family) Wing and the Gerrard (Roy C. Hill) Wing demolished and replaced with a new Patient Care Center (PCC). The Black and Hill Wings represent approximately 755,000 sqft or 72% of the Annex floor area. Burton and Atrium Wings will remain as part of the larger campus supporting the new PCC.

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In preparation for the PCC, a program is currently underway to allow for construction of the PCC. This program consists of decoupling Burton and Atrium from the Black and Hill Wings and decanting operations from Black and Hill Wings into other locations on the campus.

As areas within the Black and Hill Wings are vacated, the heating, cooling and ventilation for these areas will be reduced. Due to phasing sequence this may result in the need for temporary heating and cooling in some areas of the Black and Hill Wings.

The implication of this coming program is energy and emission reduction measures will not be considered for the Black and Hill Wings since they are in the process of being decommissioned.

It should also be noted that the potential energy and associated energy impacts from the operation of the PCC are not considered in this analysis. As a modern facility, it is expected the PCC will have a better energy performance and lower operational emissions; however, it will still have net impact on the overall energy consumptions and operational emission of the site. The level of energy and emissions that will be produced by the PCC is unknown at this time.

## **2.2 OVERVIEW OF UTILITIES AND SYSTEM DESIGN**

Each of the three main facilities are independently operated buildings, with dedicated utility connects, different system design and Building Automation System.

PSC is the newest building and is provided with chilled and hot water from the Enwave district energy network. PSC has a dedicated electrical service and domestic water connection. As the newest building PSC has all the typical modern energy and emission reduction features such as air and waterside heat recovery. The PSC is provided with a dedicated electrical service from Toronto Hydro and water service. PSC require 12 months of operation to confirm if the facility would qualify to be a Class A customer.

PGCRL is provided with district steam from the Enwave district energy system, dedicated electrical service and domestic water connection. PGCRL uses steam to generate heating water, DHW and to generate humidification. The heating water system is a high temperature design with a design setpoint of 180 °F. Chilled water is generated within the building for both comfort use (air conditioning) and for process cooling (direct chilled water connection to support equipment like data centres and lab equipment). SickKids has indicated a dedicated process heat recovery chilled water system was installed in 2023. Previously process chilled water was generated by the main chilled water plant however operational challenges prompted SickKids to install a dedicated process chilled water plant. The PGCRL is provided with a dedicated electrical service from Toronto Hydro and water service. PGCRL is a Class A customer with respect to electrical demand.

The main hospital is provided with steam from the Enwave district energy network. There are two steam connections, one for Atrium and one for Annex. District steam is used to generate heating water, DHW and humidification. Chilled water is produced on site. There are two chilled water plants in the main hospital. One is in the Burton building, and one is in the Atrium building. The plants are cross connected and will alternate providing chilled water to the facility. The Atrium plant also contains heat recovery chillers which provide heating water to the facility when there is a simultaneous need for heating and cooling. There are



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pending projects to extend the capabilities for energy sharing between the two chiller plants. There are also projects pending to increase the utilization of the heat recovery chillers for air side heat recovery as part of the Burton renovation and the reactivation and expansion of the heat recovery system for the Atrium.

The facility heat water system design temperature varies by addition and renovation. Currently the facility is operating at 140 °F which is a compromise temperature. While this temperature is below the design point of the high temperature system (180 °F) it is sufficient to satisfy the needs of the critical high temperature system zones. It should be noted that this higher temperature is only continuously or mainly required for a limited number of zones.

However, this temperature is too high for the low temperature system and the return water is “too hot” for the heat recovery chillers to operate efficiently. To ensure the correct return water temperature the returning heating water is being circulated through the cooling tower. While this strategy will ensure efficient heat recovery chiller operation it is resulting in additional emissions.

The main hospital has two electrical services and four water services, three for the Annex and one for the Atrium. The electrical service is provided by Toronto Hydro. SickKids chose to participate as a Class A customer for its Atrium building, recognizing the potential to reduce provincial peak electricity demand. Meanwhile, the Annex building operates as a Class B customer.

### **3.0 2023 ENERGY & GHG EMISSIONS**

To substantially reduce the risks and effects of climate change, and limit global warming to 1.5°C, scientists and policy makers have come to the agreement that globally society must dramatically reduce greenhouse gas emissions and achieve net zero by 2050. Recognizing the importance and benefits to addressing climate change, hundreds of organizations companies representing more than \$23 trillion in market capitalization have now committed to committing to science based targets (SBT), like net zero by 2050 or earlier<sup>5</sup> To achieve the SBTs, organizations have set in place actions to improve energy efficiency in buildings by implementing deep energy retrofits, transitioning to 100 percent renewable electricity, establishing programs that facilitate more accountability and ownership over cost and fuel management, and converting fleet to electric and biofuels. The first step in reducing energy and GHG emissions is to complete an estimate of current GHG emissions and forecast these to 2050 using business as usual assumptions. The following section presents the SickKids energy and GHG emissions profile.

#### **3.1 CURRENT ENERGY & GHG EMISSIONS**

The Atrium, Annex and PGCRL make up the SickKids corporate energy consumption and GHG emissions and contribute to provide health care services, interventions, and research. In 2023, SickKids corporate energy consumption was 352,852 GJ to which 49% was electricity and 51% steam based. In terms of GHG emissions, the consumption of fossil fuel powered energy resulted in the estimated release of 20,077 tonnes of carbon dioxide equivalent (tCO<sub>2</sub>e). Although electricity consumption accounted for half of the energy profile, it only accounted for 9% of GHG emissions due to the low emissions intensity of the Ontario grid electricity. In contrast, due to the high emissions intensity of natural gas to which steam was generated, steam accounted for 91% of the total GHG emissions. A summary of energy and GHG emissions by building asset is presented in Table 3-1.

**Table 3-1. Summary of 2023 Energy & GHG Emissions by Building Asset**

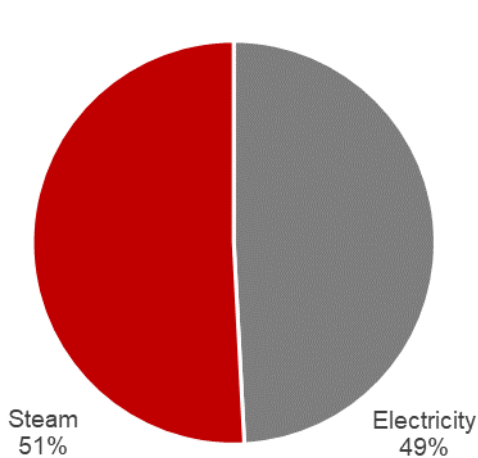
<b>Building</b>	<b>Energy (GJ)</b>		<b>GHG (tCO<sub>2</sub>e)</b>	
Atrium	171,286	34%	6,277	31%
Annex	148,954	29%	6,829	34%
PGCRL	189,133	37%	6,971	35%
<b>Total</b>	<b>509,374</b>	<b>100%</b>	<b>20,077</b>	<b>100%</b>

A breakdown of energy consumption and GHG emissions are presented in Figure 2 and Figure 3 below.

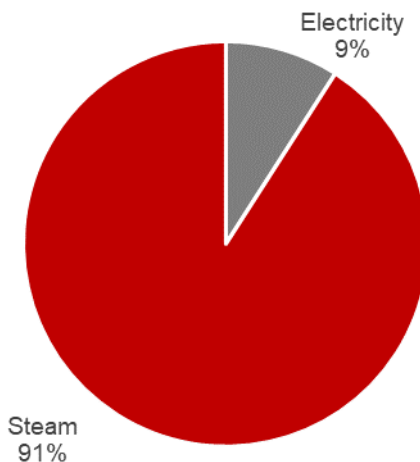
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<sup>5</sup> <https://sciencebasedtargets.org/news/more-than-1000-companies-commit-to-science-based-emissions-reductions-in-line-with-1-5-c-climate-ambition>

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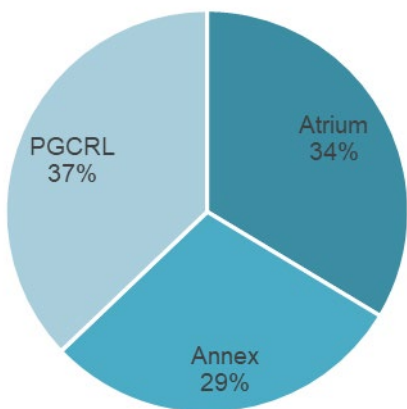


**Figure 1. Energy Use By Fuel Type**

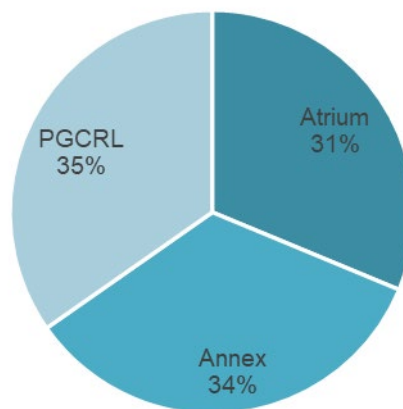


**Figure 2. GHG Emissions By Fuel Type**

The energy and GHG emissions profiles for each of SickKids buildings have similar energy and GHG emissions splits as noted in Figure 3 and Figure 4. PGCRL has the highest energy and GHG emissions footprint. While the Atrium consumes more energy than the Annex, the Annex has a higher GHG emissions footprint as it consumes more energy in the form of steam than the Atrium.



**Figure 3. Energy Use By Facility**



**Figure 4. GHG Emissions By Facility**

### 3.2 HISTORICAL TRENDS

#### 3.2.1 Energy and GHG Trends

SickKids has been tracking its energy usage and GHG emissions since the preparation of its first ECDM Plan. Figure 5 presents a trend of the utility energy consumption from 2014 to 2023.

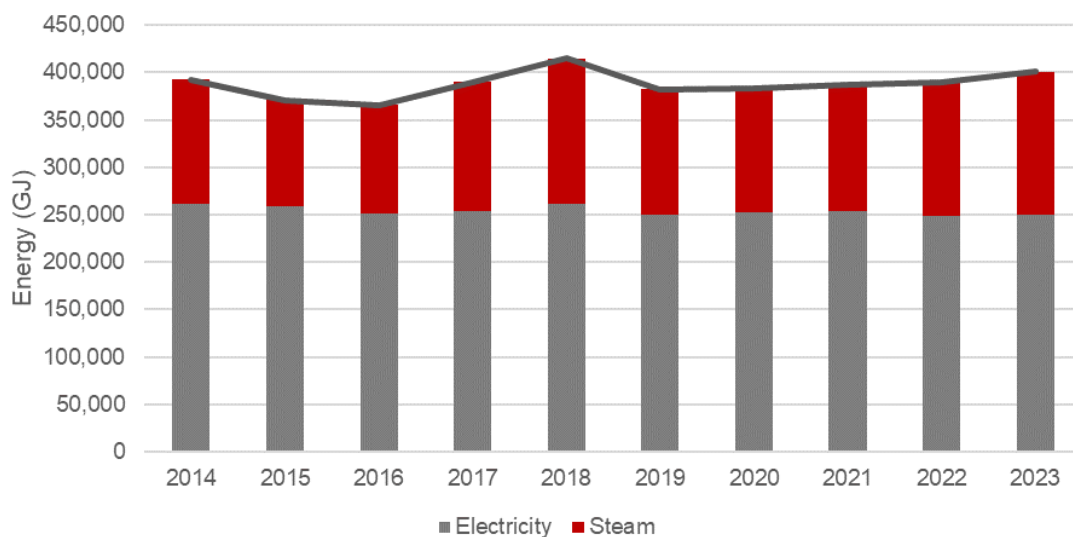


Figure 5. Energy Consumption from 2014-2023

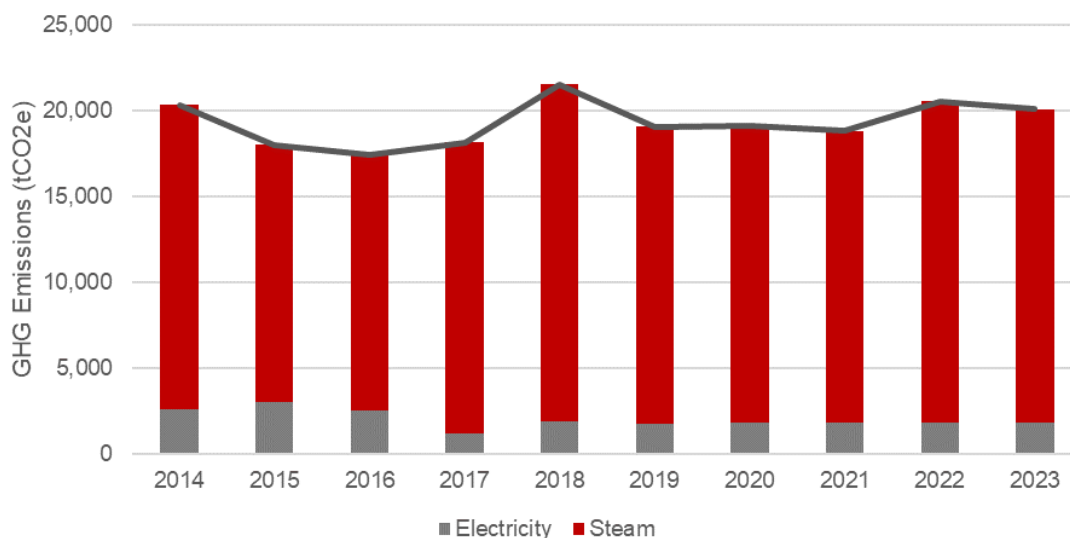


Figure 6. GHG Emissions from 2014-2023

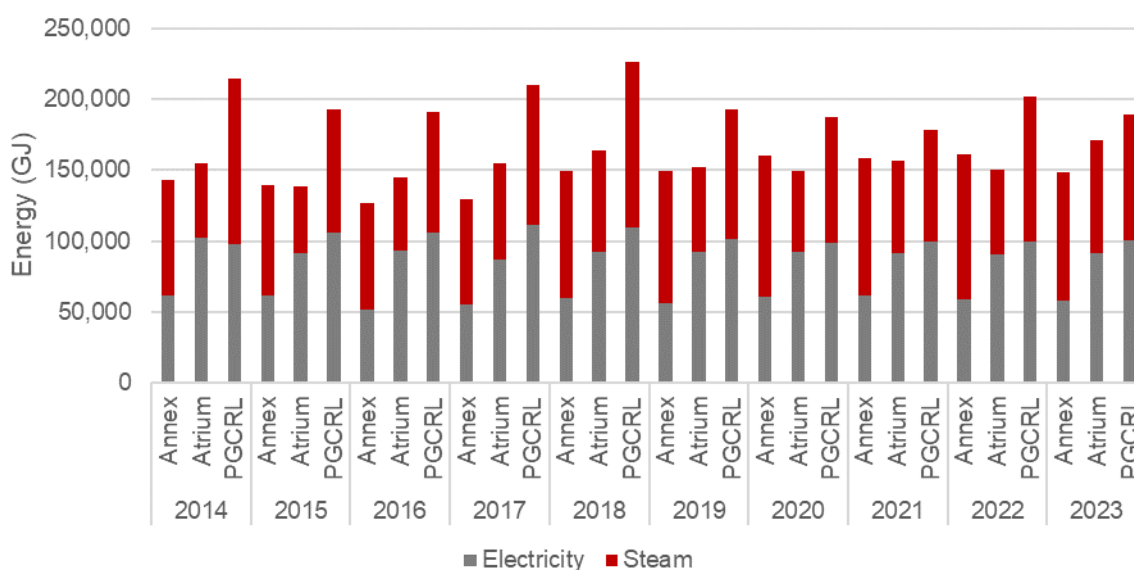
The fluctuation in energy consumption in Figure 5 is related to variability in the number of heating and cooling days (e.g., cold winters will drive up natural gas consumption to warm buildings; hot summers will

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increase cooling loads and natural gas consumption). Note that the increase in heating energy in 2018 is due to change of use in Burton wing to include a pharmacy with 100% outdoor air requirements. This change of use required additional heating for the building to maintain the stringent temperature and airflow requirements in the pharmacy.

Figure 6 shows the GHG emissions trend from 2014 to 2023. Note that the emission factor for grid electricity in Ontario varies each year, as summarized in Appendix A, depending on the electricity generation mix. The reduction in GHG emissions from electricity use in 2017 is due to the lower grid emission factor during that period.

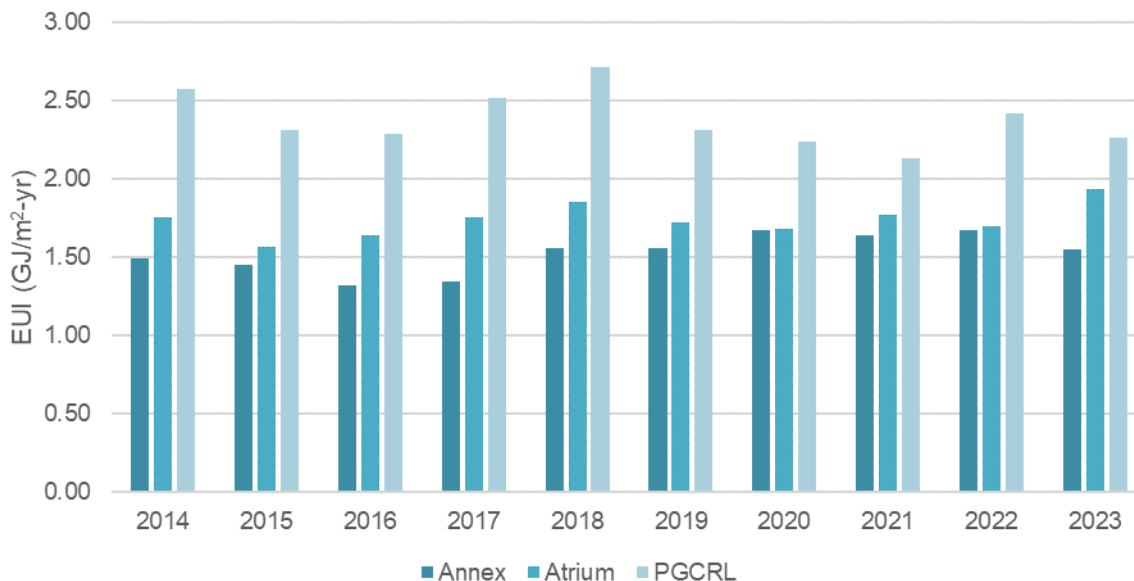
Figure 7 presents the energy profiles for each of the buildings from 2014-2023.



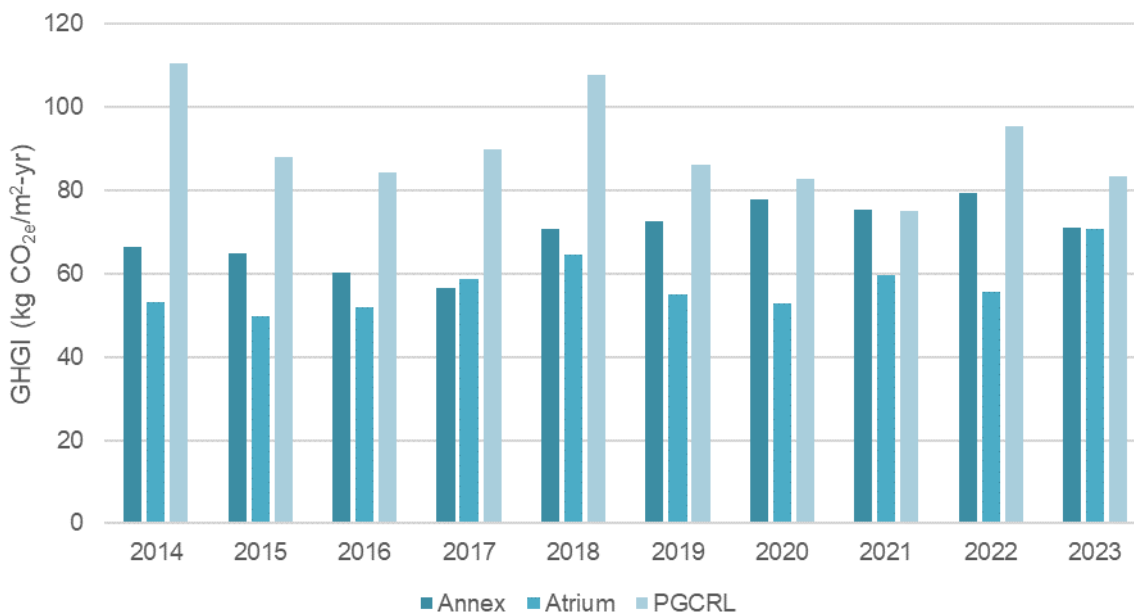
**Figure 7. Building Energy Consumption By Fuel Type from 2014-2023**

Figure 8 and Figure 9 presents energy and GHG emissions intensity trends for each of the buildings. Both figures show that PGCRL has the highest energy and GHG emissions intensity, and the highest fluctuation in energy usage and thus GHG emissions. The high energy use is expected for a medical research lab facility. As noted in the 2023 energy and GHG emissions profile, while the Atrium is the next highest energy consumer, it has a lower GHG emissions profile and intensity as compared to the Annex because the Atriums fuel mix is more electricity based.

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**Figure 8. Building Energy Intensity from 2014-2023**



**Figure 9. Building GHG Emissions Intensity from 2014-2023**

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### 3.2.2 Benchmarking Energy Performance

The average energy use intensity for healthcare facilities in Ontario is 3.58 GJ/m<sup>2</sup>/yr according to NRCAN OEE Statistics. The Main Hospital performs better than the average healthcare facilities in Ontario, with an average energy use intensity over the last 5 years of 1.8 and 1.6 GJ/m<sup>2</sup>/yr for Atrium and Annex respectively.

The average energy use intensity for labs with similar operation and climate zones in North America is 3.645 GJ/m<sup>2</sup>/yr based on Lab21 statistics. PGCRL energy use intensity is 2.3 GJ/m<sup>2</sup>/yr, performing better than the average lab facility in a similar climate zone in North America.

### 3.2.3 Demand Management Trends

Ontario's Industrial Conservation Initiative (ICI) program provides incentives for large electricity consumers to shift their electricity use to off-peak hours when the Ontario electricity system is at its highest demand. Participating in ICI program helps reduce the province's peak electricity demand, thereby deferring the need to build capital intensive peaking generation.

SickKids has participated in ICI program since 2017, and uses forecasting and identification tools to determine the peak hours when the electricity demands are likely to be the highest, and applies load reduction strategies to lower the peak. This program allows SickKids to save between \$0.5 million to \$1 million in electricity costs every year.

**Table 3-2: Historical Demand Management Trends for Class A Facilities**

History	Atrium		PGCRL	
Billing Period	Peak Demand Factor	PDF change	Peak Demand Factor	PDF change
2017	0.00017877	Baseline	0.00022935	Baseline
2018	0.00015397	0.0000248	0.00021624	0.00001311
2019	0.00015505	0.00002372	0.00022443	0.00000492
2020	0.00017443	0.00000434	0.00021433	0.00001502
2021	0.00017443	0.00000434	0.00021433	0.00001502
2022	0.00014379	0.00003498	0.00018485	0.0000445
2023	0.00016308	0.00001569	0.00018825	0.0000411

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### 3.2.4 Water Conservation Trends

SickKids is committed to water conservation for a socially responsible and ecologically conscious work environment. Water use affects energy use and GHG emissions.

Since 2017, SickKids has reduced water use with various projects and programs, such as low flow fixtures, leak repairs, close-loop cooling system, rainwater and reverse osmosis water reuse, cooling tower and water treatment upgrades, and more.

These changes have reduced SickKids' water use from 410,000 cubic meters in 2017 to 280,000 cubic meters in 2020, a difference of about 30 per cent. That's equal to more than fifty Olympic-sized swimming pools.

## 3.3 PAST INITIATIVES

The 2019 ECDM Plan identified program and project initiatives for SickKids, most of which have been implemented. Table 3-3 presents a summary of program initiatives and their implementation status.

**Table 3-3. Summary of 2019 ECDM Program Initiatives Status**

Measure Type	Measure	Status Update
<b>Behavior</b>	Assess energy savings from increasing ultra-low freezer temperature	Completed.
	Assess energy savings from turning off medical/research equipment when not in use	Ongoing. SickKids is looking to refine action.
	Expand the Lights Out Initiative across hospital and PGCR	Completed.
	Expand turn off medical/research equipment when not in use across hospital and PGCR	Ongoing.
	Regular energy performance reviews and identification of energy and water savings opportunities with building operators	Completed.
	Ventilation temperature settings and schedules adjustments to support staff, equipment, and services.	Ongoing.
<b>Organizational</b>	Assess the climatic resiliency of SickKids existing buildings	Ongoing (just starting)
	Assess the feasibility of SickKids becoming carbon-neutral	Ongoing (just starting)
	Establish policies and processes (procedures) to ensure systematic purchase of the most energy efficient building system equipment during replacements, renovations and new constructions.	Completed.



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Measure Type	Measure	Status Update
	Establish policies and processes (procedures) to ensure systematic purchase of the most energy efficient office, medical/research equipment	Completed.
	Establish policies and processes (procedures) to ensure that the most energy efficient system design is considered during upgrades, renovations and new constructions.	Completed.
<b>Atrium/Annex</b>	Deep Lake Cooling	Investigation Stage.
	Refurbish Atrium Solar Water Heating	Postponed due to funding (designed).
	Heat Integration - low temperature water distribution system	In-progress (multi-year project).
	Solar Air Heating (Elm)	Postponed due to funding (designed).
<b>PGCRL</b>	Peak Demand Shaving	Implemented.
	LED Upgrade (Energy Savings) LED Upgrade (Replacement of existing)	LED Upgrade (Complete). LED Upgrade (Replacement of existing) - In-progress.
	Process Chiller Plant Retrofit	Chiller upgraded; working to maximize heat recovery.
	Lab Fume Hood Exhaust Fan VFD control	Not completed (payback too long).
	Demand Control Ventilation	In-progress (exploring options for lab demand control).

### 4.0 INITIATIVES

A workshop was held with key project shareholders on January 31, 2024 with key project associates to discuss priorities and potential projects.

From this workshop the individual projects cited by project associates were grouped into general themes. This grouping of projects was reviewed by the project associates on February 21, 2024 to receive input into the grouping of projects and what projects should move forward.

The main clinical building (main hospital) on the campus consists of multiple interconnected additions and buildings built over many decades. SickKids currently has a redevelopment program in motion (Project Horizon) which will see a portion of the Annex building demolished and replaced with a new clinical tower. As enabling works there are current and pending projects which will see renovations within the Burton and Atrium buildings to enable the demolition of the Annex building.

As these enabling works are completed the Annex building will slowly be decanted. As the different areas are emptied from the Annex building the services to these spaces (heating, cooling and ventilation) will be reduced and where possible turned off. To support this interim condition portable supplemental cooling and heating equipment may be required. Due to the pending decommissioning no initiatives were considered for the Annex building.

Due to the magnitude of Project Horizon and the associated early works, where possible measures were selected that integrated into pending projects and/or considered the potential impact of the new tower.

### 4.1 CAMPUS-WIDE INITIATIVES

#### 4.1.1 Maintenance Backlog

The age of the facilities and systems within the SickKids campus are of different vintages. As systems and facilities age a minimum level of maintenance is required to maintain functionality and operational efficiencies. Generally, the level of required maintenance will increase as the systems age. If maintenance is deferred, then system efficiencies will typically decrease. Typically, there is also a risk that the system reliability will be impacted and the potential the cost to resolve the maintenance backlog maybe more than the sum of annual deferred maintenance.

It has been indicated the historic annual maintenance funding has not been sufficient and as a result the maintenance backlog has been increasing annually. This maintenance backlog has resulted in the energy performance as the main systems deteriorating year after year. Based on industry averages a decrease of approximately 1.5 % could be assumed if the maintenance budget is not increased.

It is recommended that the maintenance budget for the major energy consuming systems is increased to meet annual maintenance needs and begin to resolve the maintenance backlog.

### 4.1.2 Commissioning and Recommissioning

Building commissioning is the practice of verifying building systems are functioning to efficiently and to their design intent after installation. While commissioning is often associated with mechanical and electrical systems it can also apply to building envelopes.

Overtime system efficiency tends to decrease due to factors such as:

- Sensors drifting out of alignment;
- Deferred maintenance; or
- Change in space use

While independently these factors may seem like minor inefficiencies due to interconnection between systems and system components they can have an overall significant impact on energy performance.

For example, variable flow pumping loops rely on pressure and temperature sensors to operate. Failure of either sensor could result in the loop reverting to a constant flow operation due to loss of the control point.

Recommissioning is the process by which systems are returned to their design intent, realigned to meet owners' needs and the efficiency of the systems is restored. Typically recommissioning is recommended every 4-5 years and yield paybacks in the 2-3 year range.

It is understood that SickKids has been doing unofficial recommissioning over the last few years as resources and budgets allows. While this has allowed for select systems to be brought back into alignment the scale of the program is small compared to the potential for savings.

It is recommended that a recommissioning program is established with resources capable of taking on recommissioning of multiple systems within the campus. As part of the start up of this program systems to be recommissioned should be ranked in order of priority.

As part of the prioritization exercise the program should consider the impacts of Project Horizon and the associated early/enabling works. Where portions of systems are replaced as part of either of these projects the recommissioning effort should focus on the remaining portions of the system.

It is further recommended that a formal policy to commission all new systems be established.

As part of the policy, it is also recommended that a holistic approach to design is adopted which focuses ensures when systems are renovated all connected elements outside the renovation areas continue to function as intended. For example, if an AHU services 4 zones and 1 zone is renovated traditionally only the air flow and function of the controls within the renovated zone is verified. One common mistake is not considering the impact on the other 3 zones served by this AHU. It is common for the air flow to the non-renovated zones to be adversely impacted. Or the associated zones are not compatible with the renovation such as switching recirculated air zones to 100% OA.

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### 4.1.3 Metering, Sub-Metering and BAS trending

Currently there are three independent building automation systems (BAS) on the campus:

- Main hospital
- Patient Support Center
- PGCRL

The BAS are all different vintages, functionality and capabilities. There is a project underway to develop a sub-meter network however this project is still in the design phase.

Over the course of the investigation and analysis phase of this project trend data from the BAS was requested. It was identified that the relevant trend data is store on their respective BAS and not in a central source.

Each BAS also has different capabilities to trend, retrieve and download data and a different data format. For example, the PGCRL BAS outputted an excel file with a single date and time column followed by trend data for different BAS points. The main hospital BAS outputted an excel file with one date and time column per BAS point. While the difference may seem minor from an analytical point of view it is significantly more time consuming to process trend data when each data point has a time stamp then when there is one time stamp for multiple data points. In addition, the time required to download trend data from the main hospital BAS was significantly longer than required to download similar trend data from PGRCL.

In reviewing trend data from the main hospital two types of discrepancies where noted. First type of discrepancy noted was value for points within the trend data appeared to be incorrect. In one instance this was traced to an incorrectly mapped point. Other instances of these issues could be related to sensor calibration, sensor condition or points being mapped incorrectly. The second type of discrepancy was linked to points being offline. For example, the BAS was not recording trend data for VFD drives. The cause of this issue is unknown. In both cases the discrepancies impact the resolution at which the trend data could be reviewed.

If it is not possible to accurately meter and trend energy consumption it is not possible to accurately manage energy consumption nor assemble the information needed to build business cases to justify larger scale retrofits.

It is recommended that:

- The BAS for the main hospital is recommissioned;
- All BAS are upgraded to allow for automated retrieval of trend data;
- All trend data appears in a standard format;
- All trend data is routinely archived in a central location;

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- A submeter system is installed;
- Information from the submeters is routinely archived and stored in the same central location as the BAS trend data;
- Standard regular reporting for all systems based on trend data and sub-meter information is developed. This reporting should be automated to ensure repeatability and timely completion; and,
- Reports should be reviewed by key associates at regular intervals and anomalies in the data are identified and investigated

While the BAS for PGCRL appears to be functioning as intended as a best practice it is recommended that this BAS is also recommissioned.

### 4.1.4 Energy Sharing and Heat Recovery

As noted above SickKids has current projects in motion to increase the amount of energy transfer between the two chiller plants and exploit further opportunities for heat recovery.

Based on best available information it appears that SickKids has more chiller capacity than required. The two projects to increase the heat recovery capacity are two independent projects and it is assumed that SickKids has coordinated the projects and verified there is sufficient heat recovery chiller capacity available.

Once these two projects are complete it is recommended that SickKids verifies the remaining available capacity for heat recovery within the chiller plants and looks for opportunities for further heat recovery.

It should be noted that recovery heat is one aspect of decarbonization, finding a sink for the recovered heat is another challenge. Heat recovered from the exhaust air can be used for both building heating and water heating for domestic water (see below).

It is recommended that once the new heat recovery systems are online a study be completed to determine the spare capacity within the plant systems to recover more energy, identify additional sources to recover heat and identify sinks for recovered heat.

### 4.1.5 Low Carbon DHW heating

Currently DHW within the campus is generated using steam based instant hot water generators. Instant hot water generation is very common in healthcare facilities. In general, older facilities utilize steam-based generators while newer facilities use high temperature hot water-based generators.

In general, for most applications within a healthcare setting domestic water needs to be heated to a minimum of 60°C (140 F). This temperature requirement makes using low temperature heating water or condenser water to generate DHW challenging.

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While effective using either steam or high temperature hot water to generate domestic hot water is carbon intensive. Low temperature heating water can be and is in the case of this facility generated through low sources such as recovered heat.

Low temperature heating water can be used to either pre-heat make-up DHW through the use of a heat exchanger or use a water-to-water heat pump to generate DHW.

There are air source heat pumps designed to generate DHW available however they may not be as easily integrated into the existing system as a water-to-water heat pump or a pre-heat heat exchanger.

It is recommended that once the current heat recovery projects are completed that the feasibility of using the low water temperature loop to generate DHW is reviewed.

### 4.1.6 Plug Load Management

Plug loads is the energy loads associated with equipment (i.e. computers) within a Facility which is controlled by the end users. Managing plug loads by building operators is often challenging since the loads are controlled by the end users. However, through education and engagement it is possible to influence end user behavior and reduce plug loads. With end user buy in technology can also be deployed to assist with plug load reduction such as automated turning off equipment afterhours.

It is understood the building operations team is running an energy conservation campaign to reduce plug loads. Example of initiatives under this campaign include adding timers to control lab equipment and reducing ghost loads. It is recommended that this campaign is maintained and expanded.

### 4.1.7 Adiabatic Humidification

Under the current CSA Z317.2 standard, the only acceptable form of humidification for clinical spaces is steam. There is a pending update to the CSA Z317.2 standard that will allow for adiabatic humidification for healthcare facilities. The update is expected in the summer of 2024 and would allow for high pressure spray humidification system (a form of adiabatic) within healthcare facilities.

Based on information from the public review version of the standard update the requirements for the high-pressure spray humidification system would mirror what ASHRAE 170 has historically called for. These requirements include RO water only and ensuring no standing water within the unit. While the use of copper silver ionization as a disinfectant for the spray water is not a requirement it is a best practice and is integrated into many of the system available in the market.

In a new build application the implementation of this technology is easy. In a retrofit or replacement application there can be challenges linked to available space (these units are longer) and heating capacity (these units require larger heating coils since energy for evaporation is shifted to the heating coil). This technology has significant emissions reduction potential as such it is recommended that SickKids where explores the feasibility and where feasible implements adiabatic humidification.

It should be noted that within the adiabatic humidification process energy is still required to evaporate water, but low temperature heating water can be used as a source of energy. Low temperature heating water can

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be generated by low carbon sources such as a heat recovery chiller. This results in the potential of significant emissions savings related to deploying adiabatic humidification.

From an energy perspective the amount of energy needed to evaporate water is the same regardless of fuel source. However, if thermal energy is generated more efficiently than the current energy from the district steam there will be an energy savings. However, the magnitude of the energy savings will be significantly smaller than the potential emissions savings. Low temperature heating water conversion should be a pre-requisite for implementation of adiabatic humidification.

### 4.1.8 Low Temperature Water Heating Conversion

As noted currently both the main hospital and PGCRL utilize high temperature heating water systems. Typically, only a small number of zones require the design heating water temperature. In a typical facility most zones can operate with a significantly lower heating water temperature. In the case of the main hospital there are even zones which are already designed for a lower heating water temperature.

SickKids current use of high temperature heating water is being driven by the needs of some critical zones. A strategy which could be used to convert to low temperature heating water would be to identify the critical zones in each building which require higher heating water temperatures and only provide these zones with high temperature heating water. This higher temperature heat water for these small number of zones could be generated by either water source heat pumps or dedicated electric boilers.

Implementation would require some reconfiguration of piping and space for either a dedicated electric boiler or water source heat pump.

It should be noted it was reported that past studies by Enwave suggested 95% of heating energy could be offset by heat recovery technology.

It should also be noted that it has been reported:

- The Atrium AHUs were designed to utilize low temperature hot water; and,
- PGCRL was designed for a low temperature heating water system which was not deployed. As a result, the heating water system is currently using a cascading design where heating water flows from the higher heating water temperature systems to the lower heating water systems. This makes the heating water system within PGCRL is essentially low heating water temperature ready.

It is recommended that SickKids undertake the necessary feasibility studies to begin the scoping process.

### 4.1.9 Low Carbon District Heating

There are multiple low carbon district energy options available to SickKids.

Typically, these agreements are structured in a way that SickKids will be provided with heating and chilled water at a certain flow rate, temperature and guaranteed efficiency. The cost of the system is recovered

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over a specified time period through a fixed connection charge. Costs of the energy consumed is recovered through a pass-through consumption charge, subject to the energy efficiency guarantee.

The demarcation point between the energy provider and SickKids would typically be a heat exchanger. SickKids will be responsible for maintaining water temperatures and flows within a specified range on their side of the heat exchanger to ensure the district energy provider can meet their contractual obligations.

In both scenarios the typical model would have less plant equipment under SickKids direct control and the thermal energy is dependent and could be impacted by what is happening within the larger district energy system or source of thermal energy.

These types of systems need to be reviewed from both a commercial and technical standpoint. It is recommended that SickKids carefully consider their options and select a vendor based on economics, contract flexibility and technical potential for emissions reductions.

### **4.1.9.1 Wastewater Heat Recovery**

Wastewater heat recovery is a technology that harvests the heat in wastewater for use in a heating system. Typically, this process is done by separating solids in the wastewater from liquids and using heat pumps to either reject heat to the wastewater or harvest heat from the wastewater.

The challenge with this technology is the capacity of the system is related to the volume of wastewater available. In general, there are two main strategies utilized by these systems. Local storage of wastewater and connection to main sewer lines.

While a local storage strategy will allow for self-contained heat recovery, the storage tanks will take up physical space, and will be a significant size to make a meaningful impact on a facility of this scale. In addition to the physical location SickKids will need to maintain this system.

There are options for companies to provide wastewater heat recovery as an energy service. In this model the heat recovery system is connected to a main line in the municipal sewer system. Being a main sewer line there will always be a constant flow of sewage to harvest heat from. These systems will have local energy plant owned and operated by the service provider on or near the site. The local energy plant will consist of a wet well to hold the wastewater and associated heat recovery equipment. Typically, these contracts are structured in a way that the vendor is responsible for providing the hospital with specified volume and temperature of heating and cooling water generated at a guaranteed efficiency. As such the local energy plant will also include boilers and chillers.

In this model typically the Hospital would no longer require central plant equipment such as chillers and boilers.

### **4.1.9.2 District Heating and Cooling**

One potential source of low emissions energy would be through the Enwave district chilled water loop. This chilled water loop is primarily generated through the Enwave deep lake cooling system with supplemental cooling provided by mechanical chiller plants. Prior to returning chilled water to the lake the temperature of



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the returning chilled water needs to be reduced to a similar value as it was taken from the lake. This waste heat can be harvested via heat pumps and be used as a source of building and DHW heating.

Within this agreement there is typically the option for a customer to also export energy to the district energy system when the district energy system requires more thermal energy. This could allow clients like SickKids who have excess chiller capacity to recover costs in at some points in the year.

An alternative option would be for Enwave to “purchase” SickKids chiller plant and provide SickKids with thermal energy. In this scenario, SickKids would no longer own chilled water equipment. This would have the advantage of SickKids no longer having to own, maintain and life cycle replacement of the chilled water plant.

### 4.1.10 Geo-Exchange

Geo-exchange system is another low carbon source of heating and cooling, utilizing heat pumps to store energy in the earth. During the summer waste heat from cooling is deposited into the ground and this heat is retrieved during the winter.

Their multiple variations of this technology however a conventional closed loop geo-exchange system is the most common configuration in the Toronto area. In this variation energy is transferred to the earth via circulating a glycol/water mixture through a series of vertical wells. Each well consists of a tube encased in thermally conductive typical between 244-259 m (800-850') in depth. To prevent thermal interference and for installation reasons the wells are spaced at between 6-9 m (20'-30') apart in a grid. For redundancy reasons the wells are typically clustered into smaller sub-groups each containing the same number of wells.

An alternative variation on a closed loop vertical geo-exchange system is a borehole thermal energy system (BTES). A BTES uses shallower wells in a spiral pattern instead of a grid and will operate at a higher temperature. The theory behind the spiral pattern is that the heat will be better contained within the field which along with the higher operational temperature will allow for a more compact field.

A conventional closed loop vertical geo-exchange system design, operations and construction is addressed in CSA 448 standard series. CSA 448 does not address BTES. There are many working examples of BTES in operation but because the system is not addressed in CSA 448 there are potential risks linked to procurement of a BTES over a conventional design. These risks will be linked to the procurement model for a geo-exchange system.

Modern closed looped geo-exchange systems regardless of configuration are typically located under buildings. The tubing used for construction of geo-exchange systems typically carries a 50-year warranty however the industry considers the service life to be significantly longer normally like the building's service life. As a result, modern geo-fields are often located under buildings. This prevents sterilization of land that could be used for future expansion and decrease the potential for damage due to excavations.

Potential locations for a geo-exchange system for SickKids would be the underground parking area, under the new hospital tower and angularly drilled wells along the perimeter of the interface between the new addition and the exiting facility.

### 4.1.11 Demand Management

Our participation in the IESO's ICI program started in 2017 and continues to today, when we switched our Atrium and PGCRL buildings to Class A customers. The Industrial Conservation Initiative (ICI) is a program that enables large customers to lower their global adjustment charges on their electricity bills by adjusting or decreasing their electricity usage during the top five peak hours of the year. We use forecasting and identification tools to determine the peak hours when the electricity demands are likely to be the highest, and then we apply load reduction strategies to lower the peak. This program allows us to save between \$0.5 million to \$1 million in electricity costs every year.

Measures and strategies for demand management include: reduce AHU air flow, adjust AHU supply air temperature and space temperature, temporarily disable heat recovery operation of heat recovery chillers, and send public notification (daily news, screensaver) to reduce cooling load.

## 4.2 MAIN HOSPITAL

### 4.2.1 Lighting and Control Upgrade

The lighting system and associated controls are of varying vintages, technology types and control strategies.

The advancement in LED technology within the last few years and the Federal regulations on lamps containing mercury have made LEDs the new standard for lighting. LEDs consume less energy than alternative like fluorescent and have longer service lives. The increase in service life is one of the most significant advantages to LED technology. Traditional technologies like linear fluorescents and high intensity discharge lighting have limited-service lives in terms of both operational hours and can prematurely fail for a variety of reasons. An example of premature failure causes is vibrations which is a common cause of failure for high intensity discharge fixtures in parking lots and exterior applications.

It should be noted that the cost of replacing a lamp within a lighting fixture is more than just the cost of the lamp. The cost of replacement also includes the cost of mobilization and setup (i.e. moving furniture to access lighting fixtures). Once all these costs are considered, conversion to LEDs has a significant maintenance related cost savings.

It should be noted that since LEDs produce less waste heat there will be energy penalties related to heating and energy credits related to cooling. However, electricity is a significantly more expensive fuel which means on balance there will be an economic savings related to LED conversion.

Due to the Ontario electrical grid being a low emission grid the emissions savings related to LED lighting implementation will be minor but the annual economic savings that can be reinvested in the facility make conversion to LED a very valuable opportunity.

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### 4.2.2 CAV to VAV Conversions

Currently the HVAC system is primarily a constant air volume (CAV) design where space temperature set points are achieved by altering the supply air temperature. This is typical for a conventional hospital design.

The air flow rates to each space are dictated by CSA standard Z317.2. Normally the air flow rates required by CSA Z317.2 will exceed the air flow rates needed for peak cooling and heating, as such even if the space was a variable air volume (VAV) design it would not modulate due to code requirements for air changes.

The exception to this rule is clinical spaces are allowed to be setback afterhours as long as requirements around relative pressurization and temperature setpoints outline in CSA Z317.2 are achieved. The only way to allow scheduling is through the conversion of zones to a VAV design.

Conversion from CAV to a VAV design within a clinical space is a highly disruptive exercise. As a result, it is recommended that SickKids explore the feasibility to convert zones to an VAV design as spaces are renovated. In general, this would apply to clinics which operate on a schedule and administrative areas. There are operational advantages to implementing VAV systems within 24/7 clinical spaces however the economic savings typically are not significant. As such it is recommended that SickKids focus on the spaces with the greatest economic savings potential.

It is strongly recommended that SickKids establishes a policy that whenever a space is renovated the HVAC system is upgrade to a VAV configuration and the ability to schedule the space is considered within the design process. As noted above non-24-hour spaces will have the greatest energy savings potential however there will be operational advantage to even 24-hour spaces. As such it is recommended that this policy is applied to all spaces being renovated.

### 4.2.3 AHU Renewal

The main hospital has undergone multiple renovations as a result there are AHUs servicing zones which are fundamentally different then at time of construction.

For example, what was patient room may now be an office. AHU operations may have not been updated for the new usage, a patient room requires significantly more air changes per hour then an office, or some clinical spaces require a significantly higher amount of outdoor air then an office. Failure to adjust AHU operations to new space use will result in additional energy consumption and potentially comfort challenges for occupants. Building operations staff and Stantec's experience with past projects have observed these conditions have occurred.

Another concern would be when dis-similar spaces are now serviced by one AHU. An example that was raised by the Building Operations staff was an AHU which services an office and a DI equipment space. The heat load from the DI equipment space is determining the supply air temperature for both spaces. This is resulting the re-heat coils within the office re-heating the cooled air which is resulting in additional energy consumption and occupant comfort challenges.

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Typically, within facilities of this age there will also be zones where AHU operations do not meet current CSA ventilation requirements. Correction of air flow rates to these zones will increase energy consumption and emissions related to the zones.

Correction of AHU zoning and operations can be challenging. For example, reconfiguration of zones would be an intrusive and disruptive process. There is also the potential that new supply ductwork maybe required to achieve current air change rate requirements.

Duct leakage is also challenge within the facility. Duct leakage is due to the age of the duct work and reconfigurations over the years. There are products available that use an aerosol product introduced into the duct work to reseal the duct work. While disruptive this is less so then duct work replacement. It should be noted that if duct work is in very poor condition replacement maybe required instead of using an aerosol product.

It is recommended that SickKids completes an audit to identify problematic zones and develop strategies to address the challenges. The study should also identify if the challenges can be implemented in isolation or if the level of disruption will be sufficient that implementation during a renovation would be required.

### 4.2.4 BAS Upgrades

The BAS for the main hospital is a hybrid design which consists of both DDC and pneumatic components. The front end of the system is DDC while the field level actuators are primarily pneumatic. It is assumed based on the age of the facility there are a limited number of DDC field devices and the large plant equipment like the chillers are DDC controlled.

Pneumatic control technology is an obsolete technology which is no longer available on most new pieces of major equipment. There still are replacement parts and terminal equipment such as VAV boxes with pneumatic controls generally still available, however availability is becoming more limited. From a maintenance perspective ongoing maintenance of pneumatics is also challenging from a labor point of view.

Pneumatics while simple in operation have less control capability when compared to DDC system. This lower level of control translates directly into inefficiencies with respect to both energy and emissions. It should be noted the pending update to CSA Z317.2 includes provisions that hospitals should be equipped with DDC controls instead of pneumatics.

Conversion from pneumatics to DDC can be a complicated and capital-intensive process due to factors like the number of pneumatic control devices within the system, access restrictions to these devices (i.e. in concealed ceilings) and the need for larger equipment removal required to replace pneumatic controller (i.e. removal of radiator to change valve from pneumatic to DDC). As a result, pneumatic to DDC conversion generally occurs through renovation projects and life cycle replacements. The exception is when there are a small number of controllers remaining then there could be a dedicated pneumatic to DDC conversion program.

It is recommended that SickKids implements a policy the pneumatics are replaced with DDC during all renovations and life cycle replacements.

### 4.3 FUTURE UTILITY COSTS UNCERTAINTIES

Canada is a signature to the Paris Accord which requires Canada to be operational net zero emissions by 2050. It should be noted net zero is not gross zero which means some use of fossil fuels will be allowed beyond 2050. At this time all major political parties are committed to Canada's commitment to Net Zero, while they may disagree on the path to Net Zero all are committed to the outcome. This is a common commitment around the globe.

This transition to net zero will have implications on energy costs in the future. While the magnitude of the impact of these changes in cost is unknown it is probable that energy will cost significantly more in the future.

Some of the key unknowns and drivers related to electricity are summarized below:

- Zero emissions power generation is a commitment that the Canadian Federal Government has made. This will involve construction of new generation assets
- Electrification is a global movement meaning the cost of critical materials required for construction of electrical generation assets and electrical distribution are increasing in demand which is also resulting in increased costs
- Electrification in Ontario has resulted in rapid changes in the projected electrical demand within the province. This will necessitate additional generation assets being brought online and improvements in the electrical distribution system

The result of the above factors is a significant capital outlay will be required to meet Ontario's current and future electrical needs. It is unknown if the Provincial government will absorb a portion of these costs directly or through a subsidy to rate payers, but it is very probable electrical rates will increase in the future potentially significantly.

Some key unknowns and drivers related to natural gas are summarized below:

- Natural gas is a global commodity. The ultimate cost is determined by global political and economic factors outside of Canada. As a result, there is potential for swings in the costs of natural gas.
- Currently there is a shift in the historic supply chain for natural gas as Europe shifts the source of their natural gas supply. This may impact the price of natural gas as more expensive production is brought online.
- Canada has enacted a price on carbon. Our current pricing system has the cost of carbon increasing each year, currently the price of carbon until 2030 has been announced by the Federal Government. It is unknown the price of carbon beyond 2030 or how this price of carbon will be enforced in the market. However, it is very probable that the price of carbon will continue to increase to drive transition to net zero
- Low to zero emission fuels such as renewable natural gas and hydrogen will be a critical element in the eventual transition to net zero. To generate these fuels a significant capital outlay will be

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required to develop generation and distribution infrastructure. It is unknown how these costs will be recovered.

- Ontario uses natural gas generators to respond to peaks in our electrical demand. The IESO pathway to net zero includes maintaining these generators but transitioning them to low-to-zero emissions fuels. As a result, the cost of carbon and fossil fuels does have an impact on the price of electricity

The results of the above factors will be there is unknowns' price of natural gas and eventual low to zero emissions fuels in the future. Due these fuels being a commodity there are also potential instability in the price of these fuels which will impact the cost of electricity.

While the potential magnitude of changes in utility costs is unknown it is a risk that should be considered in asset planning. As a result, it is strongly recommended that SickKids consider energy efficiency as key goal and considers the energy savings potential as a key deciding factor in project approvals.

### 4.4 THIRD PARTY FINANCING

The drive to net zero has led to the creation of multiple firms that offer financing to assist organizations with the capital needed for the retrofits needed for the transition to net zero. Many of these firms are part of the Canadian Infrastructure Bank's (CIB) aggregator program.

The CIB is a bank that was created by the Canadian Federal Government to provide funding to organizations for retrofits needed to transition existing buildings to Net Zero. Direct funding from the CIB is geared towards larger scale capital projects. Many organizations and projects will not qualify for direct CIB funding. To solve this issue the aggregator program was created.

In the aggregator program CIB will provide funding to organizations who will assist organizations with retrofit projects that would not qualify for direct CIB funding. The concept is by bundling the saving of all the projects completed by an aggregator the sum will meet the requirements of direct CIB funding and smaller projects will be completed.

There are many firms that are part of the CIB aggregator program each offering a different project execution model.

On one end of the spectrum there are aggregators with models that are very flexible. In this model the client has freedom to select vendors, construction partners, projects and level of service provided to them during the operations period.

On the other end of the spectrum there are aggregators who will assume total ownership of the project and the end client will have minimum input into construction partners and the aggregator will play a significant role during the operations period.

There are also aggregators with programs between these extremes.

It is recommended that if SickKids investigates the third-party financing model that the commercial terms are carefully reviewed, and preference be given to aggregators who give SickKids the most flexibility.

### 4.5 NEXT STEPS

As noted above in reviewing the BAS trend data it was identified that data gaps and data quality made it challenging to determine how energy is used within the main hospital. As a result, energy end-uses for the main hospital were estimated based on higher level review of utility data, assumptions on operations and typical energy end-uses within peer facilities.

It is recommended that SickKids proceeds ahead based on findings of this report with:

- Enabling measures such as BAS, metering and sub-metering
- Lighting upgrades as opportunities present
- Re-commissioning, retro-commissioning and commissioning program

These types of measures are shown to support future analysis or are proven to work in other facilities, as such the business case and scope of work for implementation is commonly understood. This decreases the value of further studies to refine the associated business cases.

For the more capital-intensive measures, more detailed studies are needed to develop a business case to support implementation and define appropriate Scopes of Work.

Within the current market these types of studies are typically based on ASHRAE Energy Audit Standard 211-2018. While the ASHRAE Energy Audit Standard focuses on the entire building, the levels of rigor can be used to define the scope of work for more targeted studies.

Within the ASHRAE 211-2018 there are 3 levels of energy audit efforts. The typical levels of effort are summarized below.

- Level 1: Studies based on observations and analysis is based on typical values. These are the highest level of study and intended as a first step in developing energy and emission management plans. Concepts for energy conservation and emissions reduction are identified and described in general terms. The current study is in alignment and in some respects exceeds the level 1 standard.
- Level 2: Studies are based on more rigorous analysis which includes analysis using commercially available software or spreadsheet calculations which consider weather data. Information is based on site visits and available design and operation information. Calibration of the energy analysis to utility bills is not technically required. Industry best practices include a general comparison of energy analysis results to utility bills. Energy and emission reduction strategies are developed to a concept level of engineering. Further study is required to refine the business case, however Level 2 energy audits complete an initial level of screening.
- Level 3: These are the most detailed studies in level of rigor. Energy analysis will be calibrated to at minimum utility bills. It is common practice to also calibrate to measured data (sub-meter or BAS trend data) for select systems. Energy conservation and emission reduction measures are developed to an early schematic design level. A cost consultant is typically involved to prepare estimates of opinions of probable costs.

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Within the Canadian marketplace the most common energy audit is a level 2 audit with elements of a level 3. Depending on the risk tolerance of an organization, follow-up studies of specific systems more aligned with the Level 3 standard may be completed.

It is recommended that SickKids completes further targeted studies for the following heating, cooling, humidification and ventilation measures that are aligned with the level of rigor are aligned with an ASHRAE Level 2 or 3 energy audit.

- Energy Sharing and Heat Recovery
- Low Carbon DHW heating
- Low Temperature Water Heating Conversion
- Low Carbon District Heating
- Geo-Exchange
- Adiabatic Humidification

It should be noted that the recommended heating, cooling, humidification, and ventilation measures have a large degree of interaction between measures. As such the potential savings from implementing all measures is not the sum of the savings potential from the individual measures. Therefore, it is recommended that bundles of measures are developed and studies are completed to establish a business case for the bundles of measures.

### **4.6 SUMMARY OF INITIATIVES**

A summary of the initiatives and high-level estimates potential energy and GHG saving potential and level of effort is included in Table 4-1.



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**Table 4-1: Summary of Initiatives**

#	Measure	Energy Potential (2024-2029)	GHG Potential (2024-2029)	Effort / Cost	Estimated Completion Year
<b>Campus-wide Initiatives</b>					
	Metering, Sub-Metering and BAS trending	N/A	N/A	TBD	Ongoing, as soon as possible
	Recommissioning & retro-commissioning	4 – 8%	4.5 – 9%	\$0.6 – 1.2 M	Ongoing, as opportunities present
	Energy Sharing and Heat Recovery	3 – 10%	5 – 20%	\$5 – 8M	First, need to study and understand more (paired low carbon DHW heating)
	Low Carbon DHW heating	1 – 3%	6 – 8%	\$3 – 5 M	First, need to study and understand more (paired with energy sharing and heat recovery)
	Adiabatic Humidification	3 – 15%	15 – 30%	10 – 15M	Need to study and understand more
	Low Temperature Water Heating Conversion	8 – 20%	15 – 40%	10 – 15M	Need to study and understand more
	Low Carbon District Heating	0 – 20%	0 – 40%	TBD	Conduct a feasibility assessment
	Geo-Exchange	0 – 20%	0 – 40%	TBD	Conduct a feasibility assessment
<b>Main Hospital Initiatives</b>					
	Lighting Control Upgrade	2–4%	0.1–0.5%		As opportunities present themselves.
	CAV to VAV Conversions	5 – 15%	8 – 20%		renewal/renovations, as opportunities present themselves.
	Airflow and Thermal Comfort Assessment; Duct Refurbishment and Air Distribution Corrections	TBD	TBD		renewal/renovations, as opportunities present themselves.
	BAS Upgrades	TBD	TBD		Ongoing, as opportunities present themselves.
	AHU Replacement: HVAC System Renewals	TBD	TBD		Currently ongoing AMP

### 5.0 CORPORATE LEADERSHIP

Meeting the 2030 and 2050 greenhouse gas (GHG) reduction targets necessitates a dual approach. First, SickKids must implement conservation-focused actions, such as building decarbonization plans. Simultaneously, SickKids must shift internal priorities to embed climate-resilience actions into policies, programs and projects while ensuring the well-being of occupants in indoor spaces. The following best management corporate actions have been identified by staff and subject matter experts.

#### 5.1 INITIATIVES

The following is a list of the proposed corporate initiatives that are discussed in detail in the following sections:

- C1: Complete a Climate Risk and Resilience Assessment
- C2: Update Asset Management Policy and Plans
- C3: Update Purchasing Policy
- C4: Develop an Internal Cost of Carbon Policy
- C5: Install Electric Vehicle (EV) Chargers
- C6: Provide Staff with Active and Sustainable Transportation Options
- C7: Provide More Spaces to Help Staff and Families De-Stress

##### 5.1.1 Complete a Climate Risk and Resilience Assessment

A Climate Risk and Resilience Assessment (CRRRA) involves evaluating SickKids vulnerability to climate-related risks and developing strategies to enhance resilience. This assessment considers the projected changes in the local climate (e.g., changes in temperature, precipitation, etc.) and how might these changes impact to assets, and how might the programs, operations and staff be impacted. By identifying climate related impacts and assessing through the CRRRA, SickKids can then identify resilience measures (design, program, operational and policy) to reduce the consequence's when climate events do occur (e.g., backflow valves to reduce the risk of sewer backups due to intense precipitation, designing building HVAC systems to accommodate a higher range of external temperatures, shading on windows, cool roofs, etc.).

##### 5.1.2 Update Asset Management Policy and Plans

With Ottawa's climate expected to undergo significant changes in the coming decades<sup>6</sup>, it is recommended that SickKids update its Asset Management Policy and Capital Asset Management Plans (CAMP) to include the objective of investing in and upgrading assets to mitigate and adapt to climate change, as part of asset management planning. For example, having de-carbonization plans will align or accelerate end-of-life rehabilitation initiatives for individual building components (e.g., roof, windows, mechanical equipment, etc.).

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<sup>6</sup> Average temperatures will rise by approximately 1.8°C by the 2030s, 3.2°C by the 2050s, and 5.3°C by the 2080s. Precipitation patterns may become wetter overall, with more intense events. While snowfall may decrease, freezing rain and freeze-thaw cycles are expected to increase. The number of days with temperatures exceeding 30°C could reach up to 43 days per year by the 2050s.

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with the expected updates in the CAMPs. This initiative would be implemented after initiative C1 has been completed.

### 5.1.3 Update Purchasing Policy

SickKids has supported the purchase of environmentally friendly products and services in principle and as set out in its Purchasing Policy. However, the policy does not directly prioritize low- to no-GHG emission products and services. It is recommended that in support of this ECDM, SickKids update its Purchasing Policy to prioritize the procurement of goods and services that have a low to no-carbon footprint.

### 5.1.4 Develop an Internal Cost of Carbon Policy

Although the social and environmental benefits of reducing energy and GHG emissions are well established, their recognition or importance in decision making processes are often under-represented. Applying an internal cost of carbon (ICC) allows organizations to better account for these benefits and is a key component to moving an organization towards its energy and GHG reduction targets. To support many of the proposed initiatives in this Plan, it is recommended that SickKids establish an ICC which would be used to calculate the value (expressed as a cost) of GHG emissions associated with capital project decision-making. It is recommended that the policy require that SickKids staff internalize the cost of corporate GHG emissions in their respective budgets and pay into an internal carbon reserve fund that can be used to support climate mitigation and adaptation projects at both the corporate and community level.

While it is simple enough to commit to an ICC policy, establishing the actual cost of carbon is difficult. As there is no true global benchmark, the price of carbon typically can range anywhere between CAN \$1–\$50 per tCO<sub>2</sub>e if the cost is associated with a voluntary or regulatory GHG program, or between CAN \$200–\$400 per tCO<sub>2</sub>e if the cost is based on a more comprehensive assessment of the cost of carbon and its associated damages. While a high ICC of \$400 per tCO<sub>2</sub>e is the preferable route, starting with an ICC that is significantly higher than current provincial policy without adequate education and change management is likely to stall the implementation of the policy. It is therefore recommended that SickKids use Canada's 2030 carbon tax value of \$170/tCO<sub>2</sub>e and increase this value annually by 5-6%.

### 5.1.5 Install Electric Vehicle (EV) Chargers

To encourage the transition to low/no-carbon forms of transportation, there is an opportunity for SickKids to install electric vehicle (EV) charging stations within its parking lots. This would not only support environmental goals, but would also enhance the company's image, employee satisfaction, and overall workplace experience. This initiative would be implemented opportunistically (e.g., major renovations, new construction).

### 5.1.6 Provide Staff With Active and Sustainable Transportation Options

Active transportation and other sustainable transportation options, like electric vehicle car share, e-bikes, virtual meetings, and alternative work arrangements, can play a key role in reducing GHG emissions that occur in the community. SickKids can expand active transportation programs by providing employee transit programs, dis-incentivizing staff parking and providing protected bike parking.

**5.1.7 Provide More Spaces To Help Staff and Families De-Stress**

By designing environments that reduce stress and enhance overall well-being, SickKids staff and patient families can benefit from improved mood, productivity, resilience, and recovery. Wellness rooms, for instance, have shown positive outcomes in health systems.<sup>7</sup> Where there is a major renovation or new construction of a building, the opportunity to incorporate wellness rooms should be considered by staff and designers. Key characteristics of wellness rooms tend to include minimalist aesthetics, soundproof walls and calming colors, the use of natural and adjustable lighting, the incorporation of partitions or screens, comfortable seating, plants, and a small fridge stocked with fruits, vegetables, yogurt, and natural juices. This initiative would be implemented opportunistically (e.g., major renovations, new construction).

**5.2 SUMMARY OF CORPORATE INITIATIVES**

A summary of the corporate initiatives is presented in the following table.

**Table 5-1. Summary of Corporate Initiatives**

Initiative		Carbon Potential: 2024-2050	Effort / Cost	Estimated Completion Year
<b>C1</b>	Complete a Climate Risk and Resilience Assessment	C	Staff Time \$\$	2025
<b>C2</b>	Update Asset Management Policy and Plans	C	Staff Time \$\$	2025/26
<b>C3</b>	Update Purchasing Policy	C	Staff Time \$	2025/26
<b>C4</b>	Develop an Internal Cost of Carbon Policy	C	Staff Time	2025/26
<b>C5</b>	Install Electric Vehicle (EV) Chargers	CCC	Staff Time \$\$	As opportunities present themselves.
<b>C6</b>	Provide Staff With Active and Sustainable Transportation Options	C	Staff Time \$\$	2024
<b>C7</b>	Provide More Spaces To Help Staff and Families De-Stress	C	Staff Time \$\$\$	As opportunities present themselves.
<b>LEGEND</b>				
<b>GHG Emissions:</b> C: Lays the foundation for other efforts, though by itself may not reduce GHG emissions measurably			<b>Financial Resources:</b> \$: \$0–\$25,000 \$\$: \$25,000–\$100,000	

<sup>7</sup> [Health systems create new spaces for employee well-being | Health Facilities Management \(hfmmagazine.com\)](https://www.hfmmagazine.com/health-systems-create-new-spaces-for-employee-well-being/)

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Initiative	Carbon Potential: 2024-2050	Effort / Cost	Estimated Completion Year
CC: Reduces total annual carbon emissions by 0 to 50 tCO <sub>2e</sub> CCC: Reduces total annual carbon emissions by 50 to 500 tCO <sub>2e</sub> CCCC: Reduces total annual carbon emissions by more than 500 tCO <sub>2e</sub>		\$\$\$: Over \$100,000 \$\$\$\$: Over \$1,000,000	

### 6.0 ECDM PLAN IMPLEMENTATION

#### 6.1 GOVERNANCE AND COLLABORATION

The Sustainability Office and Governance Committee currently holds the responsibility of leading the implementation of the ECDM Plan. This responsibility includes:

- Ensuring SickKids meets all energy related regulatory requirements
- Serving as a primary point of contact for all energy related matters
- Generating and distributing reports to Council and Staff
- Monitoring and verification of energy performance
- Promotion of energy education and awareness
- Acting as a resource in the planning, development and implementing of energy efficiency projects

Projects will be implemented on a case-by-case basis and brought forth for senior management's consideration and approval as necessary.

#### 6.2 MONITORING EXISTING & EVALUATING NEW INITIATIVES

This ECDM Plan contains a list of recommended initiatives to be completed over the next five years. Implementing the initiatives requires dedicated resources and systems in place to ensure that the policies, programs, and projects recommended are implemented and tracked so that SickKids's energy and GHG emissions reduction targets are met. The intention of the ECDM Plan is to dovetail energy conservation, energy demand management, and GHG emissions as part of SickKids normal course of business for asset retrofits, renewals and life cycle replacement projects. Success in this endeavor requires incorporating conservation and demand management options at the initial design stages. In so doing, this ensures that options for improving energy efficiency are considered, evaluated, and quantified in terms of life cycle costing analysis, including cost, maintenance, energy, GHG reductions and other co-benefits that may accrue to SickKids. When evaluating future initiatives, a checklist should include the following:

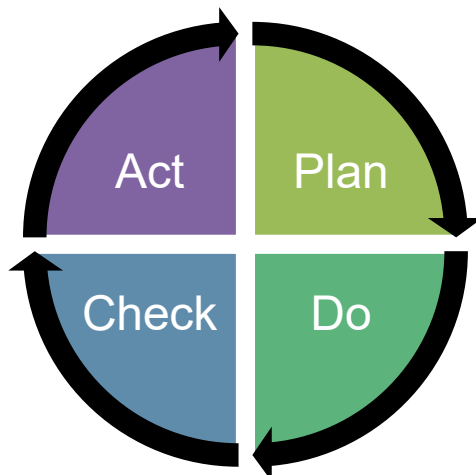
- Project base case
- Energy efficient options
- Project costs (base case vs. energy efficient case)
- Project savings (in terms of energy, maintenance, avoided GHG emissions)
- Maintenance savings
- Financial benefits
- Environmental benefits
- Co-benefits
- Incentives/funding available
- Overall benefits
- Life cycle analysis recommendations

This ECDM Plan will be in place for five years until an update to the ECDM Plan will be initiated as part of the requirements of *O. Reg. 507/18s*. At that point, the initiatives herein will be evaluated in consultation with the various departments, as part of the departmental strategic operations planning process. This will be an opportunity to review and prioritize potential strategies based on resources and emerging technological opportunities.

### 6.3 REPORTING & COMMUNICATION

#### 6.3.1 Monitoring & Reporting

An ongoing feedback loop, known as the Deming Cycle, facilitates continuous improvement and can be used to facilitate the continuous improvement of the ECDM Plan ensuring that it remains as a living document. Moving forward, making progress towards SickKids's energy and GHG reduction targets, GHG emission forecasts, and the priority of the initiatives will be regularly reassessed and refined. The four components of the Deming Cycle, shown below in Figure 10, are “plan, do, check and act.” A run through the plan-do-check-act cycle should occur on an annual basis and should coincide with SickKids's annual budget cycle for planning each year's capital and operating budgets.



**Figure 10. The Deming Cycle (Plan-Do-Check-Act)**

A monitoring framework provides SickKids with a task list of items to track that will help re-assess the effectiveness of ECDM Plan initiatives, GHG emissions, and other activities contained within the ECDM Plan over time (the “check” components of the cycle). Monitoring includes two components. The first is the monitoring of the ECDM Plan initiatives - what is being done, who is doing it, is the activity funded, etc. The second component is the compilation of the energy and GHG emissions inventory to monitor the success of the ECDM Plan initiatives. Tracking, measuring, and sharing progress towards the GHG emission reduction targets and the initiatives identified in the ECDM Plan is essential to maintaining momentum for change. The success of the ECDM Plan will be measured by the results achieved relative to prior reporting years.

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On an annual basis, it is recommended that an energy and GHG emissions report be prepared, which should include at a minimum:

- Current energy and GHG emissions profile in aggregate and broken down by asset.
- Change in energy and GHG emissions from the prior year and the baseline.
- Follow up actions from the prior year's report.
- A description of the work that has been completed.
- Extent to which GHG emissions reduction have been met.
- Identification of any issues or challenges faced in advancing each initiative.
- An indication of progress toward achieving each initiative, using the following scale:
- Not Started: The initiative has not been implemented.
- On Track: The initiative has been implemented. For various initiatives, progress will be measured through quantitative and qualitative primary indicators (Table 6-1) and secondary indicators (as identified).
- Outstanding: An issue, barrier and/or challenge is prohibiting the initiative from being implemented.
- Delayed: The initiative has been delayed or placed on hold.
- Completed: The initiative has been completed.
- List of new initiatives to address issues, barriers, and challenges.
- Timing and assigned responsibilities of the initiatives.

**Table 6-1. ECDM Plan Key Performance Indicators**

Key Performance Indicator (KPI)	Measurement
Building Energy Intensity	Energy use per unit area
Building Emissions Intensity	Greenhouse gas emissions per unit area
Building Energy Cost Intensity	\$ per unit area

The implementation of the ECDM Plan (the “plan and do” components of the cycle) will require the formulation of an annual work plan to define what actions are undertaken annually. To aid in successful implementation, the annual work plan should tie into departmental business plans and budgets to ensure responsibilities and resources are allocated accordingly. Progress will be reported to identified stakeholders, as noted in the following section.

### 6.4 COMMUNICATION STRATEGY

The overall goal of the communication strategy is to outline tools and techniques to assist SickKids with ongoing internal communication about the ECDM Plan, including implementation and progress towards the targets. The communication strategy is focused on internal communication for SickKids staff and council and is not designed to be public. The key objectives of the strategy are:

- To communicate the presence and importance of the ECDM Plan



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- To share progress towards the GHG emission reduction targets
- To motivate multiple audiences about what they can do to reduce SickKids’s energy use and GHG emissions
- To communicate coming changes in business practices to support the ongoing implementation of the ECDM Plan

### 6.4.1 Communication Tactics

The communications strategy includes a series of strategic tactics (Table 6-2).

**Table 6-2. Suggested Communication Tactics**

Tactic	Description/Rationale
Host quarterly ECDM Plan Meetings	<p>The intent of these meetings is to:</p> <ul style="list-style-type: none"> <li>• Share best practices between departments</li> <li>• Provide status/progress updates on Energy conservation and GHG emission reduction strategies across all departments</li> <li>• Prioritize work</li> <li>• Share funding opportunities</li> <li>• Collaborate on shared initiatives that flow into annual work plans and budgets.</li> </ul> <p>Once a year the team will review the ECDM Plan and progress towards its goals.</p>
Develop an annual corporate Energy and GHG Emissions Progress Report	<p>The Environmental Initiatives Division will gather information from all departments, and report annually on energy and GHG emissions. They will also ensure the development of a one-page, graphic summary document which can be used to communicate results with a wide range of audiences including internal staff and Council.</p>
Increase awareness of the ECDM Plan and implement general energy skills training for all staff	<p>Develop (or adopt) a stand-alone webinar that would be suitable for all SickKids staff. The webinar could cover:</p> <ul style="list-style-type: none"> <li>• The presence of the ECDM Plan</li> <li>• The role of all staff members in contributing to energy conservation and GHG emission reductions</li> <li>• Easy tips and reminders for every day corporate energy conservation and GHG emission reductions</li> </ul>
Work to integrate key messaging into existing communications	<p>Work alongside Human Resources to share tips and reminders about energy conservation and GHG emission reductions with all staff.</p>
Create (and publicize) a “Bright Lights” program	<p>Create a staff-based program to celebrate success. Suggest working with the Human Resources to develop a staff recognition program. This could include:</p> <ul style="list-style-type: none"> <li>• Seeking nominations for staff that have made a difference with energy efficiency</li> <li>• Developing short vignettes</li> <li>• Circulating stories and photos</li> </ul>

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Tactic	Description/Rationale
Facilitate open lines of communication	Ensure that staff across the organization have knowledge of, and access to an ECDM Plan information-sharing portal. This portal might be used to: <ul style="list-style-type: none"> <li>• Share innovative ideas</li> <li>• Identify areas of concern</li> <li>• Provide feedback or solutions</li> </ul>

### 6.4.2 Recommendations

The following table includes supporting details for each of the tactics.

**Table 6-3. Timing and Responsibility of Suggested Communication Tactics**

Tactic	Audiences	Level of Effort				Timing
		Very Low	Low	Med	High	
Host quarterly ECDM Plan Meetings	Senior leaders, representing key departments					Quarterly, Ongoing
Develop an annual corporate Energy and GHG Emissions Progress Report	Council All staff					Annually
Increase awareness of the ECDM Plan and implement general energy skills training for all staff	All staff					End of Year Two
Work to integrate key messaging into existing communications	All staff					End of Year One
Create (and publicize) a “Bright Lights” program	All staff					End of Year One
Facilitate open lines of communication	All staff					End of Year One

# **ENERGY CONSERVATION & DEMAND MANAGEMENT PLAN**

Appendix A Emission Factors

## **APPENDIX**

## Appendix A EMISSION FACTORS

Steam GHG Emission Factor: 73.8 gCO<sub>2e</sub>/lb

Ontario’s grid electricity emission factor:

<b>Ontario Grid Emission Factor</b> (t CO <sub>2e</sub> /GWh)	
2013	64
2014	35.3
2015	41.6
2016	35.9
2017	16.4
2018	25.6
2019	25
2020	25.8
2021	26.2
2022	26.2
2023	26.2

Notes: The electricity grid intensities are calculated from Canada’s greenhouse gas and air pollutant emissions projections (<https://publications.gc.ca/site/fra/9.866115/publication.html>).

