



Net Zero Transition Program

Final Report

TO Live

June 4, 2024

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Executive Summary



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Executive Summary

TO Live engaged KPMG LLP (“KPMG”) to develop recommendations for a net zero transition program for their Meridian Hall (“MH”) and Meridian Art’s Centre (“MAC”) theatres to address Scope 1 and 2 emissions, as well as specific Scope 3 emissions material to their operations. KPMG was supported by the engineering consultancy Rathco ENG (“Rathco”). This report presents TO Live’s baseline emissions, proposed targets, recommended decarbonization initiatives, and a potential roadmap to achieve targets. These targets are in alignment with the City of Toronto’s broader climate objectives of reaching net zero within Scopes 1 and 2 by 2040 under its TransformTO initiative.

This report presents our findings, which are based on the following:

- Engagement with more than 10+ internal stakeholders, including TO Live Project and Senior Leadership, building operations staff, and the City of Toronto’s Environment and Climate Division;
- Engagement with more than 10+ external stakeholders which included Hariri Pontarini Architects, Enwave Energy Corporation, Noventa Energy, and the Calgary Arts Common Centre; and,
- A review of over 100+ documents and drawings, as well as 75+ energy consumption utility datasets of TO Live’s MH and MAC theatres.

Additional background information on the report, including our approach, is included in Appendix A.

¹ STLC was excluded from our scope of work due to its ongoing redevelopment.

² Scope 1 emissions refer to direct greenhouse gas emissions from sources owned or controlled by an organization, while Scope 2 emissions refer to indirect emissions from the consumption of purchased electricity, steam, heating and cooling.

³ Scope 3 emissions refer to all other indirect greenhouse gas emissions that occur in a company’s value chain, including both upstream and downstream activities, such as water usage, waste disposal and purchased goods and services. In the case of this work, Scope 3 emissions were limited to purchased goods and services, waste and water.

Project Background

The primary objectives of our work were the following, and related to MH and MAC, but excluding the St. Lawrence Centre for the Arts (“STLC”):¹

1. Propose a quantification process for baselining emissions and establishing performance metrics for TO Live’s operations and individual facilities;
2. Provide recommendations on a transition plan to reach net zero by 2040; and,
3. Suggest potential initial steps to implement the Net Zero Transition Plan.

Current Baseline

TO Live’s 2023 Scope 1 and 2² emissions baseline were calculated by TO Live based on guidance provided by KPMG regarding calculation methodologies. It consists of the following sources, in order of their magnitude:

- Purchased steam (443 tCO_{2e}): Emissions from providing heating at MH;
- Natural gas (253 tCO_{2e}): Emissions from providing heating at MAC and cooking in MH;
- Purchased electricity (115 tCO_{2e}): Emissions from utilizing lighting, power HVAC systems and any equipment (e.g., computers) requiring electricity;
- Diesel usage (0.2 tCO_{2e}): Emissions produced by backup diesel generators for additional energy needs; and,
- Refrigerants (0 tCO_{2e}): There were no reported emissions produced from refrigerant leakages from air conditioning units.

Overall, TO Live’s 2023 Scope 1 and 2 baseline emissions are estimated at 811 tCO_{2e}.

For information on TO Live’s Scope 3³ baseline emissions, please refer to Appendix A.



Executive Summary

Performance Targets

Overall, KPMG recommended targets that align with the City of Toronto's broader climate goals outlined in TransformTO^{4,5}, which include the following:

- Energy consumption targets:
 - Interim 2030: Greenhouse gas emissions from City-owned buildings are reduced by 60 percent from 2008 levels; based on 2023 readings, this would result in an emissions profile of **324.4 tCO₂e** for TO Live.
 - Interim 2030: 50% consumed from renewable and low-carbon sources;
 - Long-term 2040: 100% consumed from renewable and low-carbon sources
- Purchased goods and services targets:
 - Interim 2030: 25% reduction in food procurement emissions.

Pathways Assessed

To reach net zero, while there are many options, we identified three main pathways of altering energy consumption at the two in-scope facilities: two for Meridian Hall, and one for the Meridian Art Centre. These pathways are complemented by installing solar PV and high efficiency chillers at both sites. A summary of the pathways are as follows:

- Meridian Hall:
 - Pathway #1: Retain the existing steam system and pursue fuel switching through technology such as air source heat pumps (ASHP); and,

- Pathway #2: Convert the steam system to hot water and pursue fuel switching.
- Meridian Art Centre:
 - Pathway: pursue fuel switching from the existing natural gas heating system.

Scenarios Development

From these pathways, 24+ technologies were analyzed and shortlisted down to six scenarios: four for Meridian Hall, and two for the Meridian Art Centre.

In developing the six scenarios, the range of low carbon technologies evaluated and included was influenced by technical feasibility, cost, control, and space constraints. The approach to shortlisting involved assessing each technology based on these criteria, ensuring they met our low carbon goals, were cost-effective, could be managed independently by TO Live, and fit within facility spatial limitations.

Achieving TO Live's net zero goals involves shifting the energy load to electricity, but due to space constraints and feasibility, onsite electricity generation is limited, making offsite generation essential. The current grid's carbon intensity is beyond TO Live's control, so the scenarios include some dependance on grid decarbonization policies and TO Live's ability to secure renewable energy contracts (e.g., through a Power Purchase Agreement) or carbon credits. The additional costs of renewable contracts and/or credits are estimated and included in this report.

⁴ City of Toronto (November, 2021). Transform TO Net Zero Strategy – A Climate Action Pathway to 2030 and Beyond.

⁵ City of Toronto (n.d.). Short-Term Implementation Plan for 2022-2025.

Executive Summary

Preferred Scenario

Based on a review of 6 combination scenarios within the pathways available, the scenarios scoring the highest in our evaluation and reach net zero for both facilities are the following:

- Meridian Hall: Scenario #3 – Steam to Hot Water + Wastewater Energy Exchange (WEE)
- Meridian Art Centre: Scenario #2 – Heat Recovery Chillers (HRC)

Scenario #3 in the Meridian Hall will reduce ~85% of the total emissions whereas Scenario #2 in Meridian Arts Centre will help reduce ~74% of the total emissions. Any residual emissions can be offset by purchasing offset credits to achieve the net zero target. The chosen scenarios in MH and MAC have a CAPEX of ~\$42M and ~\$5M, and an OPEX of ~\$0.32M and ~\$0.39M, respectively.

Roadmap Development

To implement the preferred scenarios, we recommend TO Live undertake the following actions in the short, medium, and long-term.

- Obtain budget approval and initiate the feasibility study;
- Initiate equipment procurement process and removals of existing equipment;
- Plan design, and complete auxiliary services such as sewer connection, piping connection, electrical upgrade, etc.; and,
- Install and commission new equipment.

TO Live can combine the work for both Meridian Hall and Meridian Arts Centre to minimize the administrative efforts. The removals could be strategically planned in the June – July 2026 window during the FIFA World Cup, as less events and programs were already expected at Meridian Hall during that timeframe.

Additional information on the optimal time periods for a construction shutdown (based on feedback from TO Live) as well as the cost implications to TO Live's 10-year capital plan can be found in Section 5 of this report.

Decarbonization Scenario Overview

Below are the scenarios modelled for both the facilities in terms of emissions reduction potential. Note that in all cases, there is a residual amount of emissions due to the current level of carbon intensity in the electrical grid. Per federal⁶ mandates for net zero grid emissions by 2035 and provincial⁷ mandates by 2050, it is expected that this carbon intensity will be significantly reduced – however, to account for any delays, we have put forth calculations that include offset credits being purchased to fully reach net zero emissions (refer to Section 3).

Figure 1: Meridian Hall – Decarbonization Scenarios Modelled

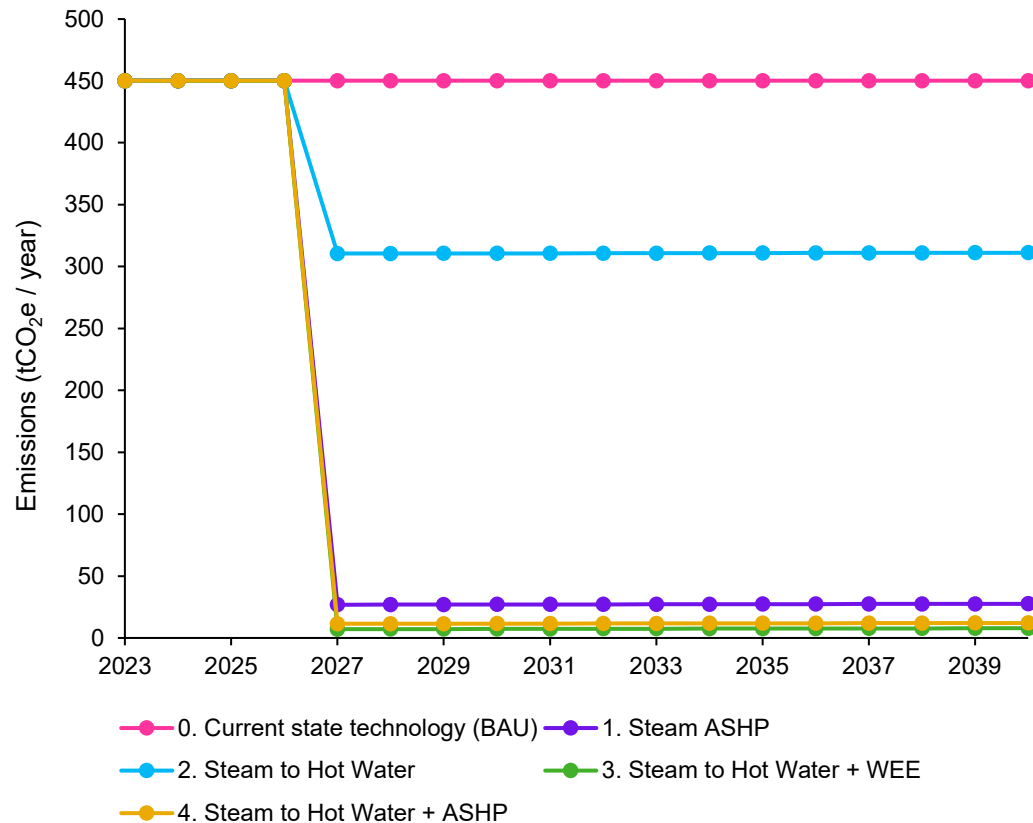
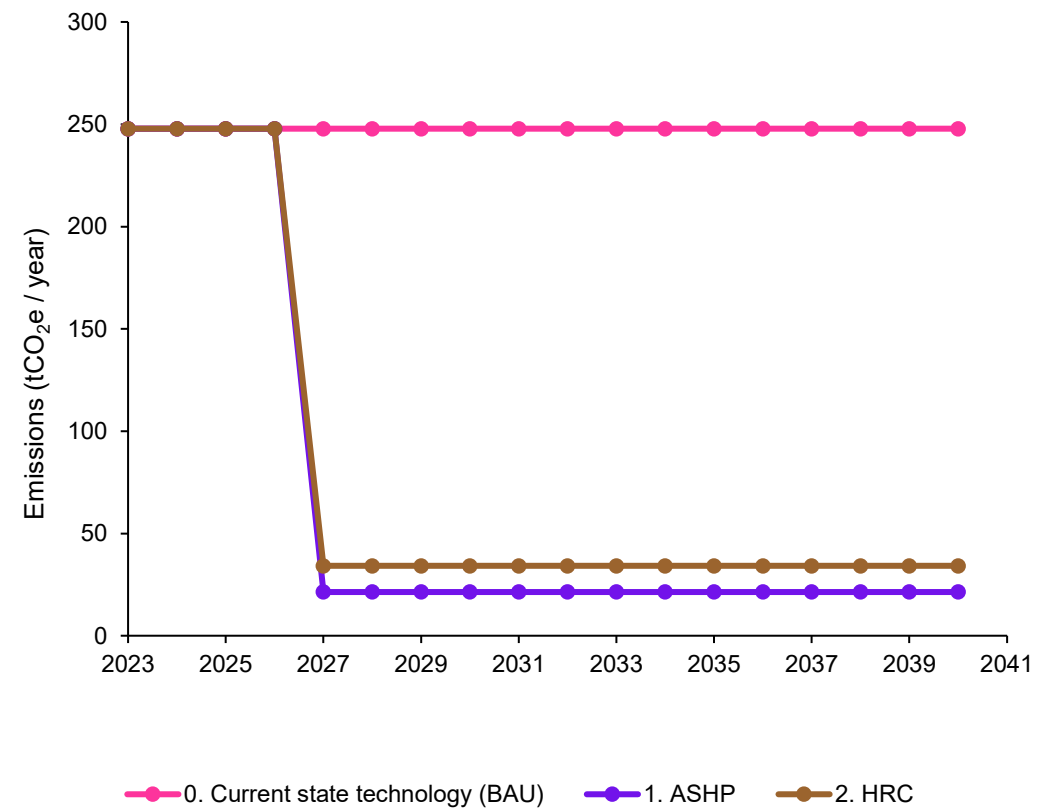


Figure 2: Meridian Art Centre – Decarbonization Scenarios Modelled



⁶ Government of Canada (August 2023). Powering Canada Forward

⁷ Government of Ontario (n.d.). Ontario's Plan for a Clean Energy Future.

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Strategy Development



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Strategy Development

The developed strategy focuses on achieving emission reductions by decarbonization initiatives, rather than measures related to energy efficiency. This approach is informed by the unique energy consumption pattern of TO Live's facilities, which is closely linked to the event schedules.

With a low baseload energy demand but high consumption during performances, emissions are less dependent on the physical attributes of the buildings, such as insulation or façades. In addition, while energy efficiency initiatives can reduce overall energy consumption, they do not lead to a reduction in the carbon intensity of the energy source itself. Therefore, for TO Live to achieve its decarbonization goals, this strategy recognizes that reducing energy demand is only part of the solution and that addressing the emissions intensity of the supplied energy is critical to reaching net zero

Below, we outline the resources used to inform the strategy's development.

Document and data review

As part of the work, we reviewed a total of over 175+ individual pieces of data and documents, which included the following:

- Utility bills;
- Building condition assessments;
- Prior energy modelling reports;
- MH / MAC schematics, blueprints, and technical drawings;
- 10-year capital planning budget; and,
- City of Toronto's TransformTO strategy.

Site visits

We conducted two site visits, attending MAC on April 2nd, 2024 and MH on April 9th, 2024. The visits provided KPMG and Rathco Eng with an opportunity to review facility operations, as well as understand any limitations (e.g., spatial) that may impact implementing specific decarbonization technologies.

Stakeholder Engagement

We completed 25+ hours of stakeholder meetings to understand appetite for specific changes to the facilities. Stakeholders engaged included the following:

- TO Live Project Leadership;
- TO Live Senior Leadership;
- TO Live building operators;
- Architectural consultants;
- City of Toronto Divisions;
- Utility providers; and,
- Operators in peer venue facilities.

As a output from stakeholder engagement, the requirement to lower or maintain operating costs at current levels was identified as a key criteria for prioritizing scenarios.

Energy and Financial Modelling

We completed modelling of selected decarbonization technologies to further inform the evaluation of various initiatives, from a financial and emissions reduction perspective.



2.1

Target Setting



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Performance Targets and Metrics

Overview

The City of Toronto adopted the TransformTO Net Zero Strategy in December 2021, which focuses on achieving net zero Scope 1 and Scope 2 GHG emissions community-wide by 2040.^{8,9} TO Live, an agency of the City, is required to adhere to the City of Toronto's net zero targets as well as broader approach in establishing itself as a leader in addressing climate-related issues and supporting welfare of the community.

Performance targets

In line with TransformTO, TO Live is considering setting interim and 2040 targets for various sources of energy, as well as food procurement. The interim targets emphasize that work that needs to be done immediately to achieve the proposed long-term net zero target.

In TransformTO, the City of Toronto identified ~30 actions to be taken immediately to support the transition to net zero. These actions are categorized under 10 broader categories, and have been evaluated for their potential impact and relevance for inclusion into TO Live's strategy.

Relevant implementation actions for TO Live to consider in its undertaking of a net zero transition strategy are summarized in Table 1.

Table 1: Performance Targets relevant to TO Live

Actions for implementation between 2030	
Categories of identified actions	Lead by Example – Corporate emissions are reduced by 60 per cent over 2008 base year, by 2030. This would result in an emissions profile of 324.4 tCO₂e for TO Live.
	Greenhouse gas emissions from existing buildings are cut in half, from 2008 levels, by 2030. See the above example for the overriding emissions target requirement.
	All City-owned facilities have achieved zero waste
	50 per cent of community-wide energy comes from renewable or low-carbon sources & 25 per cent of commercial and industrial floor area is connected to low carbon thermal energy sources, by 2030. This would require 1960 MWh of renewable energy for TO Live
	100 per cent of new buildings are designed and built to be near zero greenhouse gas emissions, by 2030. This would apply to any redevelopment of the St. Lawrence Centre for the Arts.
	Develop and implement strategies to improve greenspace infrastructure to build climate resilience
	Ensure equitable implementation and ongoing improvement of engagement and reporting
Identify pathways to more sustainable consumption in City of Toronto operations and in Toronto's economy	

⁸ City of Toronto (November, 2021). Transform TO Net Zero Strategy – A Climate Action Pathway to 2030 and Beyond.

⁹ City of Toronto (n.d.). Short-Term Implementation Plan for 2022-2025.

2.2

Emissions Baseline



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Scope 1 & 2 – Emission Baseline

Introduction

The following section provides an overview of TO Live’s Scope 1 and 2 emissions. For Scope 3 emissions analysis, refer to Appendix A.

The selected year for TO Live’s emissions baseline is 2023. Figure 3 outlines the emission sources included in the Scope 1 and 2 baseline. To quantify the Scope 1 and 2 baseline, TO Live multiplied its energy usage data (drawn from relevant utility data) by corresponding emission factors. The methodology for quantification is in-line with guidance from the GHG Protocol.¹⁰

Emissions baseline

The estimated 2023 Scope 1 and 2 emissions for MH and MAC are 519.4 and 291.6 tCO₂e, respectively. Key takeaways from the emissions baseline are summarized on the next page.

Sources of emissions for MH and MAC are identified on pages 16 and 17.

Data quality

TO Live’s Scope 1 and 2 baseline utilized actual energy billing to gather electricity, natural gas and steam usage. Data quality used to quantify its emissions baseline was appropriate and did not require any proxies or extrapolations. Emission factors for various fuels were sourced from credible organizations such as the Government of Canada and the US Environmental Protection Agency.

Figure 3: Scope 1 and 2 Emissions Profile for MH & MAC

		Meridian Hall	Meridian Arts Centre
Scope 1 and 2 Emission Sources		Natural Gas	 Natural Gas
		Electricity	 Electricity
		Steam	 Diesel
		Diesel	 Refrigerants
		Refrigerants	

¹⁰ GHG Protocol (n.d.). A Corporate Accounting and Reporting Standard.

Baseline – Key Takeaways for both MC and MAC



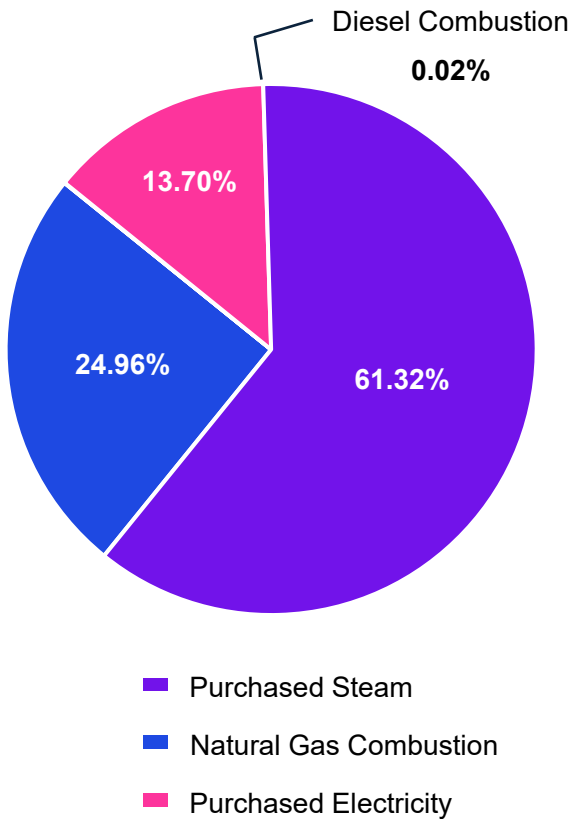
Key takeaways

- **MH:** Steam is a major source of emissions for MH as the facility uses steam from Enwave Corporation for its domestic (i.e. commercial) hot water (DHW) and space heating needs as per Table 1 and Figure 4.
- **MAC:** Natural gas is a major source of emissions for MAC as the facility uses natural gas boilers for its DHW and space heating needs.
- **Both** the facilities rarely use diesel for power backup.
- **Both:** No refrigerant leakages were observed in either of the facilities; hence, there were no identified emissions from refrigeration.
- **Both:** A relatively low carbon-intensity electricity grid of Ontario accounts for significantly reduced emissions from electricity.

Table 2: Scope 1 and 2 Emissions Baseline

Location	2023 Facility Emissions (tCO ₂ e)					Total
	Natural Gas	Electricity	Steam	Diesel	Refrigeration	
Meridian Hall	8.8	67.5	442.9	0.2	0	519.4
Meridian Arts Centre	243.7	47.9	0	0	0	291.6

Figure 4: Scope 1 and 2 Emissions Baseline (for MH & MAC)



Meridian Hall Overview

Overview

Most of MH’s emissions come from space heating utilizing steam, followed by electricity.

The facility utilizes a hybrid energy distribution system with the following characteristics:

- Space heating is distributed to terminal units via steam and hot water piping;
- DHW is provided by steam-to-hot water heat exchanger in winter and cooler months, and a dedicated vertical tank heater in the summer;
- Auxiliary heating is provided by cabinet, baseboard, and unit heaters; and,
- Chiller provides space cooling, with heat rejection through cooling towers

Emissions profile

The facility has almost 85% of its emissions coming from purchased steam followed by about 13% from purchased electricity. Emissions associated with natural gas use are from ovens utilized for cooking purposes in kitchens.

Emissions in scope

This study primarily targets the reduction of emissions from thermal energy, as it presents the most significant opportunity. The annual emissions calculated from thermal sources amount to 450 tCO₂e.

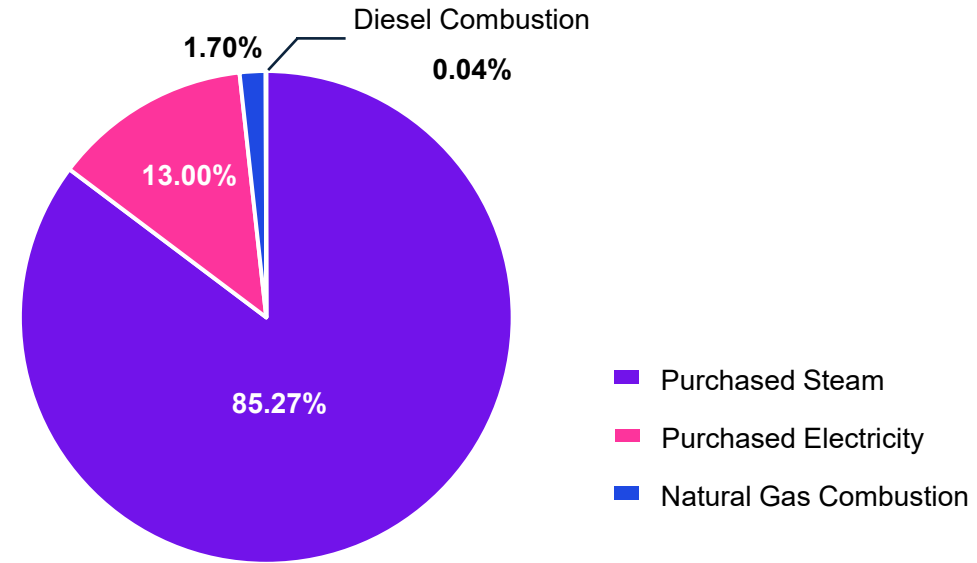
Table 2: Thermal sources at Meridian Hall

Facility	Domestic Hot Water	Space Heating	Cooling
Meridian Hall	Steam, Electric Resistance	Steam	Chiller + Cooling Tower

Table 3: In scope - baseline energy and emissions for the thermal systems at Meridian Hall

Energy Source	Consumption (MWh / year)	Emissions (tCO ₂ e / year)
Electricity	279	8.0
Steam	2,156	442.1
Total	2,436	450.1

Figure 5: Meridian Hall’s Scope 1 and 2 Emissions



Meridian Arts Center Overview

Overview

Most of MAC’s emissions come from space heating utilizing natural gas, followed by electricity.

The facility utilizes a hybrid energy distribution system with the following characteristics:

- Three natural gas boilers provide heating;
- Heating hot water is circulated through the heating loop via pumps;
- Heating and cooling are provided by indoor air handling units (AHUs) equipped with hot water (HW) or chilled water (CHW) cooling;
- Auxiliary heating is provided by hydronic cabinet unit, baseboard, and unit heaters;
- Two chillers provide space cooling, with heat rejection through cooling towers; and,
- Domestic hot water is provided by three separate gas-fired instantaneous type heaters located in the basement level chiller and boiler room.

Emissions profile

The facility has almost 85% of its emissions coming from natural gas followed by about 16% from purchased electricity.

Emissions in scope

Similar to MH, the annual emissions calculated from thermal sources amount to 248 tCO₂e.

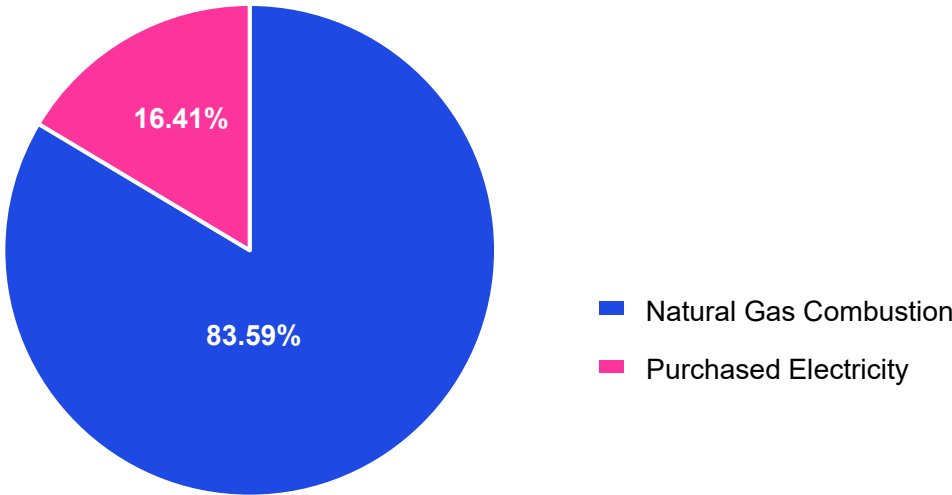
Table 5: Thermal sources at Meridian Hall

Facility	Domestic Hot Water	Space Heating	Cooling
Meridian Arts Centre	DHW boiler	Space heating boiler	Chiller + Cooling Tower

Table 6: In scope - baseline energy and emissions for the thermal systems at Meridian Arts Centre

Energy Source	Consumption (MWh / year)	Emissions (tCO ₂ e / year)
Electricity	153	4.4
Natural Gas	1,331	243.5
Total	1,484	247.9

Figure 5: Meridian Arts Centre’s Scope 1 and 2 Emissions



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Transition Planning



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3.1

Pathways Assessed



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Decarbonization Pathways – Methodology (1/3)

Decarbonizing MH and MAC requires shifting towards thermal systems with a lower carbon intensity, combined with implementing energy efficiency measures. Below, we outline the pathways and fuel switching technologies assessed to complete this shift, how we determined their reasoning for inclusion, and how they were assessed, as well as discussion related to options that were excluded and the reasoning behind that move.

Meridian Hall

Pathway #1 - Retain the existing steam system and pursue fuel switching

Measure 1: Retain the steam system, make efficiency, and control changes to the system and invest in a steam generating air source heat pump (ASHP). Electric boiler backup to be provided.

An ASHP is an alternative for the current steam-dependent system, allowing for thorough decarbonization as backup/peak heating will be provided by an electric boiler. This pathway allows for the use of an efficient technology that produces steam, which would be critical in maintaining the existing piping of the building. This pathway will also allow for a potential deployment of a green steam solution in the future if Enwave is able to provide this solution as part of its own 2030 goals.

Assessment approach:

The federal government has a decarbonization plan for 2040, and although not mandatory, following Canada's plan can yield tax discounts for green technologies. As the carbon tax also increases quickly, electrification of heating has become more cost-competitive over the lifetime of a project.

Without commitments or a clear plan on Enwave's decarbonization pathway, we assumed the Enwave steam connection would be decommissioned, and the existing in-building steam heating distribution system would be connected to steam ASHPs and steam electric boilers. These technologies were deemed to be the only cost competitive

and realistic low carbon solutions for the site that could provide steam heating.

An alternative option considered included biomass boilers. However, biomass was ruled out due to the large space requirements and the challenges associated with the location as regular fuel deliveries would be required via truck.

Pathway #2 - Convert the steam system to hot water and pursue fuel switching

Measure 2: Steam to hot water conversion, with Enwave still providing steam and TO Live converting it to hot water on-site

Although still dependent on Enwave's steam, this measure would be a first step to decarbonization. Electricity-dependent technologies (such as heat pumps and electric boilers) produce hot water more easily and efficiently than steam. Furthermore, there are energy savings associated with hot water heating compared to steam due to better heat transfer and fewer losses. In this scenario, the Enwave steam system provides nearly all of the building's heating through a steam-to-hot water heat exchanger and assumes decarbonization of the Enwave system will occur further down the line. This system sees a reduction in the use of Enwave steam due to efficiency improvements while retaining the steam piping network to a degree.

Measure 3: Steam to hot water conversion & wastewater energy exchange

By lowering the temperature of the steam to hot water conversion system, the wastewater energy exchange scenario becomes competitive. A potential wastewater source was identified for this technology near the Meridian Hall site, which can provide over 5 MW of heating during certain times of the year. However, there are likely significant coordination and design challenges to access and connect to the sewer infrastructure.

Decarbonization Pathways – Methodology (2/3)

Meridian Hall (Continued)

Measure 4: Steam to hot water conversion & Air Source Heat Pumps

Air-source heat pumps (ASHP) are a common way to decarbonize heating through electrification. Industry advancements have led to efficiency increases, and this technology is becoming more cost competitive as the federal government has introduced the Clean Technology Investment Tax Credit. This scenario requires less infrastructure than the wastewater case. Electric boilers are also expected to provide peak heating. The site possesses enough rooftop area to take some of the units, however we note that the structural integrity of the roof has not been assessed as part of this work. We estimate that 5000 m² of space would be required on the roof – however, a detailed design study would be required to calculate the area more accurately.

Measure 5: A high-level solar assessment will also be conducted at this site.

Meridian Hall has a large rooftop with space available for solar PV. Toronto is exposed to a great deal of sunlight year-round and there are tax incentives for solar PV. Some shading at this site is expected, though not quantified, and the structural integrity of the roof has not been assessed as part of this work.

Measure 6: A heat recovery chiller will be assessed for as a potential addition to the system.

A heat recovery chiller (HRC) can transfer heat efficiently from a cooling system to a heating system. Meridian Hall has a server room/walk-in cooler that works year-round, so there is an opportunity for utilizing this technology given the simultaneity of the heating and cooling loads during the winter. Heat can be transferred from the server room/cooler to the venue environment. This technology alone cannot meet the decarbonization goals

for the building and must be paired with other strategies. This technology is assumed to produce hot water, and therefore should not be paired with the steam system.

Assessment approach:

The technologies assessed in this pathway were mainly selected based on the potential to be dependable sources of building heating decarbonization and generate savings through the length of the project. These technologies have a track record of decarbonization capabilities and have been implemented in projects across Ontario. The location of the source of wastewater energy also facilitated the choice of such technology, which was not present at MAC.

We assumed the Enwave steam connection would be decommissioned for Measures 3 through 6. In addition, the existing in-building steam heating distribution system would be decommissioned and replaced with a hot water system. ASHPs, wastewater energy exchange, HRCs, and electric boilers were selected as the viable technology options as these technologies were deemed to be the only cost competitive and realistic low carbon solutions for the site.

Alternate options considered included biomass boilers. Biomass was not included due to the large space requirements and the challenges associated with the location as regular fuel deliveries would be required via truck.

Decarbonization Pathways – Methodology (3/3)

Meridian Arts Centre

Pathway #1

Measure 1: Fuel Switching to Biomass Boilers

The biomass option is very attractive in terms of reducing carbon footprint – its emissions factor is generally lower than the electricity grid, depending on the fuel source. There are also federal incentives to help reduce upfront costs for biomass boilers through the proposed investment tax credit. It can be cost competitive depending on the fuel source. However, after assessing this site, we did not recommend this scenario as there is unlikely to be space available for a large biomass plant and fuel storage silo.

Measure 2: Electrification of Heat Energy using Air Source Heat pumps

Air-source heat pumps (ASHP) are a common way to decarbonize heating through electrification. Industry advancements have led to efficiency increases, and this technology is becoming more cost competitive the federal government has introduced the Clean Technology Investment Tax Credit. Electric boilers are to provide peak heating. The site possesses enough rooftop area to take some of the units, however the structural integrity of the roof has not been assessed as part of this work. Pending a detailed design study, we estimate that 3500 m² of space would be required on the roof.

Measure 3: Electrification using Heat Recovery Chillers and Electric Boilers

Although not as advantageous, in theory, as detailed in the Meridian Hall section, HRCs can yield significant decarbonization help to MAC – fall/spring seasons usually require lots of heating and cooling loads simultaneously, and the use of an HRC can help provide clean and efficient heating (and cooling) during these times. The HRC can only provide a small portion of annual heating and DHW heating, so this technology alone cannot meet the decarbonization goals for the building and must be paired with other strategies. Electric boilers are to provide peak heating.

Measure 4: A high-level solar + façade assessment

Meridian Arts Centre has a large rooftop with some space available for solar PV. Toronto is exposed to a great deal of sunlight year-round and there are tax incentives for solar PV. Some shading at this site is expected, but has not been quantified, and the structural integrity of the roof has not been assessed as part of this work. The west-side of the building has a wall with direct sunlight exposure that could potentially implement a solar façade upgrade to produce additional electricity – this side of the building was selected.

Assessment approach

The technologies assessed here were mainly selected based on its potential to be a dependable source of building energy decarbonization and that could generate savings through the length of the project. These technologies have a track record of decarbonization capabilities and have been implemented in big projects across Ontario. There is a likely a better opportunity for solar for this one based on the orientation and the smaller degree of shading in comparison to MH.

Alternate options considered included wastewater energy exchange and heat recovery from the TTC. Wastewater energy exchange was not included because there was no large energy wastewater resource nearby. Heat recovery from the TTC was not included due to the infrastructure and coordination complexities and distance from the connection.

Pathways excluded:

Renewable Natural Gas (RNG) - Steam boilers using RNG would require a natural gas supply to sites and supporting infrastructure. In addition, combustion of natural gas requires a stack and reduces local air quality due to the on-site emissions. RNG costs are typically much higher than natural gas and would therefore lead to high heating costs

Geo-exchange – space requirements are too extensive to be viable at either site.

Electric Boilers – Although it has a low capital cost, their efficiencies are much lower compared to ASHP and would require significantly more electrical infrastructure upgrades.

Decarbonization Pathways – Summary (1/2)

Decarbonizing MH and MAC requires shifting towards thermal systems with a lower carbon intensity, combined with implementing energy efficiency measures. Below, we outline the pathways and fuel switching technologies assessed to complete this shift.

Meridian Hall

Pathway #1

The first decarbonization pathway for MH consists of the following measures:

- i. Retain the existing steam system and pursue fuel switching;
- ii. Install solar PV on roof;¹¹ and,
- iii. Install higher efficiency chillers for cooling.¹²

Technologies assessed for fuel switching are listed below:

1. Biomass: Burn organic materials to generate heat or electricity;
2. Electric steam boilers: Utilize electricity to generate steam;
3. Steam air source heat pumps: Extract heat from the air to generate steam;
4. Renewable natural gas: Lower carbon substitute for conventional natural gas;
5. Deep lake water cooling: Utilize water temperature from deep lakes to provide heating and cooling;¹³ and,
6. 'Green' steam:¹³ Waiting for Enwave to decarbonize their steam system.

Pathway #2

The second decarbonization pathway for MH consists of the following measures:

- i. Convert the steam system to hot water and pursue fuel switching;
- ii. Install solar PV on roof; and,
- iii. Install higher efficiency chillers for cooling.

Technologies assessed for fuel switching are listed below:

1. Wastewater energy exchange: Capture and reuse the thermal energy from wastewater mains to heat or cool buildings;
2. Air source heat pumps: Transfer heat between the inside of a building and the outside air;
3. Geo-exchanges: Utilize geothermal heat pumps for heating and cooling;
4. Electric hot water boilers: Utilize electricity to heat water;
5. Heat recovery from chilled water plant: Capture waste heat generated during the cooling process and repurpose it for heating applications; and,
6. Deep lake water cooling³: Utilize water temperature from deep lakes to provide heating and cooling.

¹¹ Solar is considered as an option with conjunction to other options for each scenario.

¹² Existing cooling technologies shall be retained to the end of their useful life and replaced with more efficient units at that time.

¹³ Enwave has not committed to an extension of the deep lake water cooling network, nor to disclosing further details regarding its future pivot to 'green' steam as of the publication date of this report.

Decarbonization Pathways – Summary (2/2)

Meridian Art Centre

Pathway #1

The decarbonization pathway for MAC consists of the following measures:

- i. Pursue fuel switching from the existing natural gas heating system;
- ii. Install solar PV on roof; and,
- iii. Install higher efficiency chillers for cooling.

Technologies assessed for i) fuel switching are below.

1. Wastewater energy exchange: Capture and reuse the thermal energy from wastewater mains to heat or cool buildings.
2. Air source heat pumps: Transfer heat between the inside of a building and the outside air;
3. Geo-exchanges: Utilize geothermal heat pumps for heating and cooling;
4. Heat recovery from TTC: Capture and reuse the thermal energy from TTC subways to heat or cool buildings;
5. Biomass: Burn organic materials to generate heat or electricity;
6. Electric hot water boilers: Utilize electricity to heat water;
7. Renewable natural gas: Lower carbon substitute for conventional natural gas; and,
8. Heat recovery from chilled water plant: Capture waste heat generated during the cooling process and repurpose it for heating applications.

Assessment Methodology

To determine the preferred pathway and fuel switching technology, we utilized the following three-step process.

1. Evaluation Criteria Analysis

We first assessed technologies against the evaluation criteria. The evaluation criteria provided a first cut at short-listing the feasible and practical fuel switching technologies for both MH and MAC for further investigation.

2. LCOE Analysis

The second step involves completing a levelized cost of energy (LCOE) analysis on the short-listed technologies.

3. Short-List Comparative Analysis

The final step involved assessing both the evaluation criteria and LCOE, and conducting a workshop with TO Live's project leadership to identify the preferred pathways and fuel switching technologies to pursue in the net zero strategy. Note that an emphasis was placed on OPEX costs per direction from TO Live stakeholders.

Scenario Supplement– Energy Conservation Measures

A set of energy conservation measures (ECMs) can complement decarbonization scenarios. These ECMs can help sustain the energy, emissions, and cost savings over a longer horizon. The below list identifies the low- and no-cost ECMs across the electrical and thermal systems, envelop, etc., that could be considered for implementation. Please note the list excludes those already undertaken by TO Live (e.g., LED lighting). Overall, the energy consumption reductions expected from these ECMs is ~5%, as indicated in the “Savings by Design Workshop Summary”, completed by Sustainable Buildings Canada (SBC) for TO Live.

Lighting

1. Install lighting occupancy sensors for indoor space and photovoltaic sensor for outdoor space, as appropriate.

HVAC

1. Install programmable thermostats and schedule space temperature setbacks and minimum outside air temperature based on occupancy;
2. Control exhaust fans from washrooms, kitchen, or any other space with occupancy sensors or timers;
3. Connect installed fan speed drives to building automation system; and
4. Survey and repair steam traps, de-scape boiler tubes, and perform boiler tune-up on a regular basis.

Domestic Hot Water (DHW)

1. Install low flow faucets, urinals, toilets, and showerheads;
2. Ensure hot and chilled water pipes are well insulated; and,
3. Optimize DHW setpoint around 140F (60°C) if it is currently high.

Chiller

1. Implement chilled water temperature reset (manual by season or automatic, based on outdoor temperature);
2. Regularly clean and service chiller condenser tubes to reduce fouling and keep heat exchange at peak performance; and
3. Clean cooling towers and optimize water chemistry to keep surfaces clean and flow even across the surfaces, and reduce debris buildup that could foul the condenser.

Envelope

1. Replace any faulty weather stripping and weather seals; Consider conducting air tightness analysis to find areas of energy leakage and fix the problem areas; and
2. Perform a thermographic scan of the building envelope to reveal areas of significant radiant loss and air infiltration. Weatherize or insulate the affected parts of the building.

General

1. Integrate computerized maintenance management software (CMMS) to closely track maintenance activities.

3.2

Evaluation Criteria Analysis



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Introduction

We utilized an evaluation criteria to assess each decarbonization technology. The purpose of the evaluation criteria was to systematically rank each type of technology against one another to determine those for further assessment in an LCOE analysis.

The evaluation criteria is summarized in Table 8.

The following pages summarize the results of the evaluation criteria analysis. In the analysis, each criteria is assigned a rank, using the following four-tiered scoring approach:

-  Good: Excels in meeting the evaluation criteria;
-  Fair: Adequately meets the evaluation criteria;
-  Poor: Falls short in meeting the evaluation criteria; and,
-  Bad: Significantly fails to meet the evaluation criteria.

Technologies with a green overall ranking were selected for further investigation in the LCOE analysis.

Technologies without poor (red) and/or bad (black) rankings for any criteria are ranked green overall and shortlisted, with minor exceptions as noted. Technologies with two or more poor (red) and/or bad (black) rankings for any criteria are ranked red overall, with minor exceptions as noted. All other technologies are ranked as fair (orange).

Table 8: Evaluation Criteria

Criteria	Description
Lifecycle costs	Total cost of owning, operating, and maintaining the technology over its entire lifespan.
CAPEX	Initial capital expenditure required for the purchase and installation of the technology.
OPEX	Ongoing operational and maintenance costs associated with the technology.
GHG reduction potential	Capacity of the technology to decrease GHG emissions
Suitability	How appropriate the technology is for the specific context, and project requirements.
Schedule	Timeframe needed to implement the technology from planning through to operation.
Spatial Impacts	Physical space requirements and changes to the existing layout needed to accommodate the technology.

Pathway #1 – Meridian Hall

The technology rankings against the design criteria for pathway #1 at MH are summarized below.

#	Category	Technology	Evaluation Criteria							Rank
			Lifecycle Cost	CAPEX	OPEX	GHG reduction potential	Suitability	Schedule	Spatial impact	
1	Heating	Biomass	●	●	●	●	●	●	●	
2	Heating	Electric Steam Boiler ¹⁴	●	●	●	●	●	●	●	
3	Heating	Steam Air Source Heat Pump	●	●	●	●	●	●	●	
4	Heating	Renewable Natural Gas	●	●	●	●	●	●	●	
5	Heating	Wait for Enwave “Green Steam”*	●	●	●	●	●	●	●	
6	Heating	Deep Lake Water Cooling ¹⁵	●	●	●	●	●	●	●	
7	Cooling	High Efficiency Chillers	●	●	●	●	●	●	●	

¹⁴ Electric Steam Boilers are ranked as orange overall since they are not being considered as a primary means of energy, but as a backup to address energy peaks.

¹⁵ Enwave has not committed to an extension of the deep lake water cooling network, nor to disclosing further details regarding its future pivot to ‘green’ steam as of the publication date of this report. However, conversations remain ongoing and this may be re-examined at a future date

Pathway #2 – Meridian Hall

The technology rankings against the design criteria for pathway #2 at MH are summarized below.

#	Category	Technology	Evaluation Criteria							Rank
			Lifecycle Cost	CAPEX	OPEX	GHG reduction potential	Suitability	Schedule	Spatial impact	
1	Heating	Wastewater Energy Exchange	●	●	●	●	●	●	●	●
2	Heating	Air Source Heat Pump	●	●	●	●	●	●	●	●
3	Heating	Geo-exchange (with Heat Pumps)	●	●	●	●	●	●	●	●
4	Heating	Electric Hot Water Boilers ¹⁶	●	●	●	●	●	●	●	●
5	Heating	Heat Recovery from Chiller Water Plant	●	●	●	●	●	●	●	●
6	Heating	Heat Recovery from Enwave Chilled Water System	●	●	●	●	●	●	●	●
7	Cooling	Deep Lake Water Cooling	●	●	●	●	●	●	●	●
8	Cooling	High Efficiency Chillers	●	●	●	●	●	●	●	●

¹⁶ Electric Hot Water Boilers are ranked as green overall since they are not being considered as a primary means of energy, but as a backup to address energy peaks.

Pathway – Meridian Art Centre

The technology rankings against the design criteria for the decarbonization pathway at MAC are summarized below.

#	Category	Technology	Evaluation Criteria							Rank
			Lifecycle Cost	CAPEX	OPEX	GHG reduction potential	Suitability	Schedule	Spatial impact	
1	Heating / Cooling	Wastewater Energy Exchange	●	●	●	●	●	●	●	
2	Heating / Cooling	Air Source Heat Pump	●	●	●	●	●	●	●	
3	Heating / Cooling	Geo-exchange (with Heat Pumps)	●	●	●	●	●	●	●	
4	Heating / Cooling	Heat Recovery from TTC	●	●	●	●	●	●	●	
5	Heating	Biomass Boilers	●	●	●	●	●	●	●	
6	Heating	Electric Hot Water Boilers	●	●	●	●	●	●	●	
7	Heating	Biogas / Renewable Natural Gas Boilers	●	●	●	●	●	●	●	
8	Heating / Cooling	Heat Recovery from Chilled Water Plant	●	●	●	●	●	●	●	
9	Cooling	High Efficiency Chillers	●	●	●	●	●	●	●	

3.3

LCOE Analysis



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Introduction

An LCOE analysis was completed on the short-listed technologies that scored as green overall in the evaluation criteria analysis.

The LCOE analysis for each short-listed technology required consolidating the following metrics:

- Initial capital costs: Initial investment to procure, install and commission the equipment and infrastructure to operate the energy system.
- Annual operating costs: Operating costs, including all recurring costs to operate the system, outlined below.
 - Replacement costs: Replacements throughout lifecycle;
 - Operating and maintenance costs: Regular maintenance, operator staff, admin and insurance costs;
 - Fuel costs;
 - Electricity costs; and,
 - Carbon taxes: Payable as a result of the use of combustion on-site (if applicable).

A summary of the decarbonization scenarios assessed in the LCOE are summarized below:

Meridian Hall

Pathway #1: Retain the existing steam system and pursue fuel switching using scenario #1, combined with solar PV and high efficiency chillers.

Scenario 1) Steam Air Source Heat Pump (ASHP)

Pathway #2: Convert the steam system to hot water and pursue fuel switching using scenarios 2), 3) or 4), combined with solar PV and high efficiency chillers.

Scenario 2) Steam to Hot Water

Scenario 3) Steam to Hot Water + Wastewater Energy Exchange (WEE)

Scenario 4) Steam to Hot Water + ASHP

Meridian Art Centre

Pathway #1: Pursue fuel switching from the existing natural gas heating system utilizing scenario 1) or 2), combined with solar PV and high efficiency chillers.

Scenario 1) Air Source Heat Pump

Scenario 2) Heat Recovery Chillers

Introduction

Additional Measures

Each of the scenarios include proposed measures for cooling and solar PV sizing. Below, we describe how these measure were determined.

Cooling

The current MH chillers and cooling tower are nearing the end of their service lives with adequate efficiency. Higher efficiency chillers will lower energy consumption and, in turn, decarbonize the buildings. As a result, the following considerations should guide the cooling strategy across scenarios:

- Retain the existing cooling technologies until the end of their useful life and upgrade to higher efficiency units at the time of replacement. This approach maximizes the utility of current investments while planning for future improvements. Regular efficiency assessments and maintenance will optimize performance until replacement is necessary; and,
- Consider Enwave's deep lake water cooling if and when it becomes available due to its low carbon emissions and ability to free space in the mechanical room/rooftop. This option represents a forward-thinking, low-carbon solution that aligns with long-term sustainability goals. Additionally, this system can offer operational cost savings and reliability improvements by reducing dependency on traditional cooling methods.

These considerations will help strike a balance between immediate needs and long-term decarbonization objectives.

Solar PV

Each scenario includes solar installation as a default add-on. MH considers solar PV rooftop installation over a 2,700 m² whereas MAC considers solar façade on west side of the building across 440 m².

Please note that solar PV should be further investigated for rooftop or façade integration and that architectural, structural and façade specific advice should be sought after by TO Live.

Meridian Hall – LCOE Results

Table 12 summarizes the LCOE results for each of the four scenarios. LCOE calculations considered 25 years as a measure life and includes the total CAPEX (including Enwave contract terminating cost, wherever applicable) and OPEX cost (including the offset credit cost for residual emissions as mentioned in subsequent slides). Table 13 outlines the list of assumptions considered in the analysis.

Overall, Scenario 2 (Steam to Hot Water) has the lowest LCOE amongst all of the options, however it also has the lowest amount of emissions abated. Scenario 3 (Steam to Hot Water + Wastewater Energy Exchange) has the highest amount of annual GHG emissions saved. Scenario 4 narrowly comes ahead as the lowest annual operating cost. Regardless of the scenario, however, all come with OPEX savings, as BAU for MH has the highest operating cost compared to the other scenarios.

The following pages outline the CAPEX and OPEX costs in more detail.

Table 12: LCOE Results

Criteria Assessed	BAU	1. Steam ASHP	2. Steam to Hot Water	3. Steam to Hot Water + WEE	4. Steam to Hot Water + ASHP
LCOE (\$ / MWh)	-	1,450	534	864	863
Capital cost (\$M 2024)	-	74.44	23.12	42.19	48.08
Avg annual operating cost (\$M / year; avg over 25 years)	0.79	0.46	0.56	0.32	0.30
GHG emissions abated (tCO _{2e} / year)	-	423.16	139.56	442.91	438.63

Highest scoring scenario
 Runner-up scenario
 3rd place scenario

Table 13: Modelling assumptions¹⁷

Parameter	Assumption	Remarks
Prices		
Electricity	\$187/MWh	Price in year 2024
Natural gas	\$28/MWh	Price in year 2024
Carbon tax	\$80/tCO _{2e}	Price in year 2024
Escalations		
Electricity	3%/year	Increase in electricity price per year
Natural gas	3%	Increase in natural gas price per year
Carbon tax escalation	\$15/year	Increase in carbon tax per year until 2030
Carbon tax escalation	3%	Increase in carbon tax price beyond 2030
Inflation	2.5%	Annual increase on prices / costs

¹⁷ Sources for assumptions can be found in Appendix D.

Meridian Hall – Capital Expenditure

The CAPEX for each scenario were quantified as a one time cost incurred during one fiscal year. All the scenarios including solar is considered for implementation in 2026.

The CAPEX consists of the following components:

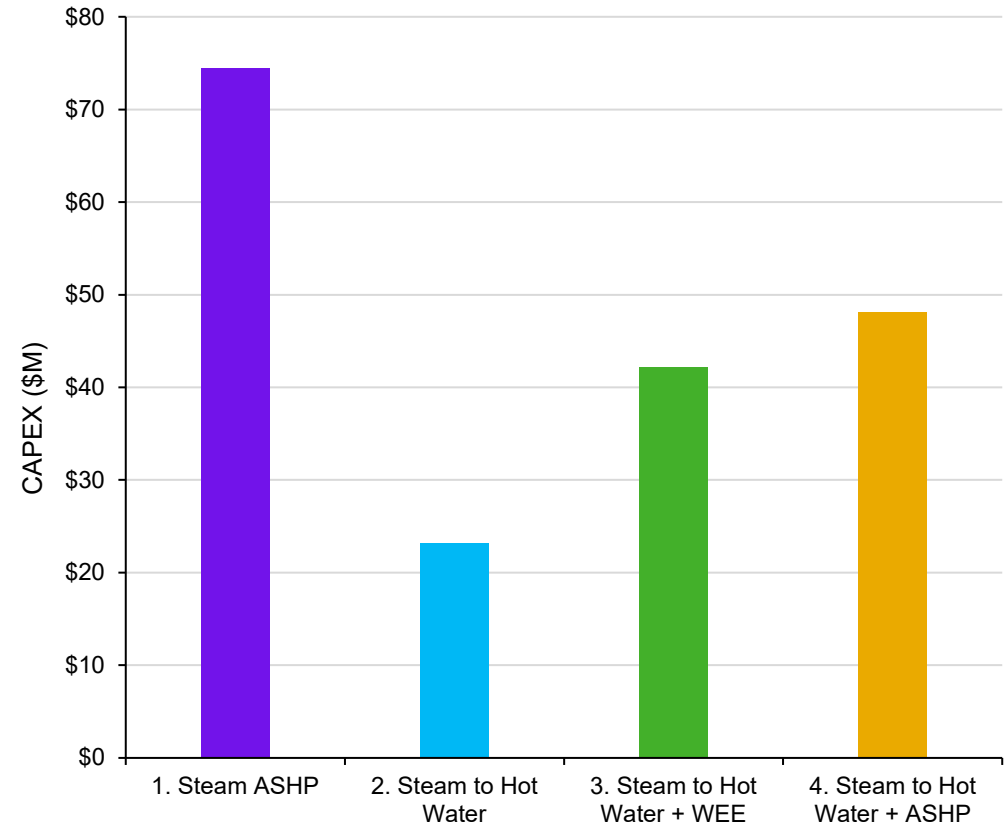
- Equipment installed cost;
- Infrastructure cost (e.g., building modifications, wastewater energy connection);
- Removals;
- Commissioning;
- Contractor overhead and profit (OH&P);
- Permitting and design;
- Contingency (considered as 25%); and,
- Project management fee (considered as 5%).

Figure 6 summarizes the CAPEX results. Scenario 2 (Steam to Hot Water) is the lowest CAPEX option whereas Scenario 1 (Steam ASHP) is the highest capex option.

Since scenario 2, 3, and 4 consider switching from steam to hot water, TO Live will need to terminate their existing contract with Enwave which currently provides steam for thermal uses. A contract termination cost of \$1,496,252 at the end of year 2027 is considered as a capital cost for the mentioned scenarios. These scenarios also factor in an extra 25% cost for accelerated construction to convert from steam to hot water within a 5-week period in 2026 during MH's closure.

The CAPEX also include a project management fee (5% of the total cost) for all scenarios.

Figure 6: CAPEX across various scenarios



Meridian Hall – Operating Expenditure

The OPEX consists of the following components:

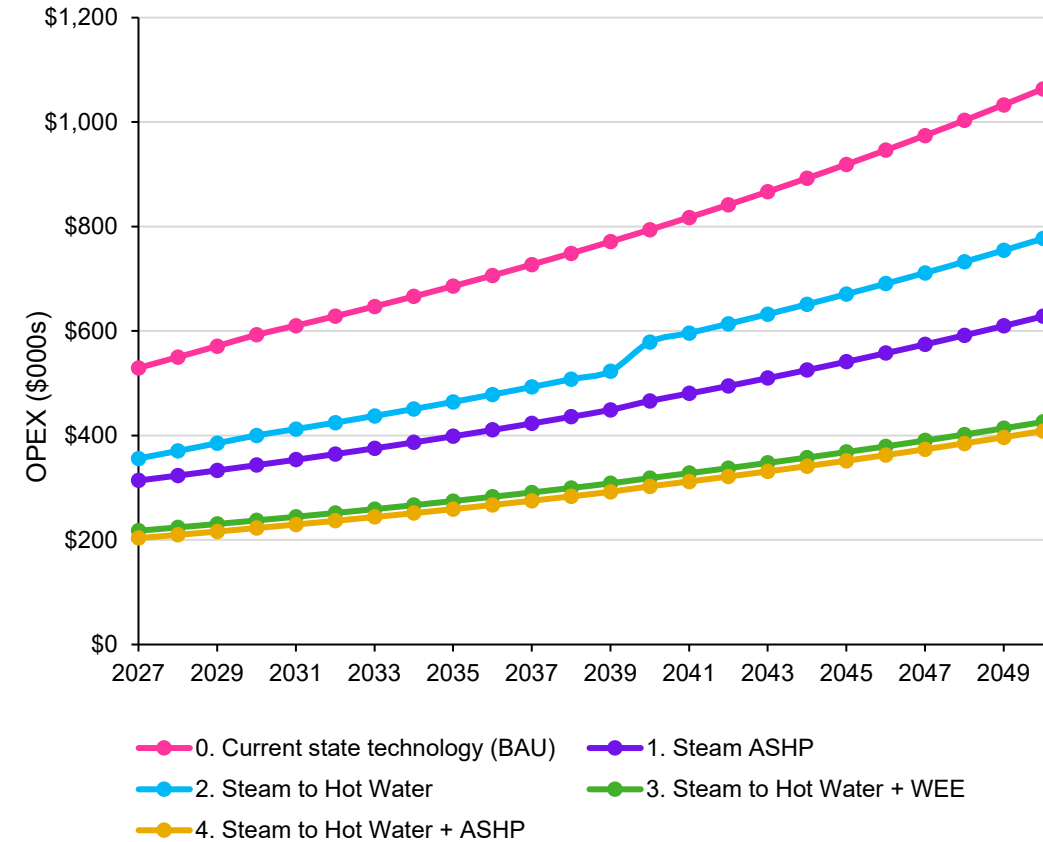
- Maintenance, replacement and refurbishment costs;
- Savings in energy consumed;
- Increases in energy prices by 3% annually; and,
- Increases in carbon tax by 15 points annually until 2030.

The OPEX begins in 2027 after the implementation of technologies in 2026.

Figure 7 summarizes the OPEX results. Each scenario assessed has a lower OPEX than the BAU scenario, with Scenario 4) steam to hot water conversion + ASHP costing the least. Since there will still be some residual emissions in year 2040, both from thermal and non-thermal sources (taking a conservative approach where grid is not decarbonized), TO Live can purchase offset credits to achieve its net zero goal. The offset credit cost in year 2040 and beyond is considered as an OPEX, and hence, added in the figure on right.

It is important to note that Scenario 2) (Steam to Hot Water) has significantly lower emissions abated compared to other scenarios. As a result, the cost of offset credits plays a much larger role, contributing an average of ~\$40,000 to the annual OPEX compared to a contribution in the range of \$1,000 to \$3,500 for the other scenarios.

Figure 7: OPEX across various scenarios



Meridian Hall – Addressing Residual Emissions

The BAU scenario emits 450 tCO₂e. The introduction of proposed technologies will still leave some emissions, which can be offset through either grid decarbonization or the purchase of emissions reduction offset credits. Given the uncertainty surrounding grid decarbonization, TO Live may need to consider acquiring offsets as a strategy to reach net zero emissions by 2040 should the grid not decarbonize per federal and provincial planning.¹⁸ Offsets are calculated using the following information:

- Current Offset Credit value in 2024: \$86.5/tCO₂e¹⁹
- Future Offset Credit value in 2040, adjusting for 2.5% inflation: \$128.4/tCO₂e ; and,
- Emissions balance in year 2040.

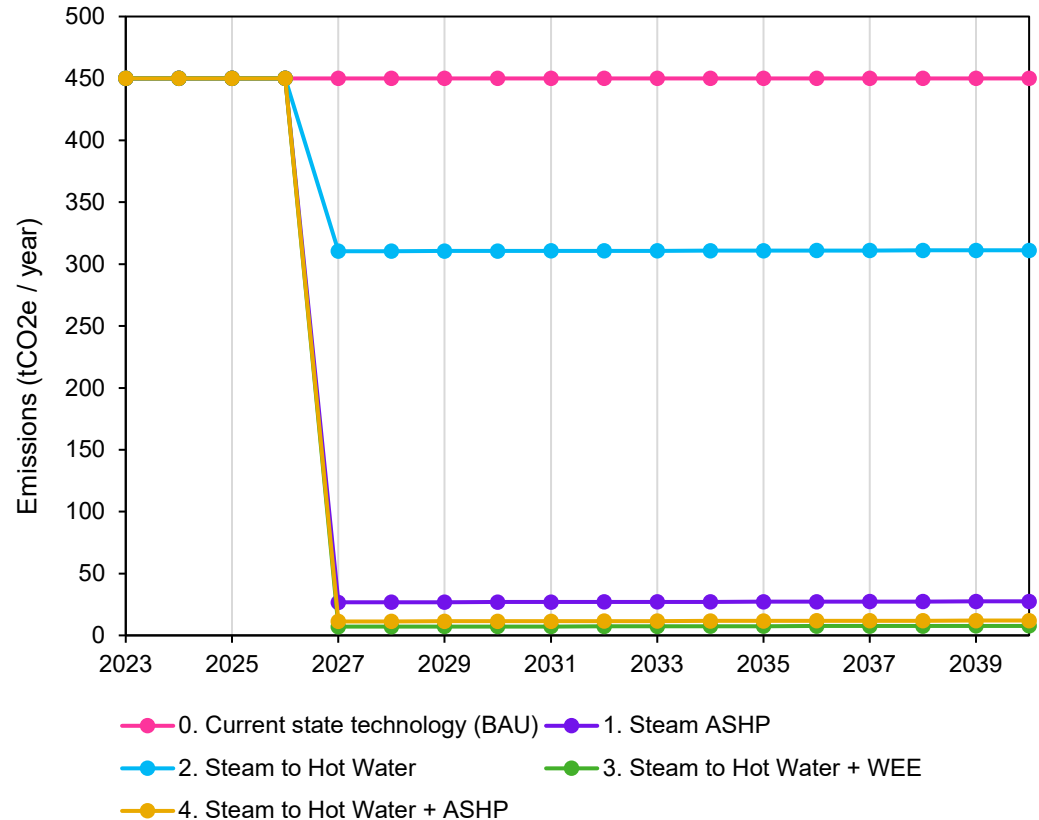
Note that non-thermal electricity consumption (separate from this analysis) will also require offsets should grid decarbonization not occur. It has been included as its own cost below and would apply to all scenarios, including BAU.

Table 14: Summary of offset costs across scenarios

Scenario	Offset costs in year 2040	Average offset cost (2040 – 2051)
1. Steam ASHP	\$3,539	\$4,114
2. Steam to Hot Water	\$39,956	\$45,980
3. Steam to Hot Water + WEE	\$1,003	\$1,198
4. Steam to Hot Water + ASHP	\$1,553	\$1,830
Residual Non-Thermal Electricity	\$7,778	\$8,942

¹⁹ Reuters (2023). Canada strikes first deal to backstop carbon credit prices

Figure 8: Emissions Profile Projections



¹⁸ Per federal mandates for net zero grid emissions by 2035 and provincial mandates by 2050, it is expected that this carbon intensity will be significantly reduced – however, to account for any delays, we have put forth calculations that include the cost of offsets being purchased to fully reach net zero emissions.

Meridian Arts Centre – LCOE Results

Table 15 summarizes the LCOE results for each of the two scenarios. LCOE calculations considered 25 years as a measure life and includes the total OPEX cost (including the offset credit cost for residual emissions as mentioned in subsequent slides). Table 16 outlines the list of assumptions considered in the analysis, which are unchanged from Meridian Hall's analysis.

Scenario 1 (Air Source Heat Pump) has the lowest LCOE amongst all of the options, as well as the highest amount of emissions abated. Scenario 2 (Heat Recovery Chillers) has the lower CAPEX costs and reduces GHG emissions by a similar amount. Scenario 1 has the lowest OPEX cost, however all come with increased OPEX costs compared to the BAU for MAC. This is due to the lower cost associated with natural gas boilers. When viewed in aggregate, however, either scenario plus any of the scenarios for MH (excluding MH's Scenario 2) will yield lower OPEX costs in aggregate compared to the BAU scenario for both facilities combined.

The following pages outline the CAPEX and OPEX costs in more detail.

Table 15: LCOE Results

Location	BAU	1. ASHP	2. HRC
LCOE (\$ / MWh)	-	620	334
Capital cost (\$M 2024)	-	20.78	4.93
Avg annual operating cost (\$M / year; avg over 25 years)	0.20	0.26	0.39
GHG emissions abated (tCO _{2e} / year)	-	227.65	214.91

Highest scoring scenario
 Runner-up scenario
 3rd place scenario

Table 16: Modelling assumptions¹⁹

Parameter	Assumption	Remarks
Prices		
Electricity	\$187/MWh	Price in year 2024
Natural gas	\$28/MWh	Price in year 2024
Carbon tax	\$80/tCO _{2e}	Price in year 2024
Escalations		
Electricity	3%/year	Increase in electricity price per year
Natural gas	3%	Increase in natural gas price per year
Carbon tax escalation	\$15/year	Increase in carbon tax per year until 2030
Carbon tax escalation	3%	Increase in carbon tax price beyond 2030
Inflation	2.5%	Annual increase on prices / costs

¹⁹ Sources for assumptions can be found in Appendix D.

Meridian Arts Centre – Capital Expenditure

The CAPEX for each scenario are quantified as a one time cost.

The CAPEX consists of the following components, similar to Meridian Hall:

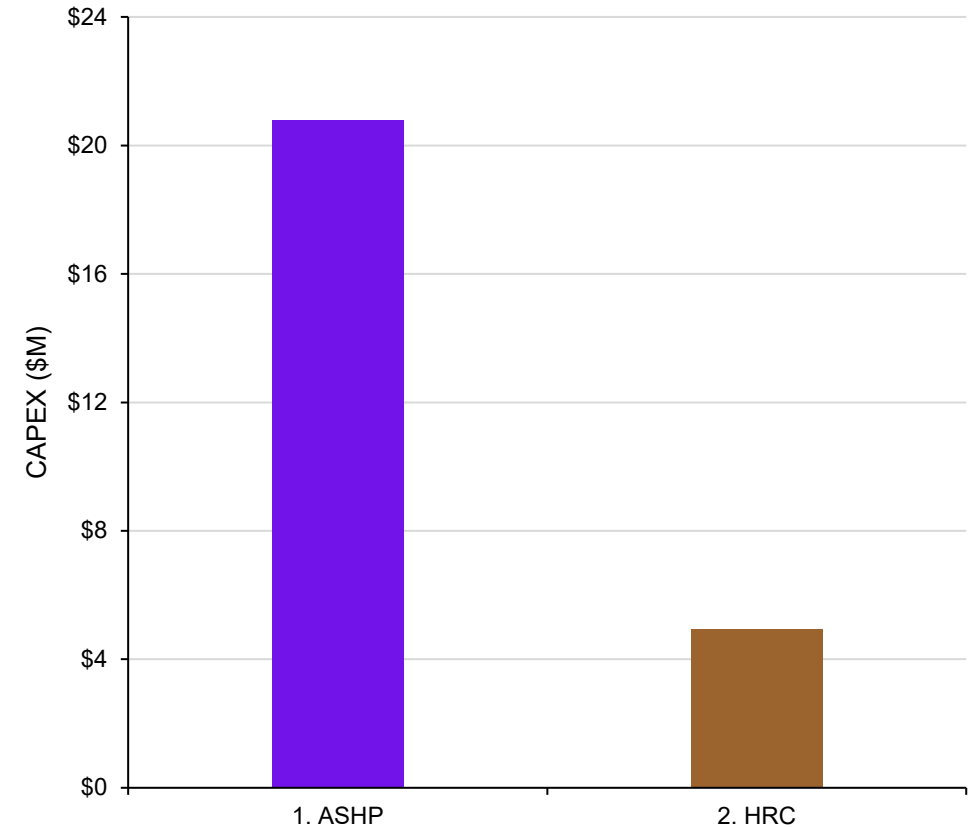
- Equipment installed cost;
- Infrastructure cost (e.g., building modifications, wastewater energy connection, etc.);
- Removals;
- Commissioning;
- Contractor overhead and profit (OH&P);
- Permitting and design;
- Contingency (considered as 25%); and,
- Project management fee (considered as 5%).

Figure 9 summarizes the CAPEX results. Scenario 1) (Heat Recovery Pumps) have a significantly lower CAPEX than Scenario 2) (Air Source Heat Pumps).

The CAPEX also include project management fee (5% of the total cost) for all scenarios.

As noted previously, scenarios are considered for implementation in the year 2026.

Figure 9: CAPEX across various scenarios



Meridian Arts Centre – Operating Expenditure

The OPEX consists of the following components, similar to Meridian Hall:

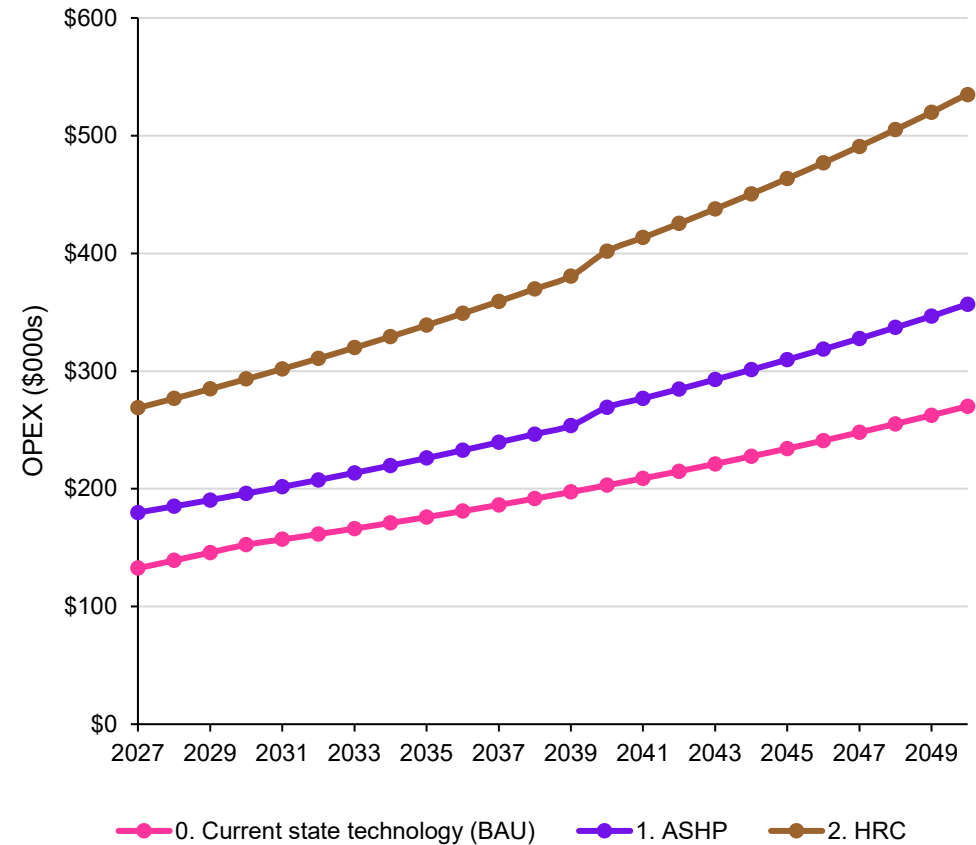
- Maintenance, replacement and refurbishment costs;
- Savings in energy consumed;
- Increases in energy prices by 3% annually; and,
- Increases in carbon tax by 15 points annually until 2030.

The OPEX begins in 2027 after the implementation of technologies in 2026.

Figure 10 summarizes the OPEX results. Here, the OPEX for BAU is lower than the two proposed scenarios, as operating current natural gas boilers is cheaper than proposed electrical boilers. Similar to Meridian Hall scenarios, a cost associated with offset credit is added in the OPEX in the year 2040 and beyond to achieve net zero.

However, when viewed in aggregate, either scenario plus any of the scenarios for MH (excluding MH's Scenario 2) will yield lower OPEX costs in aggregate compared to the BAU scenario for both facilities combined.

Figure 10: OPEX across various scenarios



Meridian Arts Centre – Addressing Residual Emissions

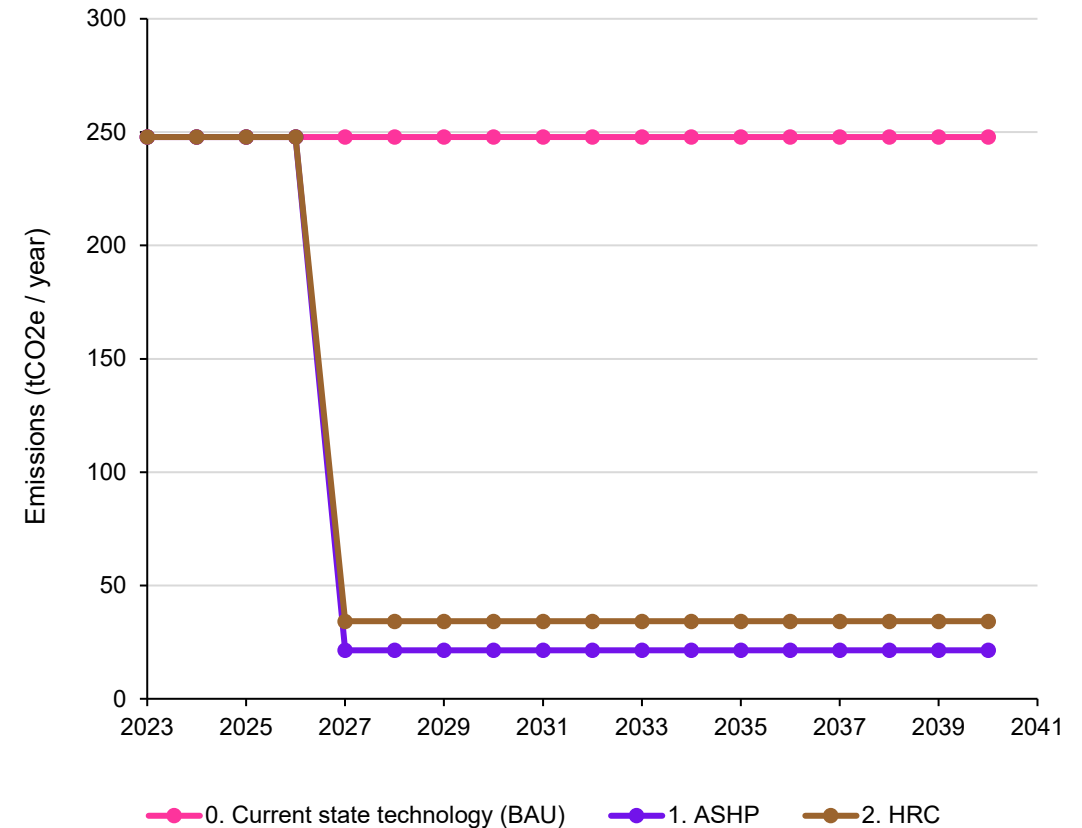
Similar to Meridian Hall, the cost of offsets in the year 2040 to abate the remaining emissions for 2040 is shown in Table 17.²⁰

Note that non-thermal electricity consumption (separate from this analysis) will also require offsets should grid decarbonization not occur. It has been included as its own cost below and would apply to all scenarios, including BAU.

Table 17: Summary of offset costs across Scenarios

Scenario	Offset costs in year 2040	Average offset cost (2040 – 2051)
1. ASHP	\$2,597	\$2,985
2. HRC	\$4,323	\$4,866
Residual Non-Thermal Electricity	\$5,616	\$6,456

Figure 11: Emissions Profile Projections



²⁰ Per federal mandates for net zero grid emissions by 2035 and provincial mandates by 2050, it is expected that this carbon intensity will be significantly reduced – however, to account for any delays, we have put forth calculations that include the cost of offsets being purchased to fully reach net zero emissions.

3.4

Scenario Comparison



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Preferred Scenario – Meridian Hall

The four scenarios were assessed using the criteria below. Based on the evaluation, **Scenario #3: Steam to Hot Water + WEE** scored the highest.

Table 18: Meridian Hall - Scenario Evaluation

Scenario	LCOE ²¹	GHG Reduction Potential	Suitability	Schedule	Spatial Impact	Stakeholder Feedback ²²	Overall Assessment
Scenario #1: Steam - Air Source Heat Pump (ASHP)							
Scenario #2: Steam to Hot Water							
Scenario #3: Steam to Hot Water + WEE							
Scenario #4: Steam to Hot Water + ASHP							

Legend:

- Good: Excels in meeting the evaluation criteria
- Fair: Adequately meets the evaluation criteria
- Poor: Falls short in meeting the evaluation criteria

²¹ The LCOE column compares the measurement of the average net present cost of energy generation across scenarios over their lifetime.

²² Stakeholder feedback column assesses the feedback received from stakeholders over the interest and comfortability of pursuing specific scenarios.

Preferred Scenario – Meridian Arts Centre

The two scenarios were assessed using the criteria below. Based on the evaluation, **Scenario #2: Heat Recovery Chillers** scored the highest.

Table 19: Meridian Arts Centre - Scenario Evaluation

Scenario	LCOE ²¹	GHG Reduction Potential	Suitability	Schedule	Spatial Impact	Stakeholder Feedback ²²	Overall Assessment
Scenario #1: Air Source Heat Pump (ASHP)							
Scenario #2: Heat Recovery Chillers							

Legend:

- Good: Excels in meeting the evaluation criteria
- Fair: Adequately meets the evaluation criteria
- Poor: Falls short in meeting the evaluation criteria

²¹ The LCOE column compares the measurement of the average net present cost of energy generation across scenarios over their lifetime.

²² Stakeholder feedback column assesses the feedback received from stakeholders over the interest and comfortability of pursuing specific scenarios.

4

Implementation Roadmap



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Implementation Roadmap

This section presents a potential implementation plan for each decarbonization scenario. TO Live selected Scenario #3 (Steam to Hot Water + WEE) for MH and Scenario #2 (Heat Recovery Chillers) for MAC for modelling in this roadmap. Solar PV installation has been added as a default add on to each of the selected scenarios.

Tables 20 and 21 present high-level implementation roadmap for the selected scenarios as well as an estimated implementation timeline. These roadmaps are based on industry leading practices (i.e., the activities themselves, the sequencing of activities, etc.), and assume 2026 as a target year for completing the removal and construction elements for the chosen scenarios. This timeline was based on a suggested optimal window from TO Live. The roadmaps provide an initial projection, and will be refined by TO Live throughout the implementation process.

Solar installation has been presented separately from the identified scenarios for implementation at both the facilities. TO Live could gain some benefits by combining the timelines for these activities for both facilities in areas such as budget approval, feasibility studies, procurement, etc.

The implementation roadmap provides the schedule for various activities that need to be completed in order to implement TO Live’s selected scenario. The scenario includes within the schedule terminating the existing contract with Enwave, as well as considerations around technical feasibility studies, the removal of the existing steam system, procurement of new equipment, installation and commissioning, etc.

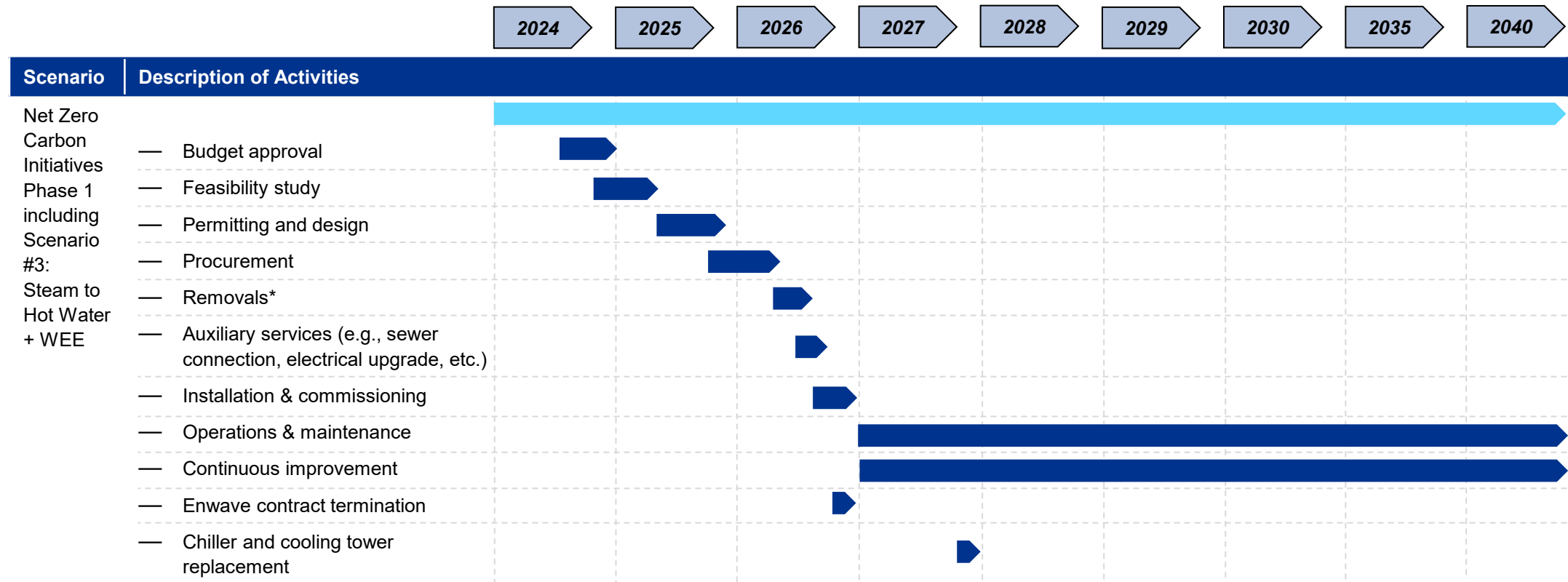
There are potential risks associated with the implementation of all of recommendations included in this report. For example, some of these activities may go beyond the timeframe included in this section and/or require additional dedicated funding; this will depend on what is found during technical feasibility studies, which have yet to be conducted and fall outside of the scope of this initial engagement. There also may be additional requirements around the availability of contractors, the cost of construction activities accelerating, and stakeholder management risks that will need to be considered as implementation begins.

Description	Page No.
Scenario Implementation	
Meridian Hall – Scenario #3	47
Meridian Arts Centre – Scenario #2	48



Implementation Roadmap – Meridian Hall

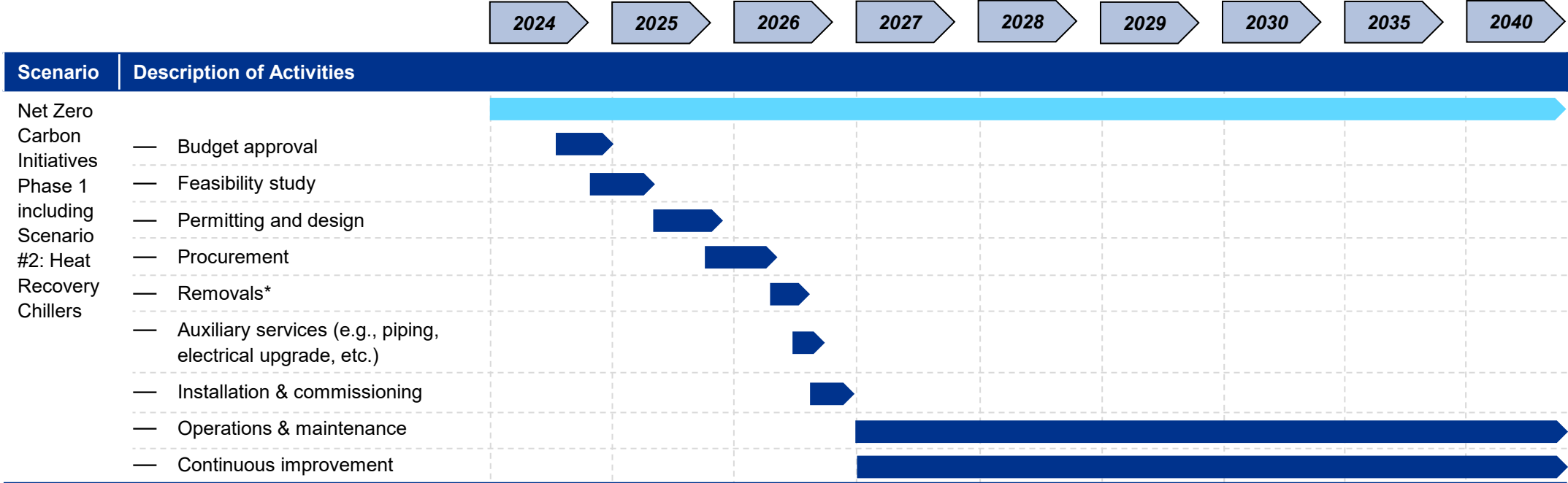
Table 20: Meridian Hall – Implementation roadmap



*Based on feedback from TO Live, we propose removals could be carried out in the June – July 2026 window during the FIFA World Cup, as less events and programs were already expected at Meridian Hall during that timeframe. In addition, TO Live wishes any venue shutdown not to occur when the STLC is closer for redevelopment. Therefore, 2026 is an optimal time for a shutdown.

Implementation Roadmap – Meridian Arts Centre

Table 21: Meridian Arts Centre – Implementation roadmap



*Based on feedback from TO Live, we propose removals could be carried out in the June – July 2026 window during the FIFA World Cup, as less events and programs were already expected at Meridian Hall during that timeframe. In addition, TO Live wishes any venue shutdown not to occur when the STLC is closer for redevelopment. Therefore, 2026 is an optimal time for a shutdown.

5

Reporting Considerations



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5.1

Updates to 10-year Capital Plan



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TO Live's Capital Budget Planning

TO Live's Current Capital Budget

TO Live's 2024 Capital and Operating Budget provides an outline of the funding available for 'Net Zero Carbon Initiatives' (NZCI) spanning from 2024 to 2027, with a substantial amount of capital becoming available in later years (e.g., 2033). This funding is allocated to fund decarbonization initiatives, such as those outlined in this report.

Implementation Roadmap

The implementation roadmap, as outlined in Section 4, highlights the pursuit of fuel switching measures in the year 2026. The reasons for this chosen timing are as follows:

- It allows TO Live to reach the City's TransformTO goal of reducing corporate emissions by 60% by 2030;
- It allows TO Live to satisfy the City's emissions budget requirements of accelerating the path towards net zero through an ambitious yet feasible transition plan;
- It ensures TO Live's venue shutdowns do not occur concurrently with the STLC redevelopment;
- It enables TO Live to accelerate its decarbonization process, gain early financial benefits (e.g., operational savings) and reputational advantages; and,
- It minimizes revenue losses as construction closures align a potential shutdown of activities during the 6-week World Cup period in the summer of 2026. TO Live, like other venues and theatres, expects a major drop-off in venue bookings during major sporting events. This was experienced during the Pan American Games, where TO Live had a shutdown period from the start to the finish of the sporting event.

Overview of Changes

To accommodate this timing, TO Live should consider updating its Capital Budget Plans by advancing funding. The adjustments to consider may include the following:

- Shifting a portion of the allocated funding for the planning, procurement, and detailed design of decarbonization initiatives;
- Consolidating a significant portion of the committed and uncommitted funds to 2026 for the construction of decarbonization initiatives;
- Making minor shifts for smaller building upgrades to support the implementation of specific energy efficiency measures, such as building automation systems; and,
- Pulling forward the committed funding from "Recommendations from BCA" as, after consulting with TO Live, much of that anticipated State of Good Repair (SOGR) work will not be required as the Net Zero work will address most of its items.

The following pages outline the adjustments to the capital budget plans for TO Live's consideration, separated by the MH and MAC facilities.

Meridian Hall

Funding MH’s decarbonization initiatives can be implemented into the following three phases:

- Phase 1: Fuel switching to hot water + wastewater energy recovery under an accelerated schedule, terminating the Enwave steam contract, and installing solar PV;
- Phase 2: Upgrading the cooling towers and chillers into more energy efficient units and converting natural gas stoves to electric; and,
- Phase 3: Installation of various energy efficiency measures.

Table 22 and Figure 12 illustrate the emission reductions and costs associated with the three phases.

Changes to Capital Plan for Consideration

To fund all three phases, adjustments to consider including in the capital plan are as follows:

- Advancing funding from later years for the implementation of Phase I NZCI. This includes advancing a significant amount (\$10M) of capital locked in 2033 to 2026;
- Creating a dedicated line item for Phase II NZCI of \$1,600,000 in 2028 to upgrade the chillers and cooling tower;
- Creating a dedicated line item for Phase III NZCI of \$300,000 annually between 2029 to 2034 to fund various energy reduction measures; and,
- Re-allocating funding from “Recommendations from BCA” to NZCI rows as required.

Changes for consideration are detailed further in Table 23 on the next page.

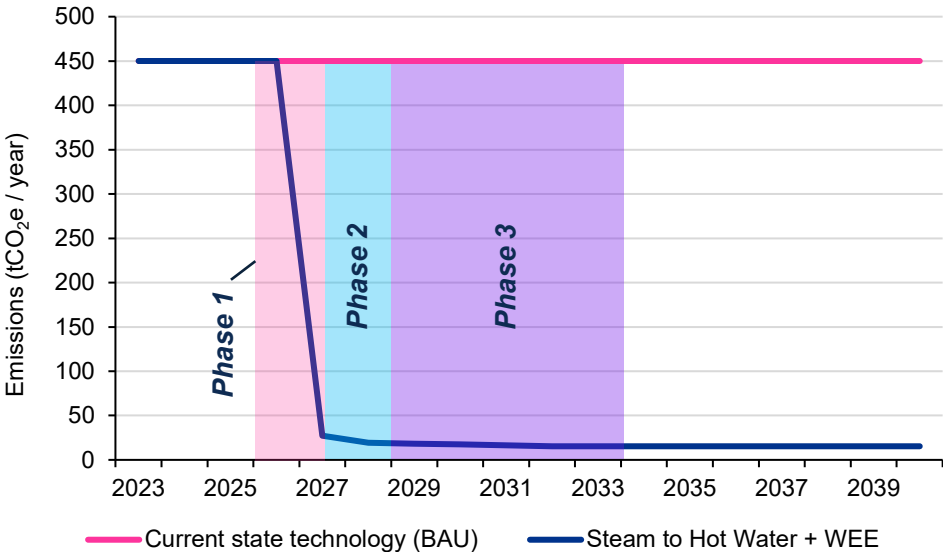
Uncommitted Funding

TO Live should consider moving all of its uncommitted NZCI line items to committed, as required. In addition, specific mechanical system projects (e.g., heaters and fan coils, AHUs, cooling and chilled water plant replacements) can be considered as available funds to implement energy efficiency measures.

Table 22: Emission Reductions & Costs Across Phases

Phase	Emissions reduction (tCO ₂ e)	Total Cost (\$M)
Phase 1	423	42.2
Phase 2	12	1.6
Phase 3	7	1.8

Figure 12: Emission Reductions Across Phases



Meridian Hall

Table 23 outlines MH's capital budget changes for consideration.

Table 23: Capital Budget Changes for MH (000s)

Capital Planning Line Item	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2024 – 2034 Total
Committed												
NZCI (Phase I)		\$1,000	\$1,300							\$10,000		\$12,300
Accessibility		\$1,850	\$1,335	\$1,100								\$4,285
MH - Theatre Systems & Equipment		\$84	\$20	\$405								\$509
Sprinkler Expansion (Phase I)		\$1,500	\$838									\$2,338
Building Condition Assessment						\$90						\$90
Recommendations from BCA							\$500	\$500	\$500	\$15,000		\$16,500
Total Committed		\$4,434	\$3,493	\$1,505		\$90	\$500	\$500	\$500	\$25,000		\$36,022
Proposed Adjustments to Previously Approved 10-Year Plan												
NZCI Phase I (Hot Water, WEE and Solar PV)			\$38,886	\$1,000						(\$10,000)		\$29,886
NZCI Phase II (Cooling Towers and Chillers)				\$1,600								\$1,600
NZCI Phase III (ECM)						\$300	\$300	\$300	\$300	\$300	\$300	\$1,800
Recommendations from BCA										(\$9,000)		(\$9,000)
Total Adjustment			\$38,886	\$2,600		\$300	\$300	\$300	\$300	(\$18,700)	\$300	\$24,286
New Proposed Plan (Committed & Adjusted)		\$4,434	\$42,379	\$4,105		\$390	\$800	\$800	\$800	\$6,300	\$300	\$60,308

Meridian Arts Centre

Funding MAC's decarbonization initiatives can be implemented into the following three phases:

- Phase 1: Fuel switching to heat recovery chillers and solar façade;
- Phase 2: Upgrading the cooling two and chillers into more energy efficient units; and,
- Phase 3: Installation of various energy efficiency measures.

Table 24 and Figure 13 illustrate the emission reductions and costs associated with the three phases. Note that previously budgeted-for efficiency measures (i.e., an upgraded building automation system, façade replacement, and roof upgrade) would be funded from the original "Recommendations from BCA" line item*.

Recommended Changes for MAC

To fund all three phases, adjustments to consider including in the capital plan are as follows:

- Advancing funding from later years for the implementation of Phase I NZCI. This includes advancing a significant amount (\$10M) of capital locked in 2033 to 2026;
- Creating a dedicated line item for Phase II NZCI of \$1,600,000 in 2028 to upgrade the chiller;
- Creating a new row for Phase III NZCI of \$200,000 annually between 2028 to 2033 to fund other ECMs outside of those already included in the capital plan (e.g., AHU, auxiliary heater replacements, etc.); and,
- Re-allocate funding from "Recommendations from BCA" to NZCI rows as required.

Changes for consideration are illustrated in Table 25 on the next page.

Changes to Uncommitted Funding

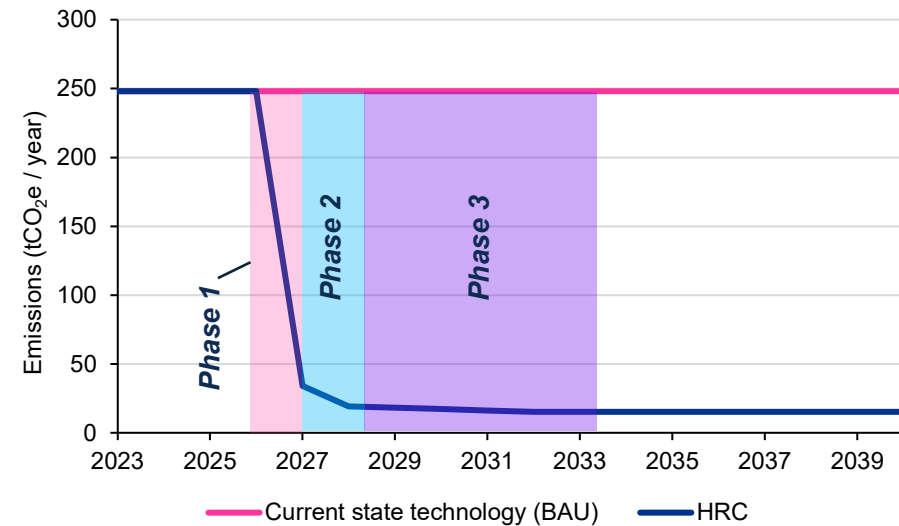
TO Live should consider moving all of its uncommitted NZCI line items to committed, as required. In addition, specific mechanical system projects (e.g., AHU, auxiliary heater replacements) as well as pump replacements should be considered to fund ECMs.

*Costs related to BAS, façade and roof replacement were provided by TO Live.

Table 24: Emission Reductions & Costs Across Phases

Phase	Emissions reduction (tCO ₂ e)	Total Cost (\$M)
Phase 1	214	4.9
Phase 2	4	1.6
Phase 3	4	1.2

Figure 13: Emission Reductions Across Phases



Meridian Arts Centre

Table 25 outlines MAC's capital budget changes for consideration.

Table 25: Capital Budget Changes for MAC (000s)

Capital Planning Line Item	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2024 – 2034 Total
Committed												
Accessibility		\$3,273	\$2,296	\$1,550	\$30							\$7,149
NZCI Phase I		\$1,881	\$1,450	\$1,300						\$10,000		\$14,631
Building Condition Assessment			\$90									\$90
Theatre Systems and Equipment		\$483	\$389	\$1,679								\$2,551
Recommendations from BCA							\$500	\$500	\$500	\$15,000		\$16,500
Total Committed		\$5,637	\$4,225	\$4,529	\$30	\$0	\$500	\$500	\$500	\$25,000	\$0	\$40,921
Proposed Adjustments to Previously Approved 10-Year Plan												
NZCI Phase I (HRC, BAS, Solar)			\$3,481	(\$1,300)						(\$9,750)		(\$7,569)
NZCI Phase II (Cooling Tower)				\$1,600								\$1,600
NZCI Phase III (Energy Reduction Measures)					\$200	\$200	\$200	\$200	\$200	\$200		\$1,200
Recommendations from BCA (incl. façade, roof)			\$5,906							(\$5,906)		\$0
Total Adjustment			\$9,387	\$300	\$200	\$200	\$200	\$200	\$200	(\$15,456)		(\$4,769)
New Proposed Plan (Committed & Adjusted)		\$5,637	\$13,612	\$4,829	\$230	\$200	\$700	\$700	\$700	\$9,544	\$0	\$36,152

5.2

Emissions Budget Submission



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Emissions Budget Submission

Toronto is implementing an emissions budget that will require TO Live to report on its decarbonization targets, as well as progress towards them, every five years. The purpose of this emissions budget is to i) provide a clear and quantifiable target for the city and its agencies to work towards and ii) allow for the tracking and measurement of progress in reducing emissions.

Using the emissions budget, the City of Toronto plans to track its progress in reaching net zero and identify any areas where further action may be needed.

The current reporting requirements for the emissions budget from an agency such as TO Live are not finalized. According to guidance from the City's Environment and Climate Division (at the time of developing the strategy), the information required will likely include submitting information on how TO Live intends to move away from on-site fossil fuel consumption and the pace at which facilities will decarbonize. Alongside the previous contents in the report, below are tables and figures to supplement future submissions.

Figure 14: Decarbonization Pathways of MH and MAC compared to Toronto's Emissions Budget Pathway

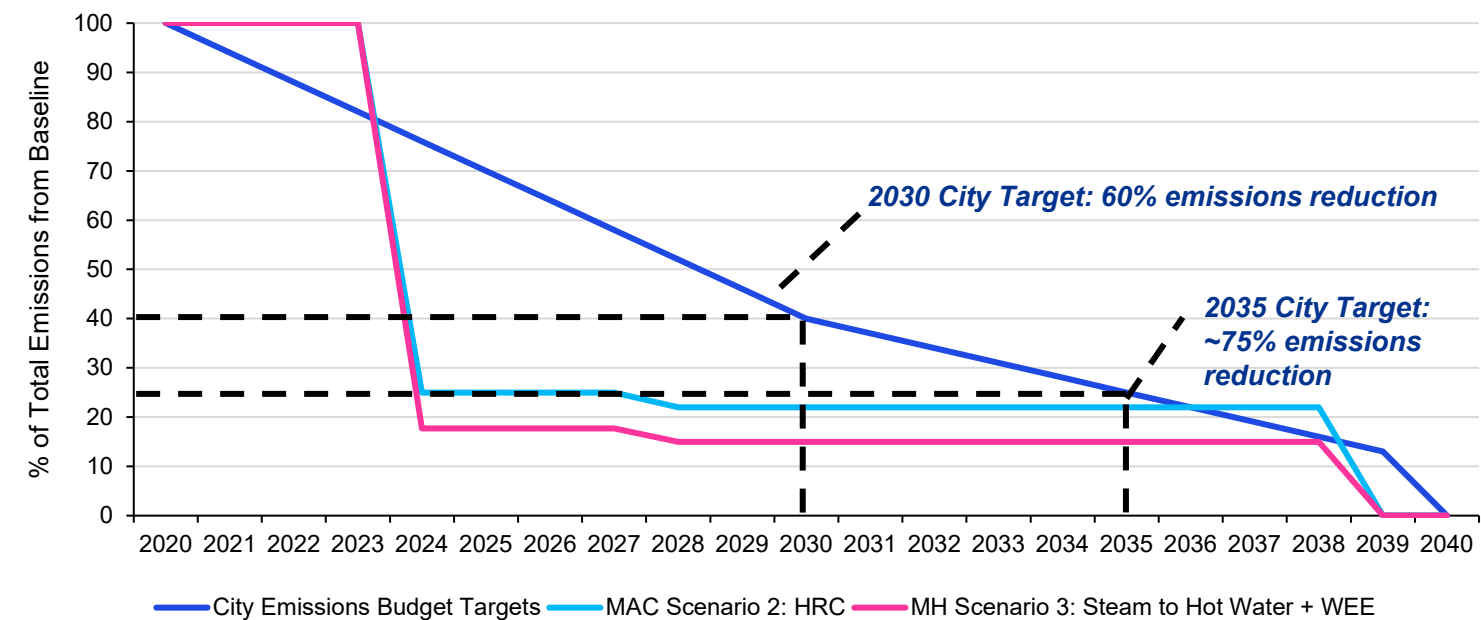


Table 27: Emissions Budget Supplement

Targets	City of Toronto	MH	MAC
2025	30%	0% (519 tCO2e)	0% (292 tCO2e)
2030	60%	~85% (92 tCO2e)	~75% (74 tCO2e)
2035	75%	~85% (85 tCO2e)	~75% (70 tCO2e)
2040	100%	100%	100%

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Appendices



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Appendix A

Scope 3 Emissions



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Scope 3 Emissions

Introduction

Scope 3 emissions refer to indirect greenhouse gas emissions that occur in the value chain, including both upstream and downstream activities. In the context of TO Live’s operations, material Scope 3 categories of emissions include water usage, waste disposal and purchased goods and services.

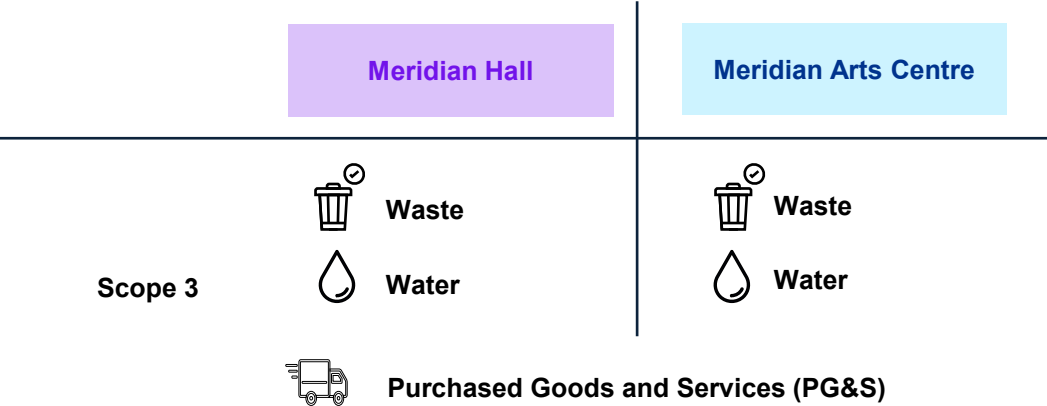
Emission baseline

TO Live’s 2023 Scope 3 emissions baseline is ~3,517 tCO_{2e}. The majority of the emissions are from purchased goods and services (~98%). The remainder are from waste disposal (~1.3%), followed by water (~0.3%).

Key takeaways on the emissions baseline are outlined on the following page. Performance targets for TO Live’s Scope 3 emissions are on the next page.

Data quality

The quantification of waste disposal and water usage emissions is considered highly accurate, as the quantification process involved using metered water utility bills and waste audit reports, respectively. Note that there are uncertainties regarding the accuracy of the purchased goods and services quantification, as it utilized a spend-based approach. Although the data quality is in-line with current standard practices of organizations establishing their emissions baseline, TO Live should consider conducting a deeper analysis of emissions that accurately capture nuances in spend, with an aim towards eventually obtaining supplier-specific GHG information where possible.



Scope 3 – Emission Profile



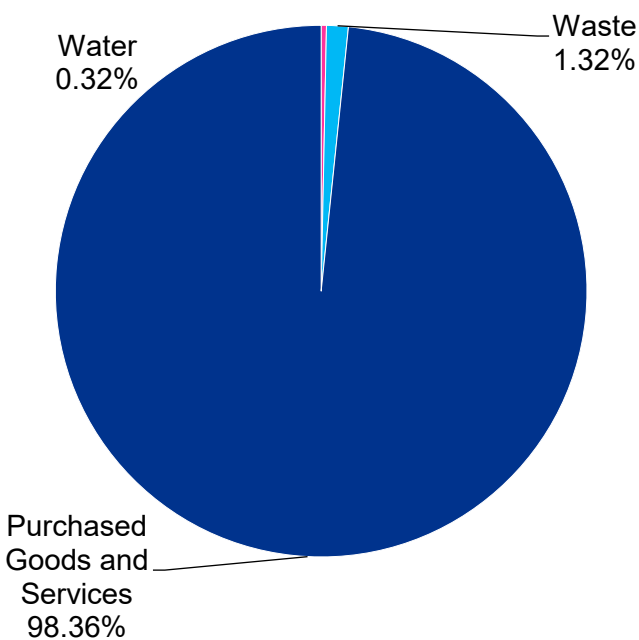
Key takeaways

- The majority of TO Live’s Scope 3 emissions are from purchased goods and services. The highest emissions from this category are from spend on the following:
 - Construction (63% of total PG&S);
 - Food and beverage (14% of total PG&S); and,
 - Administrative and support services (6% of total PG&S)
- TO Live achieves a waste diversion rate of ~40% from its waste disposal audits.
- Emissions from water usage are immaterial to TO Live’s emissions profile.

Table 26: Scope 3 Emissions Baseline

Location	2023 Scope 3 Emissions (tCO ₂ e)		
	Waste	Water	PG&S
Meridian Hall	32.8	3.6	3,468.6
Meridian Art’s Centre	8.2	4.0	

Figure 12: Scope 3 Emissions Baseline



Scope 3 – Performance Targets and Metrics

	Current (2023 baseline)	Interim target (2030)	2040 target	Sources for alignment
Water	~20,000 m ³	Maintain/reduce water consumption levels.	Maintain/reduce water consumption levels.	N/A ²³
Waste	~40% waste diversion from landfills	Achieve 70% waste diversion.	Achieve 100% waste diversion.	TransformTO, City of Toronto
PG&S	~3,468 tCO _{2e}	Measure and increase % of supplier base with net zero targets ²⁴ Reduce food-related emissions by 25%	Achieve 100% supplier base with net zero targets	Consumption-Based Emissions Inventory, City of Toronto

²³ TransformTO has not set performance targets for water consumption usage.

²⁴ The City of Toronto's next Consumption-Based Emissions Inventory (CBEI) Report is set to be released in 2027 and will include PG&S emission reduction targets for the City. Due to uncertainty over potential targets introduced, TO Live should consider assessing opportunities to increase the percentage of its supplier base to those with net zero targets.

Scope 3 – Decarbonization Opportunities

Below are three opportunities to consider undertaking in the medium- and long-term that may have a material impact on decreasing Scope 3 emissions related to purchased goods and services. We outline their description, why chosen followed by implementation roadmaps for each of the initiatives on the following pages.

ID #	Initiative	Why Chosen
1	Increase portion of suppliers to have net zero or science-based targets.	— Encourages suppliers to adopt sustainable practices, and facilitates TO Live's transition towards a low-carbon supply chain.
2	Increase suppliers with green transportation policies.	— Reduces carbon emissions associated with transportation-related emissions of suppliers and decreases emissions of value chain by aligning procurement practices with emission reduction goals.
3	Include carbon management clauses in procurement contracts (e.g., net zero roadmap).	— Drives supplier accountability, fosters emissions reduction efforts, and systematically addresses Scope 3 purchased goods and services emissions.

Implementation Roadmap



ID #	Initiative	Description of Activities
1	Increase portion of suppliers to have net zero or science-based targets	— Quantify current share of suppliers with net zero and/or science-based targets. — Identify material suppliers without net zero and/or science-based targets that can be substituted for suppliers with those targets. — Modify supplier selection criteria to ensure selection of new suppliers consider those with targets. — Establish a tracking system to monitor and assess supplier progress towards setting and achieving net zero or science-based targets. — Communicate net zero and/or science-based targets to suppliers.
2	Increase suppliers with green transportation policies	— Determine current share of suppliers with green transportation policies. — Identify material suppliers without green transportation policies that can be substituted for suppliers with those policies. — Develop a new supplier selection criteria to select new suppliers that have green transportation policies. — Establish a tracking system to monitor and assess supplier progress towards using green transportation policies.

Implementation Roadmap

			2025	2026	2027	2028	2029	2030	2035	2040
ID #	Initiative	Description of Activities								
3	Include carbon management clauses in procurement contracts (e.g., net zero roadmap).	— Assess current procurement practices, including the criteria and considerations for supplier selection. — Evaluate the extent to which sustainability and carbon management factors are integrated into the procurement process. — Identify areas for improvement and opportunities to enhance sustainability considerations in procurement contracts. — Understand the legal and contractual implications of including such clauses, ensuring they align with procurement policies and regulations. — Communicate expectations regarding carbon management and the benefits of including these clauses in procurement contracts. — Engage with suppliers early in the procurement process to communicate the commitment to carbon management and the inclusion of these clauses in contracts. — Integrate carbon management criteria into the supplier evaluation and selection process.								

Appendix B

Project Background



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Project Background

TO Live engaged KPMG to develop recommendations for a net zero transition program for their Meridian Hall and Meridian Art's Centre theatres' Scope 1 and 2 emissions as well as specific Scope 3 emissions material to their operations.

Engagement Driver

TO Live is working towards achieving net zero emissions by 2040, in line with the TransformTO Net Zero Strategy document adopted by Toronto City Council in 2021.

As a result, TO Live is looking to develop a strategic roadmap that will enable it to not only achieve the City of Toronto's strategic net zero objectives, but also become a municipal symbol in combating climate change.

Scope of Work

The scope of work included the following:

- Review TO Live's operations and identify areas for potential alignment with Toronto's Net Zero Strategy;
- Assess and quantify emissions, then propose an emissions baseline, incorporating other metrics as needed;
- Evaluate and suggest prioritization for potential decarbonization solutions, including from renewable energy technologies, and assist in creating consensus-driven decarbonization scenarios aligned with TO Live's goals; and,
- Draft a suggested implementation schedule with milestones and provide a suggested annual budget using Class D estimates.

Additional information on the scope of work can be found in the work plan on the next page.

Work Outputs

The outputs from the work included the following:

- Advise TO Live on how to establish baseline emissions & metrics for operations and individual facilities, excluding the St. Lawrence Centre for the Arts;
- Support TO Live in developing its own Net Zero Transition Plan, for review and consideration by management; and,
- Suggest the design, presentation, and potential initial steps to implement the Net Zero Transition Plan.

Work Plan

	00	01	02	03	04
	Project Initiation	Information Collation and Stakeholder Engagement	Baselining and Target Setting	Identification and Prioritization	Implementation Roadmap
Objective	› Kickoff › Review timeline and workplan › Create list of relevant stakeholders and documents/database	› Develop a thorough understanding of TO Live's current state › Review relevant documents › Engage and collaborate with relevant stakeholders	› Advise TO Live on how to establish a reliable GHG emissions baseline based on industry practices › Identify suggested performance targets and matrices that will be used to measure the progress of emissions reduction actions	› Understand the landscape of potential reduction scenarios › Identify a long list of potential emission reduction opportunities › Evaluate impacts and feasibility	› Develop recommendations detailing the roadmap › Identify annual budget requirement › Summarize studies
Activities	› Kick-off meeting › Create Project Charter › Identify and agree on document review list › Develop and agree TOCs	› Conduct document and database review › Identify relevant stakeholders and create stakeholder engagement plan	› Provide a suggested GHG baseline for TO Live operations and individual facilities › Suggest performance targets and metrics › Conduct gap analysis	› Identify emission reduction opportunities and four scenarios › Establish criteria and assess opportunities › Propose a prioritized list of opportunities	› Propose implementation plan › Draft suggested annual budget requirement › Propose TO Live Net Zero Roadmap › Final report and presentation

Appendix C

Data and Documents Reviewed



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Document and Data List

#	Name
Documents	
1	Asset register list
2	Building condition assessments
3	Energy modelling reports
4	Energy audit reports
5	Meridian Hall Centre drawings
6	Meridian Arts Centre drawings
7	10 – year Capital Planning Budget
Data	
8	Natural gas consumption utility bills (2023)
9	Purchased steam utility bills (2023)
10	Diesel refuels (2023)
11	Purchased electricity consumption utility bills (2023)
12	Water usage utility bills (2023)
13	Waste audit reports (2023)
14	Purchased goods and services list of expenses (2023)

Appendix D

Modelling Assumptions

Sources



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Modelling Assumption Sources

Parameter	Assumption	Remarks	Sources
Prices			
Electricity	\$187/MWh	Price in year 2024	TO Live Electricity Bills
Natural gas	\$28/MWh	Price in year 2024	TO Live Natural Gas Bills
Steam	\$162/MWh	Price in year 2024	TO Live Steam Bill
Carbon tax	\$80/tCO ₂ e	Price in year 2024	Government of Canada
Escalations			
Electricity	3%/year	Increase in electricity price per year	1. Financial Accountability Office of Ontario (2022), Ontario's Energy and Electricity Subsidy Programs 2. The Electricity Forum (2024), Power bills to double by 2030 in Ontario
Natural gas	3%/year	Increase in natural gas price per year	PrimeXBT (April 2024), Natural gas prices forecast & predictions for 2024, 2025 & 2030
Carbon tax escalation	\$15/year	Increase in carbon tax per year until 2030	Government of Canada
Carbon tax escalation	3%/year	Increase in carbon tax price beyond 2030	Industry assumption
Inflation	2.5%	Annual increase on prices / costs	Bank of Canada, Monetary Policy Report (April 2024)



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