



Net Zero Transition Program

Final Report Presentation

TO Live

June 18, 2024

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Executive Summary



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Executive Summary (1/2)

Project Background

TO Live engaged KPMG and Rathco Eng to develop recommendations for a net zero transition program for their Meridian Hall (“MH”) and Meridian Arts Centre (“MAC”) theatres. The primary objectives of our work were to:

1. Propose a quantification process for baselining emissions and setting targets;
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

Location	2023 Facility Emissions (tCO ₂ e)				
	Natural Gas	Electricity	Steam	Diesel	Total
MH	8.8	67.5	442.9	0.2	519.4
MAC	243.7	47.9	0	0	291.6

Pathways Assessed & Scenario Development

To reach net zero, 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:

- 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.

From these pathways, 24+ technologies were analyzed and shortlisted down to six scenarios based on technical feasibility cost, control, and space constraints: four for Meridian Hall, and two for the Meridian Art Centre.

Executive Summary (2/2)

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: Steam to Hot Water + Wastewater Energy Exchange (WEE)
- Meridian Arts Centre: Heat Recovery Chillers (HRC)

Any residual emissions can be offset by purchasing offset credits aligned with the City's policy on purchasing offset credits to achieve net zero.

Criteria	Meridian Hall – Steam to Hot Water + WEE	Meridian Arts Centre – Heat Recovery Chillers	Outcome
CAPEX / OPEX	2 nd lowest CAPEX and OPEX cost among the reviewed scenarios, with long term OPEX savings compared to current business-as-usual (BAU) costs	Lowest CAPEX among reviewed scenarios. Increased OPEX costs over time compared to BAU costs	Net increase to CAPEX budget of \$19.5 M (+\$24.3 M for MH, -\$4.8 M for MAC) Net savings for OPEX budget of \$0.24 M (+\$0.48 M for MH, -\$0.24 M for MAC)
Emissions Reductions	Maximum emissions savings possible among the reviewed scenarios	Roughly equivalent emissions savings to the other scenario reviewed	85% reduction in emissions for MH 74% reduction in emissions for MAC
Suitability, Schedule, and Spatial Impact	Meets or excels against all three criteria, indicating the suggested scenario is realistically feasible		
Stakeholder Feedback on Scenario	Positive feedback from consulted internal stakeholders on ability to implement the proposed scenario		

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Emissions Baseline



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Introduction

Objective

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

- Propose a quantification process for baselining emissions and establishing performance metrics for TO Live’s operations and individual facilities;
- Provide recommendations on a transition plan to reach net zero by 2040; and,
- Set out initial steps for TO Live to consider on its Net Zero Transition Plan.

Energy and emissions sources

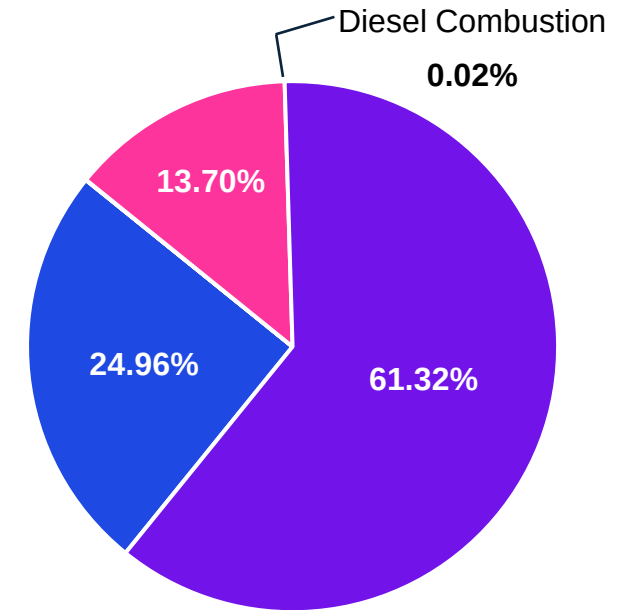
Meridian Hall		Meridian Arts Centre	
	Natural Gas		Natural Gas
	Electricity		Electricity
	Steam		Diesel
	Diesel		Refrigerants
	Refrigerants		

Scope 1 and 2 Emission Sources

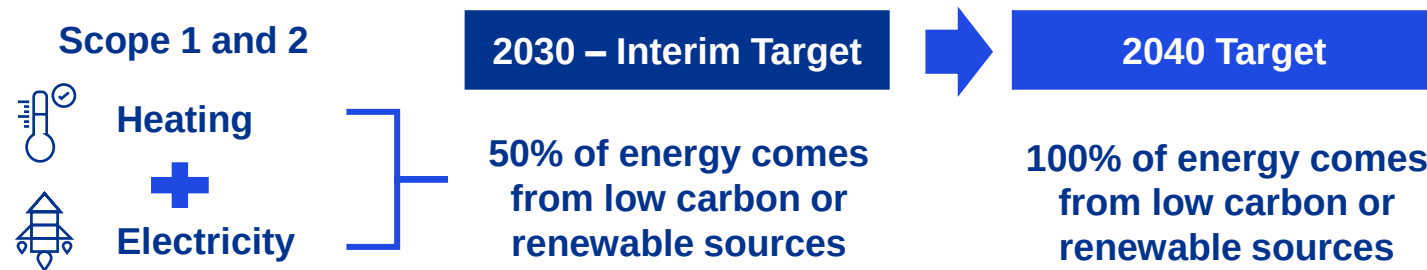
TO Live Baseline and Performance Targets

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



Performance Targets



- Purchased Steam
- Natural Gas Combustion
- Purchased Electricity

In-scope Emissions

Meridian Hall

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

The facility uses a hybrid energy distribution system:

- Space heating and DHW: Steam through Enwave
- Space cooling: Chillers

Meridian Arts Centre

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

The facility utilizes a hybrid energy distribution system:

- Space heating and DHW: Natural gas boilers
- Space cooling: Chillers

Facility	Domestic Hot Water	Space Heating	Cooling
Meridian Hall	Steam, Electric Resistance	Steam	Chiller + Cooling Tower
Meridian Arts Centre	DHW boiler	Space heating boiler	Chiller + Cooling Tower

Energy Source	Emissions (tCO ₂ e / year)	
	MH	MAC
Electricity	8.0	4.4
Steam	442.1	-
Natural gas	-	243.5
Total in-scope	450.1	247.9
Facility total	519.4	291.6
% in scope	87%	85%

2 Approach



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Approach



Step 01

Conduct a site visit for MH and MAC



Step 02

Conduct document and database review along with the stakeholder engagement



Step 03

Identify the list of decarbonization scenarios for implementation



Step 04

Assess the long-list of scenarios available for decarbonization



Step 05

Short-list scenarios for detailed analysis and modelling

Stakeholders consulted with

Completed 25+ hours of stakeholder meetings to understand appetite for specific changes to the facilities

Stakeholders

TO Live Project Leadership

TO Live Senior Leadership

TO Live building operators

Architectural consultants

City of Toronto Divisions

Utility providers & developers

Operators in peer venue facilities

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Decarbonization Pathways



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Decarbonization Pathways – MH (1/3)

Pathways #1

Retain the existing steam system and pursue fuel switching

Measures reviewed

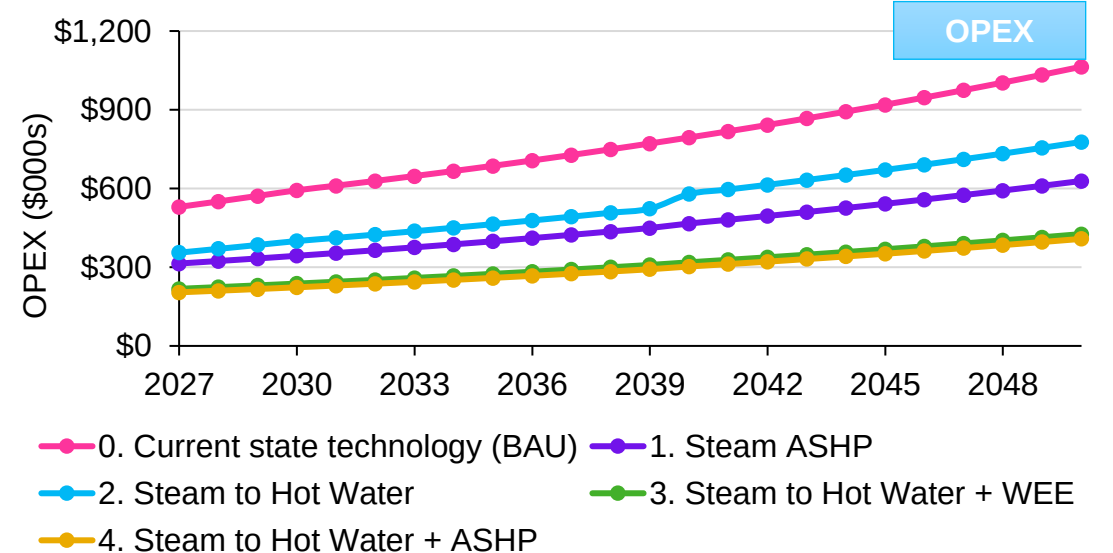
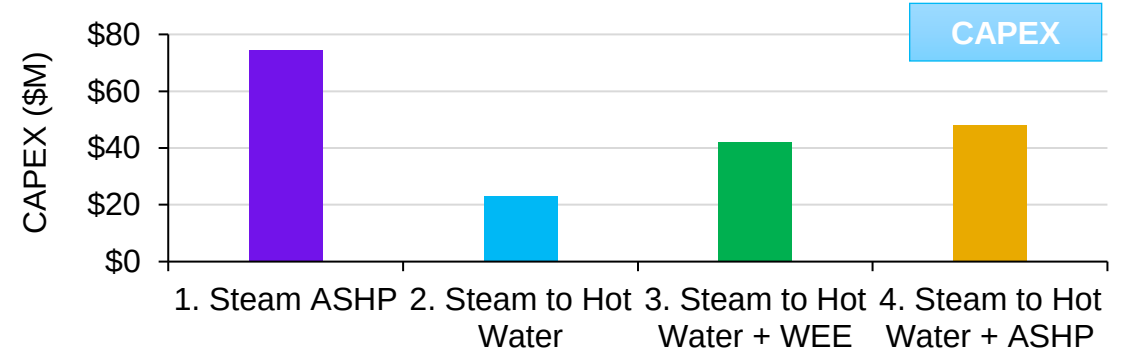
- Steam generating air source heat pump (ASHP)
- Solar PV rooftop

Pathways #2

Convert steam system to hot water and pursue fuel switching

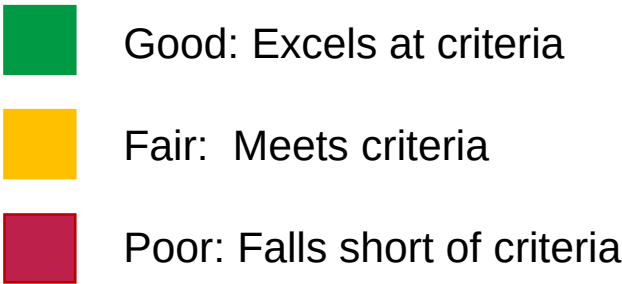
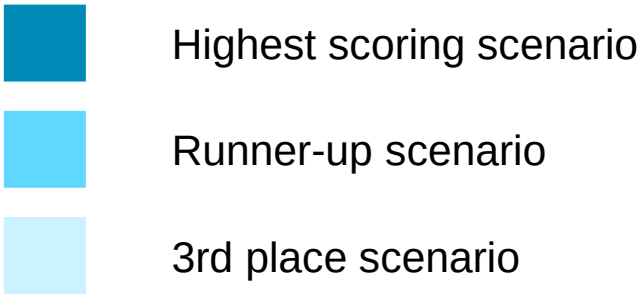
Measures reviewed

- Steam to hot water conversion, with Enwave steam system
- Steam to hot water conversion & wastewater energy exchange (WEE)
- Steam to hot water conversion & ASHP
- Solar PV rooftop



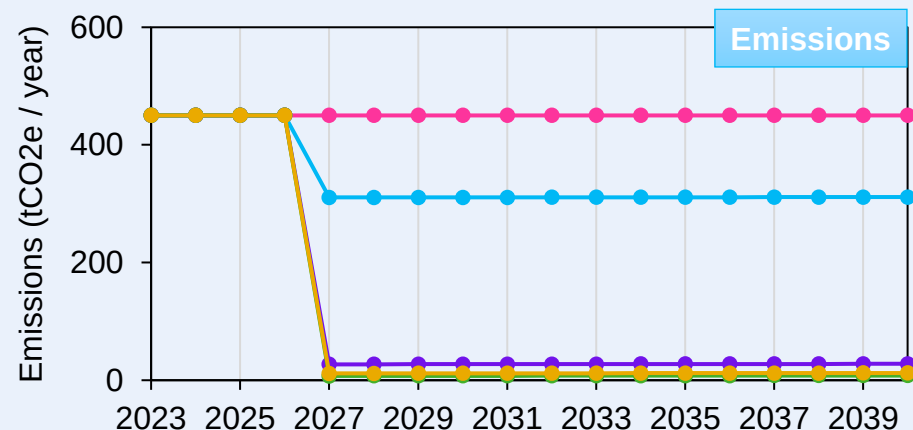
Decarbonization Pathways – MH (2/3)

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



Scenario	LCOE	GHG Reduction	Suitability	Schedule	Spatial Impact	Stakeholder Feedback	Overall
Scenario #1: Steam - ASHP	Poor	Good	Fair	Good	Fair	Poor	Poor
Scenario #2: Steam to Hot Water	Good	Poor	Poor	Good	Good	Poor	Poor
Scenario #3: Steam to Hot Water + WEE	Fair	Good	Good	Fair	Fair	Good	Good
Scenario #4: Steam to Hot Water + ASHP	Fair	Fair	Good	Good	Fair	Fair	Fair

Decarbonization Pathways – MH (3/3)



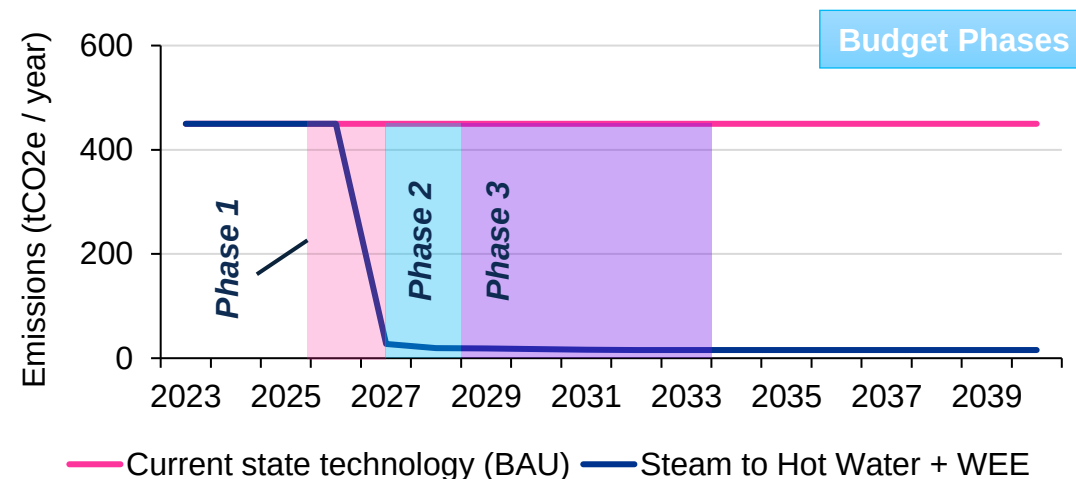
- 0. Current state technology (BAU)
- 1. Steam ASHP
- 2. Steam to Hot Water
- 3. Steam to Hot Water + WEE
- 4. Steam to Hot Water + ASHP

The residual emissions from each scenario is offset by purchasing carbon offset credit. The average offset cost for all scenarios is in the range of \$1,200 to \$9,000 per year except for scenario 2 (~\$46,000 per year).

Emission Reductions & Costs Across Phases

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

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



— Current state technology (BAU) — Steam to Hot Water + WEE

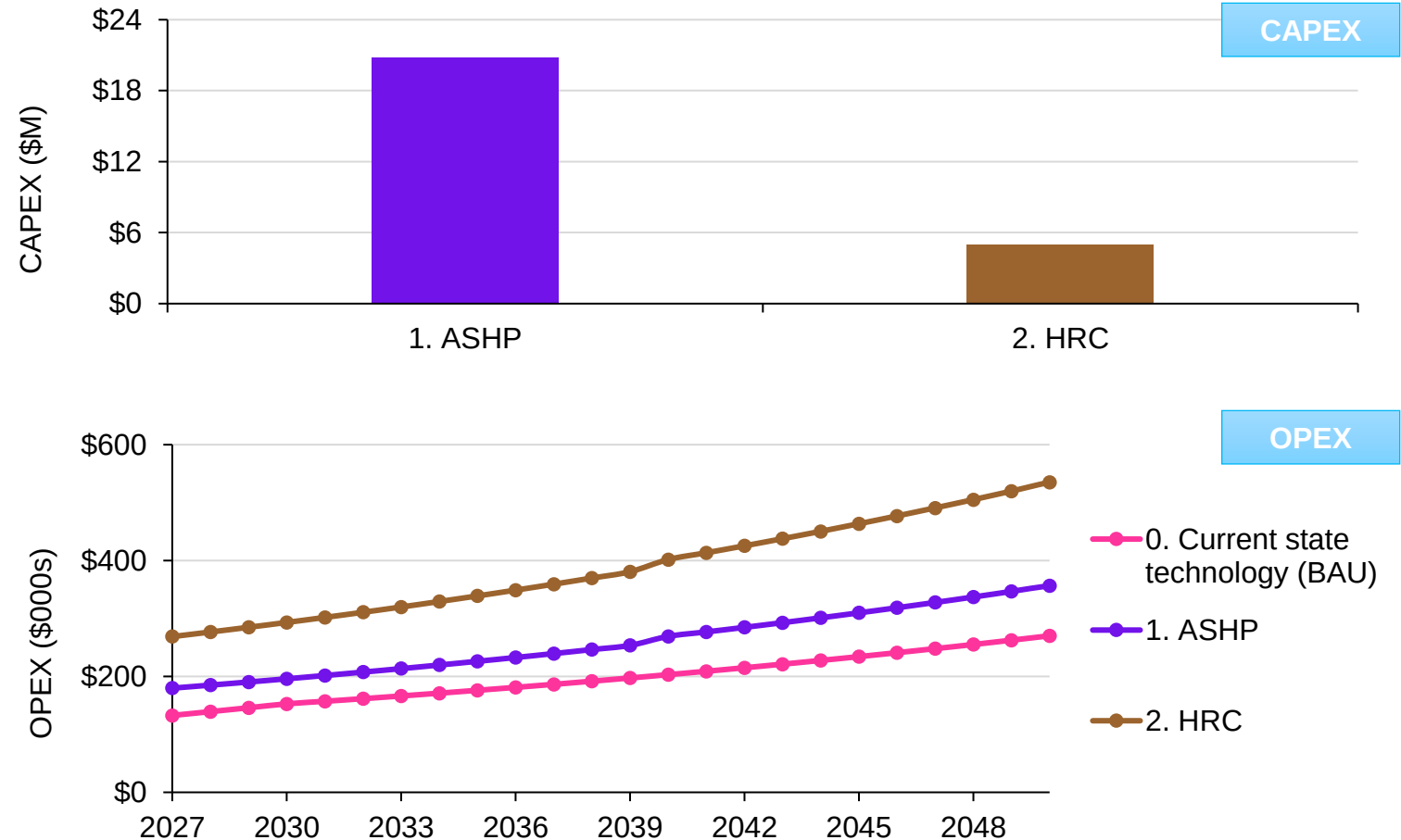
Decarbonization Pathways – MAC (1/3)

Pathways Assessed

Pursue fuel switching from existing natural gas heating system

Measures reviewed

1. Fuel Switching to Biomass Boilers
2. Electrification of Heat Energy using Air Source Heat pumps
3. Electrification using Heat Recovery Chillers and Electric Boilers
4. Solar PV rooftop



Decarbonization Pathways – MAC (2/3)

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



Good: Excels at criteria



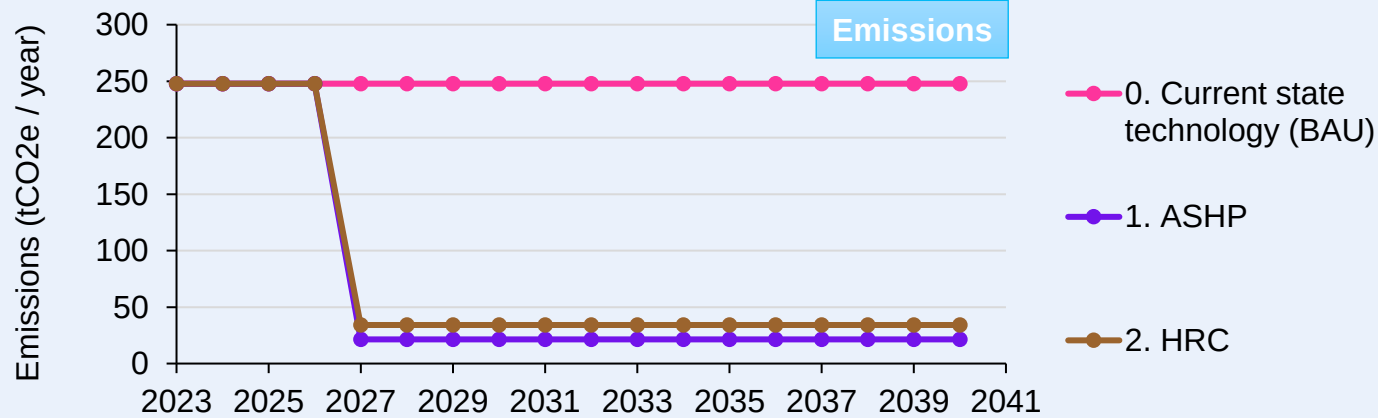
Fair: Meets criteria



Poor: Falls short of criteria

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

Decarbonization Pathways – MAC (3/3)

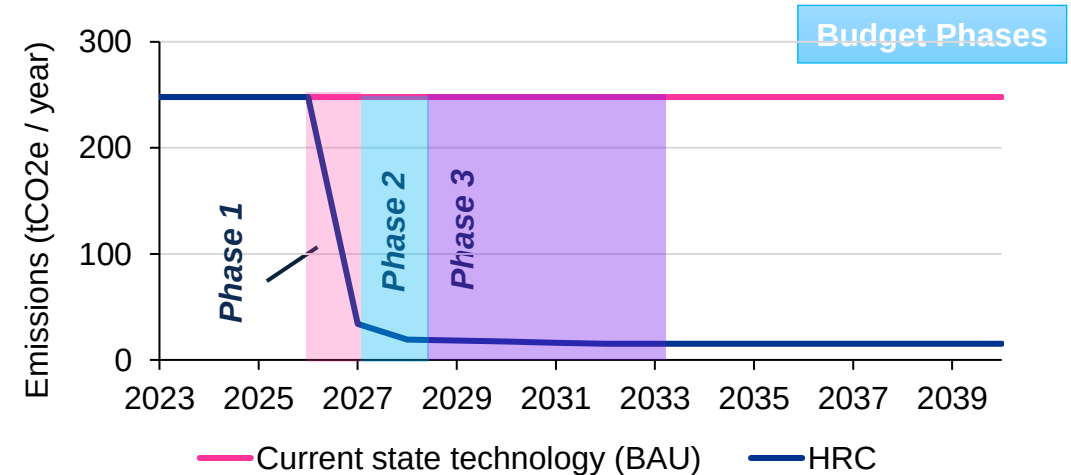


The residual emissions from each scenario is offset by purchasing carbon offset credit. The average offset cost for all scenarios is in the range of \$2,500 to \$6,000 per year.

Emission Reductions & Costs Across Phases

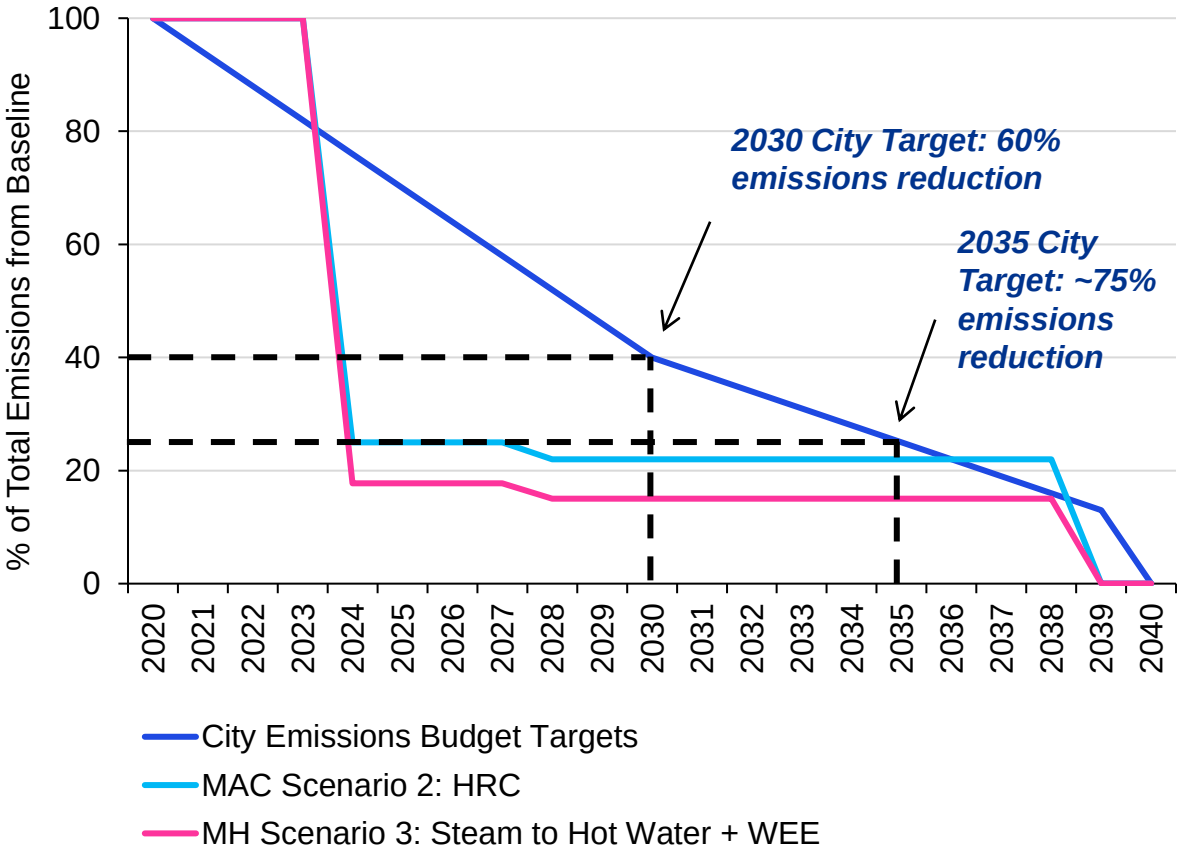
Selected: Scenario 2 – Heat Recovery Chiller (HRC)

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



Emissions Budget Submission

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



Targets	City of Toronto	MH	MAC
2025	30%	0% (519 tCO ₂ e)	0% (292 tCO ₂ e)
2030	60%	~85% (92 tCO ₂ e)	~75% (74 tCO ₂ e)
2035	75%	~85% (85 tCO ₂ e)	~75% (70 tCO ₂ e)
2040	100%	100%	100%

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