GENERAL ISSUES COMMITTEE
REPORT 22-016

9:30 a.m.
Monday, August 8, 2022
Council Chambers, City Hall, 2nd Floor
71 Main Street West, Hamilton, Ontario

Present: Mayor F. Eisenberger, Deputy Mayor J. P. Danko (Chair)
Councillors M. Wilson, J. Farr, N. Nann, R. Powers, T. Jackson, E. Pauls, B Clark, M. Pearson, L. Ferguson, A. VanderBeek, J. Partridge

Absent: Councillors T. Whitehead and S. Merulla – Personal
Councillor B. Johnson – Other City Business

THE GENERAL ISSUES COMMITTEE PRESENTS REPORT 22-016, AND RESPECTFULLY RECOMMENDS:

1. Hamilton's Climate Action Strategy Implementation Resources and Governance (CM22016/PED22058(a)/HSC22030(a)) (City Wide) (Item 8.1)

(a) That the final "ReCharge Hamilton – Our Community Energy + Emissions Plan" (CEEP), attached as Appendix "A" to Report 22-016, be approved and that it comprise the climate change mitigation component of the City's Climate Action Strategy;

(b) That the final "Climate Change Impact Adaptation Plan" (CCIAP), attached as Appendix "B" to Report 22-016, be approved and that it comprise the climate change adaptation component of the City's Climate Action Strategy;

(c) That the following supporting studies and reports be received:

(i) Hamilton's Climate Action Strategy - Final Consultation Report attached as Appendix "A" to Report CM22016/PED22058(a)/HSC22030(a);

(ii) How Much Is Climate Change Costing Canadian Communities Report, attached as Appendix "B" to Report CM22016/PED22058(a)/HSC22030(a); and,

(iii) Hamilton's Climate Action Strategy Departmental Resource Considerations Table, attached as Appendix "E" to Report CM22116/PED22058(a)/HSC22030(a);

(d) That staff be directed to prepare a Draft Terms of Reference for a Climate Change Advisory Committee of Council for the 2022-2026 Council Term, that will help guide the implementation of the City's Climate Action Strategy, and which includes a composition that ensures a diverse representation of Hamilton's community;

(e) That the City Manager be authorized and directed to establish a Climate Change Office within the Planning and Economic Development Department to lead the implementation of the City's Climate Action Strategy, and to implement the following changes within the Planning and Economic Development Department:

(i) create a Director of Climate Change Initiatives position within the Climate Change Office representing an estimated annual cost of $215,000 inclusive of salary and non-salary costs (1 permanent FTE); and,

(ii) transfer the Senior Project Manager, Air Quality and Climate Change (1 FTE) from Public Health Services, Healthy and Safe Communities Department, to the Climate Change Office within the Planning and Economic Development Department, with no impact on the levy;

(f) That the creation of two additional permanent positions within the Climate Change Office to support the implementation of Hamilton's Climate Action Strategy and to support the community and stakeholder engagement component of the Climate Action Strategy, be brought forward for Council's consideration as part of the 2023 Operating Budget;

(g) That the General Manager of Planning and Economic Development and the General Manager of Public Works, in consultation with the Executive Director of Human Resources, be directed to review the function and role of the Energy Office within the Energy, Fleet and Facilities Management Division of Public Works, and any other potential service areas, and report back to the General Issues Committee with any recommended organizational changes that would align and integrate the work of the

Energy Office or other service areas with that of the Climate Change Office;

(h) That the City of Hamilton's annual contribution of $160,000 towards the Bay Area Climate Change Office (BACCO), be referred to the 2023 Operating Budget for consideration;

(i) That, subject to Council's approval of funding through the 2023 Operating Budget, the City Manager be authorized and directed to negotiate, enter into and execute a Funding Agreement / Memorandum of Understanding with Mohawk College for the continuation of the City's participation in the Bay Area Climate Change Office, in a form satisfactory to the City Solicitor, with the funding to be administered through the Climate Change Office, Planning and Economic Development Department; and,

(j) That the following items on the Outstanding Business Lists (OBL), be removed:

(i) Item LL (General Issues Committee OBL) - General Issues Committee June 1, 2022, Item 2, respecting final public consultation, advisory committee structure and governance and organization structure and resourcing for Hamilton's Climate Action Strategy;

(ii) Item 19-L (Emergency & Community Services Committee OBL) - General Issues Committee December 19, 2021, Item 4, respecting Implementation and Resources Required re: Corporate Goals and Areas of Focus for Climate Mitigation & Adaptation; and,

(iii) Item 19-I (Audit Finance & Administration Committee OBL) - General Issues Committee December 19, 2021, Item 4, respecting Implementation and Resources Required re: Corporate Goals and Areas of Focus for Climate Mitigation & Adaptation.

2. Hamilton Regional Decarbonization Hub (CM22013/HSC22046/PED22176) (City Wide) (Item 8.2)

(a) That, should Transition Accelerator be successful in acquiring funding from the other partners in the Hamilton Region Decarbonization Hub, the Hamilton Region Decarbonization Hub, as outlined in Report CM220013/HSC22046/PED22176 and detailed in Appendices "C" and Appendix "D" to Report 22-016, be approved;

(b) That, should Transition Accelerator be successful in acquiring funding from the other partners in the Hamilton Region Decarbonization Hub, as

outlined in Appendix "C" to Report 22-016, staff be authorized and directed to contribute 7.5 percent of total 4-year funding, or up to a maximum of $240,000 for the Hub, to be funded equally between the Economic Development Investment Reserve Account 112221, Climate Change Reserve Account 108062 and Smart City Capital Project Account 3381959501;

(c) That, should the Transition Accelerator be successful in obtaining the funding, as outlined in Appendix "C" to Report 22-016, the single source procurement, pursuant to Procurement Policy #11 – Non-competitive Procurements, for technical and expert consulting services for Hamilton Regional Decarbonization Hub, at the upset limit of $240,000, be approved;

(d) That the City Manager be authorized and directed to negotiate, enter into and execute a Funding Agreement / Memorandum of Understanding and any ancillary documents required to give effect thereto, with Transition Accelerator and any additional partners in relation to the Hamilton Region Decarbonization Hub, in a form satisfactory to the City Solicitor; and,

(e) That staff be directed to report back to the General Issues Committee once funding, from the other partners in the Hamilton Region Decarbonization Hub, is secured with that report to include details on governance, evaluative framework and Key Performance Indicators.

3. 2023 - 2025 Multi-Year Outlook and Capital Financing Plan Update (FCS22064) (City Wide) (Item 8.3)

(a) That the City of Hamilton continue to seek opportunities to partner with senior levels of government in addressing ongoing recovery efforts related to the COVID-19 pandemic in 2022 and 2023;

(b) That the City of Hamilton appeal to the Province of Ontario for added financial support to address the housing crisis, as well as, additional support for mental health and addiction programs; and,

(c) That staff be directed to develop a communications action plan to assist ongoing education and advocacy efforts related to the challenges the City of Hamilton is facing in its COVID-19 recovery efforts.

4. Update to the City's Green Fleet Strategy and Action Plan (PW03147(f)) (City Wide) (Item 10.1)

That Report PW03147(f), respecting the Update to the City's Green Fleet Strategy and Action Plan, be received.

5. Response to the Bay Area Climate Change Council's Options for Travel Report (PED22181) (Ward 1) (Item 10.2)

(a) That Report PED22181, respecting the Response to the Bay Area Climate Change Council's Options for Travel Report, be received;

(b) That Item 21 of Appendix "E" to Report 22-016, respecting the prevention of bike theft by bolstering the existing bike registry programs, be REFERRED to the Hamilton Police Services Board for consideration; and,

(c) That Item 31 of Appendix "E" to Report 22-016, respecting transportation data trends, be REFERRED to the Greater Bay Area Sub-Committee for consideration.

6. 2021 Municipal Tax Competitiveness Study (FCS22061) (City Wide) (Item 10.3)

That Report FCS22061, respecting the 2021 Municipal Tax Competitiveness Study, be received.

7. Increase in Capital Project Expenses (FCS22067) (City Wide) (Item 10.4)

(a) That Appendix "A", attached to Report FCS22067, detailing work-in-progress capital projects requiring additional funding as a result of extraordinary inflation and supply chain impacts, be received;

(b) That the financing plan recommending total additional funding of $27,322,634, outlined in Appendix "F" to Report 22-016, to address budgetary shortfalls in work-in-progress capital projects, be approved;

(c) That the General Issues Committee direction to report back on any and all approved Capital Projects that will require additional funding related to the economy and correlated supply and demand issues that have created the current economic crisis be considered complete and removed from the Outstanding Business List;

(d) That the General Manager, Finance and Corporate Services, be authorized and directed to negotiate and confirm the terms, placement and issuance of all debenture issue(s), and / or private placement debenture issue(s), in either a public or private market and / or bank loan agreements and debenture issue(s) and / or variable interest rate bank loan agreements and debenture issue(s), in an amount not to exceed $13,098,000 Canadian currency in Development Charges funded municipal debt for the projects, outlined in Appendix "F" to Report 22-016;

(e) That the General Manager, Finance and Corporate Services, be authorized and directed to engage the services of all required professionals to secure the terms and issuance of the debenture issue(s) described in Recommendation (d) including, but not limited to, external legal counsel, fiscal agents and Infrastructure Ontario's Loan Program and the cost of such services be funded from one of the following sources, as deemed appropriate by the General Manager, Finance and Corporate Services: Development Charge Reserves, Non-Obligatory Reserves, and other approved funding sources;

(f) That the General Manager, Finance and Corporate Services, be authorized and directed to enter into and administer, on behalf of the City of Hamilton, all agreements and necessary ancillary documents to implement Recommendation (d) and in order to secure the terms and issuance of the debenture issue(s) described in Recommendation (e), on terms and conditions satisfactory to the General Manager, Finance and Corporate Services, and in a form satisfactory to the City Solicitor;

(g) That the additional $298,750 required from the Investment Stabilization Reserve for the completion of the Waterfalls Viewing project (#4401856819) be added to the principal outstanding on the existing internal loan; and,

(h) That the additional $1,014,300 required from the Investment Stabilization Reserve for the completion of the Dewitt – Highway 8 to Barton project (#4031911025) be added to the principal outstanding on the existing internal loan.

8. Chedoke Creek Order - Procurement Update PW19008(p) (City Wide) (Item 10.5)

That Purchase Order #97465 for Wood Canada Ltd. be increased by $780,156 and funded from Project ID. No. 5162168777, pursuant to Procurement Policy #11 (Non-competitive Procurements), for consultant services including project management, contract administration, and post construction monitoring services for the implementation of the Targeted Dredging of Chedoke Creek.

9. Red Hill Valley Parkway Inquiry Update (LS19036(m)) (City Wide) (Item 10.6)

That the revised estimated total cost of the Red Hill Valley Parkway Judicial Inquiry of up to $26,000,000, to be funded through the Tax Stabilization Reserve (110046), be approved.

10. Downtown Entertainment Precinct Master Agreement Update (PED18168(h)) (Ward 2) (Item 10.7)

(a) That staff be authorized and directed to amend the Master Agreement such that a non-HUPEG controlled entity, under the control of Oak View Group, could become the Tenant of a head lease contemplated in the Master Agreement, on terms satisfactory to the General Manager of Planning and Economic Development Department or their delegate, and in a form satisfactory to the City Solicitor; and,

(b) That the Mayor and City Clerk be authorized and directed to execute any and all necessary documents related to the amended Master Agreement, in a form satisfactory to the City Solicitor.

11. City Hall Safety Plan (HUR22012) (City Wide) (Item 10.8)

That Report HUR22012, respecting the City Hall Safety Plan, be received.

12. Definition of Affordable Housing (HSC22051/PED22183) (City Wide) (Item 10.9)

That Report HSC22051/PED22183, respecting the Definition of Affordable Housing, be received.

13. Advisory Committee for Persons with Disabilities Report 22-009, July 12, 2022 (Item 10.10)

(a) Items for Approval for the Accessibility Fair - Ability First, October 5, 2022 (Item 7.3(c))

WHEREAS, the Outreach Working Group of the Advisory Committee for Persons with Disabilities is planning an event, "Ability First", in the Forecourt of City Hall on October 5th from 11:00 a.m. until 3:30 p.m. to promote accessibility for all, no matter your ability;

WHEREAS, Ability First will be an interactive event and attracting people to attend will be a key component to its success;

WHEREAS, the media and website currently under construction require Council approval before release to the public; and,

WHEREAS, there are some details of the event that are still being finalized, but the media's basic layout and website structure will not change after approval;

THEREFORE, BE IT RESOLVED:

(i) That the draft media and website content, attached as Appendices "G" through "K" of Report 22-016, for the Advisory Committee for Persons with Disabilities' "Ability First" event to be held October 5, 2022 from 11:00 a.m. to 3:30 p.m., be approved for release to the public; and,

(ii) That the organizers of the "Ability First" event, to be held October 5 from 11:00 a.m. to 3:30 p.m., be granted permission to make minor changes to the media and website content to reflect changes to the event planning, subject to the approval by the Outreach Working Group of the Advisory Committee for Persons with Disabilities.

(b) Motion respecting In-person and Virtual Collaborative Roundtable Meeting to Discuss Changes and Challenges to Public Transportation in Hamilton (Added Item 7.4 (c))

WHEREAS, the Transportation Working Group of the Advisory Committee for Persons with Disabilities respectfully requests permission to organize and host a meeting in collaboration with Accessible Transportation Services' Annual Accessibility Event in order to provide updated information and learning about the issues faced by Hamiltonians; and,

WHEREAS, representatives of the Transportation Working Groups from other City Volunteer Advisory Committees as well as representatives from various community organizations, stakeholders (such as Canadian National Institute for the Blind, Multiple Sclerosis Society, and the Canadian Hard of Hearing Association, etc.), and the Accessible Transportation Services will benefit from the knowledge of the shared challenges faced during these challenging times;

THEREFORE, BE IT RESOLVED:

That members of the Transportation Working Group of the Advisory Committee for Persons with Disabilities be authorized to organize and host an in-person and virtual collaborative roundtable meeting by the end of 2022 with key stakeholders and staff experts, for the purpose of discussing changes and challenges to public transportation in Hamilton in the new normal.

14. Amendments to the Outstanding Business List – Items to be Referred to Another Standing Committee (Item 13.1.b.a.)

That the matter, respecting the Security Report on Theft and Vandalism Prevention in City-Owned Spaces - Results of 2-Year Pilot Program, with a due date of February 15, 2023, be REFERRED to the Public Works Committee.

15. Directions on a Potential Litigation Matter (LS22028) (City Wide) (Item 14.2)

(a) That direction provided to staff in Closed Session, respecting Report LS22028 – Directions on a Potential Litigation Matter, be approved; and,

(b) That Report LS22028, respecting Report LS22028 – Directions on a Potential Litigation Matter, remain confidential.

16. Red Hill Valley Parkway Inquiry Update (LS19036(n)) (City Wide) (Item 14.3)

That Report LS19036(n), respecting the Red Hill Valley Parkway Inquiry Update be received and remain confidential.

FOR INFORMATION:

(a) APPROVAL OF AGENDA (Item 2)

The Committee Clerk advised of the following changes to the agenda:

5. COMMUNICATIONS

5.1. Correspondence respecting Item 8.1 - Report CM22016/PED22058(a)/HSC22030(a) Hamilton's Climate Action Strategy Implementation Resources and Governance

a. Sophie Wilkinson

b. Chris and Theresa Cardey

c. Carolanne Forster

d. Liz Koblyk

e. Joseph and Stephanie Mancini

f. Ginny Pearce

g. Chris Wiebe, National Trust Canada

h. Gord McNulty

i. Marie Covert

j. Jennifer Waring

k. Laura Palumbo

l. Wayne Poole, Association of Dundas Churches

m. Dr. Sarah Sheehan, The Friends of St. Giles

n. Mary Love, Council of Canadians Hamilton Chapter

Recommendation: Be received and referred to the consideration of Item 8.1.

5.2 Correspondence from Hamilton Chamber of Commerce respecting Item 8.2 – Report CM22013/HSC22046/PED22176 , Hamilton Region Decarbonization Hub

Recommendation: Be received and referred to the consideration of Item 8.2.

5.3 Correspondence from Jeffrey Cowan and David Inkey, Hamilton Community Enterprises, respecting Item 8.1 Report CM22016/PED22058(a)/HSC22030(a), Hamilton's Climate Action Strategy Implementation Resources and Governance; and, Item 8.2 – Report CM22013/HSC22046/PED22176, Hamilton Region Decarbonization Hub

Recommendation: Be received and referred to the consideration of Items 8.1 and 8.2.

6. DELEGATION REQUESTS

6.1. Respecting Item 8.1 – Report CM22016/PED22058/HSC22030(a), Hamilton's Climate Action Strategy Implementation and Governance (for the August 8, 2022 GIC)

c. Dave Carson

d. David Hitchcock

e. Ian Borsuk, Environment Hamilton

f. Jan Willem Jansen – Video Presentation

g. Zoe Green – Video Presentation

h. Cynthia Meyer – Video Presentation

i. Joanna Sargent - WITHDRAWN

j. Ed Reece - WITHDRAWN

k. Don McLean

l. Miriam Sagar

m. Lucia Lannantuono, Hamilton 350

n. Jennifer Waring - WITHDRAWN

o. Alex Wilson

p. Anne Washington, Association of Dundas Churches

q. Sue Markey, Hamilton 350

6.2. Jeffrey Cowan, Hamilton Community Enterprises, respecting Item 8.1 – Report CM22016/PED22058/HSC22030(a), Hamilton's Climate Action Strategy Implementation and Governance; and, Item

8.2 – Report CM22013/HSC20046/PED22176, Hamilton Regional Decarbonization Hub (for the August 8, 2022 GIC)

The agenda for the August 8, 2022 General Issues Committee meeting was approved, as amended.

(b) DECLARATIONS OF INTEREST (Item 3)

There were no declarations of interest.

(c) APPROVAL OF MINUTES OF PREVIOUS MEETING (Item 4)

(i) July 4, 2022 (Item 4.1)

The Minutes of the July 4, 2022 General Issues Committee meeting were approved, as presented.

(d) COMMUNICATION ITEMS (Item 5)

The Communication Items were approved, as follows:

(i) Correspondence respecting Item 8.1 Report CM22016/PED22058(a)/HSC22030(a) Hamilton's Climate Action Strategy Implementation Resources and Governance (Item 5.1)

1. Sophie Wilkinson
2. Chris and Theresa Cardey
3. Carolanne Forster
4. Liz Koblyk
5. Joseph and Stephanie Mancini
6. Ginny Pearce
7. Chris Wiebe, National Trust Canada
8. Gord McNulty
9. Marie Covert

10. Jennifer Waring

11. Laura Palumbo

12. Wayne Poole, Association of Dundas Churches

13. Dr. Sarah Sheehan, The Friends of St. Giles

14. Mary Love, Council of Canadians Hamilton Chapter

Recommendation: Be received and referred to the consideration of Item 8.1

(ii) Correspondence from Hamilton Chamber of Commerce respecting Item 8.2 – Report CM22013/HSC22046/PED22176 - Hamilton Region Decarbonization Hub (Item 5.2)

Recommendation: Be received and referred to the consideration of Item 8.2

(ii) Correspondence from Jeffrey Cowan and David Inkey, Hamilton Community Enterprises, respecting Item 8.1 Report CM22016/PED22058(a)/HSC22030(a) Hamilton's Climate Action Strategy Implementation Resources and Governance and Item 8.2 – Report CM22013/HSC22046/PED22176 - Hamilton Region Decarbonization Hub (Item 5.3)

Recommendation: Be received and referred to the consideration of Item 8.1 and Item 8.2.

(e) DELEGATION REQUESTS (Item 6)

The following delegation requests were approved for the August 8, 2022 General Issues Committee:

(i) Respecting Item 8.1 – Report CM22016/PED22058/HSC22030(a) – Hamilton's Climate Action Strategy Implementation and Governance (Item 6.1)

1. Peter Appleton

2. Tom Cooper, Hamilton Roundtable for Poverty Reduction

3. Dave Carson

4. David Hitchcock

5. Ian Borsuk, Environment Hamilton

6. Jan Willem Jansen – Video Presentation

7. Zoe Green – Video Presentation

8. Cynthia Meyer – Video Presentation

9. Don McLean

10. Miriam Sagar

11. Lucia Lannantuono, Hamilton 350

12. Alex Wilson

13. Anne Washington, Association of Dundas Churches

14. Sue Markey, Hamilton 350

(b) Jeffrey Cowan, Hamilton Community Enterprises, respecting Item 8.1 – Report CM22016/PED22058/HSC22030(a) – Hamilton's Climate Action Strategy Implementation and Governance and Item 8.2 – Report CM22013/HSC20046/PED22176 – Hamilton Regional Decarbonization Hub (Item 6.2))

(f) STAFF PRESENTATIONS (Item 8)

(i) Hamilton's Climate Action Strategy Implementation Resources and Governance (CM22016/PED22058(a)/HSC22030(a)) (City Wide) (Item 8.1)

Janette Smith, City Manager, introduced the presentation respecting Report CM22016/PED22058(a)/HSC22030(a) - Hamilton's Climate Action Strategy Implementation Resources and Governance.

The presentation was continued by Trevor Imhoff, Senior Project Manager, Air Quality & Climate Change; and, Christine Newbold, Manager, Community Planning & GIS.

The presentation respecting Report CM22016/PED22058(a)/HSC22030(a) - Hamilton's Climate Action Strategy Implementation Resources and Governance was received.

Consideration of Report CM22016/PED22058(a)/HSC22030(a) Hamilton's Climate Action Strategy Implementation Resources and Governance, was DEFERRED until the delegates have been heard.

For disposition of this matter, please refer to Item 1.

(ii) Hamilton Regional Decarbonization Hub (CM22013/HSC22046/PED22176) (City Wide) (Item 8.2)

Cyrus Tehrani, Chief Digital Officer & Director of Innovation, introduced the presentation respecting Report CM22013/HSC22046/PED22176, Hamilton Regional Decarbonization Hub.

Dan Wicklum, Chief Executive Officer, Transition Accelerator; and, Dinara Millington, Senior Advisor, Transition Accelerator, continued with the presentation.

The presentation, respecting Report CM22013/HSC22046/PED22176, Hamilton Regional Decarbonization Hub, was received.

Consideration of Report CM22013/HSC22046/PED22176, Hamilton Regional Decarbonization Hub, was DEFERRED until the delegates have been heard.

1. Amendment to Sub-Section (a) of Report CM220013/HSC22046/PED22176

Sub-section (a) to Report CM220013/HSC22046/PED22176, respecting Hamilton Regional Decarbonization Hub, ***was amended*** by adding the words "***should Transition Accelerator be successful in acquiring funding from the other partners in the Hamilton Region Decarbonization Hub"***, to read as follows:

(a) That, ***should Transition Accelerator be successful in acquiring funding from the other partners in the Hamilton Region Decarbonization Hub***, the Hamilton Region Decarbonization Hub, as outlined in Report CM220013/HSC22046/PED22176 and detailed in Appendix "A" and Appendix "B" to Report CM220013/HSC22046/PED22176, be approved;

2. **Addition of new Sub-Section (e) to Report CM220013/HSC22046/PED22176**

Report CM220013/HSC22046/PED22176, respecting Hamilton Regional Decarbonization Hub, ***was further amended*** by adding a new sub-section (e), to read as follows:

(e) ***That staff be directed to report back to the General Issues Committee once funding from the other partners in the Hamilton Region Decarbonization Hub is secured, with that report to include details on governance, evaluative framework and Key Performance Indicators.***

For disposition of this matter, please refer to Item 2.

(iii) 2023 - 2025 Multi-Year Outlook and Capital Financing Plan Update (FCS22064) (City Wide) (Item 8.3)

The presentation and consideration of Report FCS22064, respecting the 2023 - 2025 Multi-Year Outlook and Capital Financing Plan Update, was DEFERRED until after consideration of Item 8.2.

Mike Zegarac, General Manager, Finance & Corporate Services provided the presentation respecting Report FCS22064, 2023 - 2025 Multi-Year Outlook and Capital Financing Plan Update.

The presentation, respecting Report FCS22064, 2023 - 2025 Multi-Year Outlook and Capital Financing Plan Update, was received.

For disposition of this matter, please refer to Item 3.

(g) PUBLIC HEARINGS / DELEGATIONS (Item 9)

The following delegations were received:

(i) Respecting Item 8.1 – Report CM22016/PED22058/HSC22030(a) – Hamilton's Climate Action Strategy Implementation and Governance (Item 6.1)

1. Peter Appleton
2. Tom Cooper, Hamilton Roundtable for Poverty Reduction
3. Dave Carson

4. David Hitchcock
5. Ian Borsuk, Environment Hamilton
6. Jan Willem Jansen – Video Presentation
7. Zoe Green – Video Presentation
8. Cynthia Meyer – Video Presentation
9. Don McLean
10. Miriam Sagar
11. Lucia Lannantuono, Hamilton 350
12. Alex Wilson
13. Anne Washington, Association of Dundas Churches
14. Sue Markey, Hamilton 350

(ii) Jeffrey Cowan, Hamilton Community Enterprises, respecting Item 8.1 – Report CM22016/PED22058/HSC22030(a) – Hamilton's Climate Action Strategy Implementation and Governance; and, Item 8.2 – Report CM22013/HSC20046/PED22176 – Hamilton Regional Decarbonization Hub (Item 6.2)

The General Issues Committee recessed for one half hour until 1:50 p.m.

(h) DISCUSSION ITEMS (Item 10)

(i) Response to the Bay Area Climate Change Council's Options for Travel Report (PED22181) (Ward 1) (Item 10.2)

Deputy Mayor Danko turned the Chair over to Councillor Pauls in order to speak to this matter.

Report PED22181, respecting the Response to the Bay Area Climate Change Council's Options for Travel Report, ***was amended*** by adding new sub-sections (b) and (c), to read as follows:

(b) That Item 21 of Appendix "A" to Report PED22181, respecting the prevention of bike theft by bolstering the existing bike registry programs, be REFERRED to the Hamilton Police Services Board for consideration; and,

(c) That Item 31 of Appendix "A" to Report PED22181, respecting transportation data trends, be REFERRED to the Greater Bay Area Sub-Committee for consideration.

Deputy Mayor Danko assumed the Chair.

For disposition of this matter, please refer to Item 5.

(i) GENERAL INFORMATION / OTHER BUSINESS (Item 13)

(a) Amendments to the Outstanding Business List (Item 13.1)

The following amendments to the General Issues Committee's Outstanding Business List were approved:

(1) Items to be Removed (Item 13.1.a.)

(aa) Pilot Program, Partnership Between Hamilton Civic Museums and Hamilton Public Library for Free Museum Admission
(Addressed as item 10.1 on the June 15, 2022 GIC agenda - Report PED20069(a)) (Item 13.1.a.a.)

(bb) Occupancy Agreement(s), with The Cardus Institute for the adaptive reuse of the Balfour House/Chedoke Estate
(Addressed at the May 18, 2022 GIC as Item 10.2 - Report PED19168(c)) (Item 13.1.a.b.)

(cc) City of Hamilton Public Engagement Policy
(Addressed at the July 4, 2022 GIC as Item 10.5 - Report CM21011(a)) (Item 13.1.a.c.)

(dd) Response to the Bay Area Climate Change Council's Options for Travel Report
(Addressed on this agenda as Item 10.2 - Report PED22181) (Item 13.1.a.d.)

(ee) Response to the Bay Area Climate Change Council's Options for Travel Report
(Addressed as Item 10.2 on today's agenda - Report PED22181) (Item 13.1.a.e.)

(ff) Hamilton's Climate Change Strategy
(Addressed on this agenda as Item 8.1 - Report PED22058(a)/HSC22030(a)) (Item 13.1.a.f.)

(2) Proposed New Due Dates (Item 13.1.c)

(aa) Annual Update - Implementation of the Public Art Master Plan (Item 13.1.c.a.)
Current Due Date: September 21, 2022
Proposed New Due Date: November 30, 2022

(bb) Updated Hamilton Tourism Strategy (Item 13.1.c.b.)
Current Due Date: August 8, 2022
Proposed New Due Date: November 30, 2022

(cc) Health -Related Incidents Associated with Exposure to Contaminated Waterways in the Chedoke Creek and Cootes Paradise (Item 13.1.c.c.)
Current Due Date: November 30, 2022
Proposed New Due Date: March 22, 2023

(j) PRIVATE & CONFIDENTIAL (Item 14)

(a) The Closed Session Minutes of the July 4, 2022 General Issues Committee meeting were approved; and,

(b) The Closed Session Minutes of the July 4, 2022 General Issues Committee meeting shall remain confidential.

Committee moved into Closed Session to discuss Items 14.2 and 14.3, pursuant to Section 9.1, Sub-sections (a), (e), (f), (i) and (k) of the City's Procedural By-law 21-021, as amended, and Section 239(2), Sub-sections (a), (e), (f), (i) and (k) of the *Ontario Municipal Act*, 2001, as amended, as the subject matters pertain to the security of the property of the municipality or local board; litigation or potential litigation, including matters before administrative tribunals, affecting the municipality or local board; advice that is subject to solicitor-client privilege, including communications necessary for that purpose; a trade secret or scientific, technical, commercial, financial or labour relations information, supplied in

confidence to the municipality or local board, which, if disclosed, could reasonably be expected to prejudice significantly the competitive position or interfere significantly with the contractual or other negotiations of a person, group of persons, or organization; and, a position, plan, procedure, criteria or instruction to be applied to any negotiations carried on or to be carried on by or on behalf of the municipality or local board.

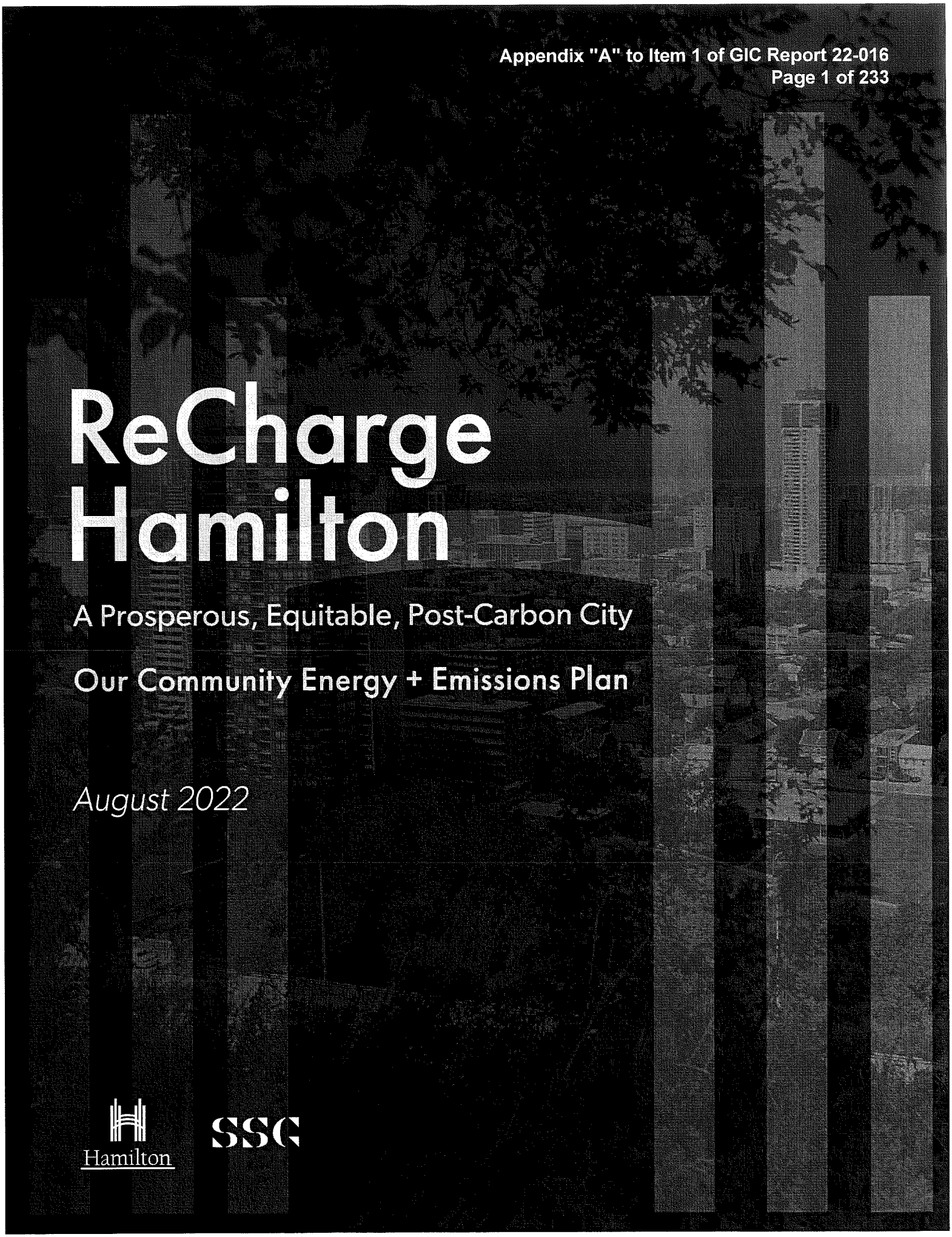
(k) ADJOURNMENT (Item 15)

There being no further business, the General Issues Committee adjourned at 6:39 p.m.

Respectfully submitted,

J. P. Danko, Deputy Mayor
Chair, General Issues Committee

Stephanie Paparella
Legislative Coordinator,
Office of the City Clerk



ReCharge Hamilton

A Prosperous, Equitable, Post-Carbon City

Our Community Energy + Emissions Plan

August 2022

Hamilton

SSG

Contributors

City of Hamilton:

Christine Newbold, Spencer Skidmore, Tom Chessman, Trevor Imhoff, Andrea McDowell

SSG/whatIf? Technologies:

Yuill Herbert, Kyra Bell-Pasht, John Kohng, Ralph Torrie, Stephen Salter, Naomi Devine, Penny Beames

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Figures

1.0 Land Acknowledgement

The City of Hamilton is situated upon the traditional territories of the Erie, Neutral, Huron-Wendat, Haudenosaunee, and Mississaugas. This land is covered by the Dish With One Spoon Wampum Belt Covenant, which was an agreement between the Haudenosaunee and Anishinaabek to share and care for the resources around the Great Lakes. We further acknowledge that this land is covered by the Between the Lakes Purchase, 1792, between the Crown and the Mississaugas of the Credit First Nation.

Today, the City of Hamilton is home to many Indigenous people from across Turtle Island (North America) and we recognize that we must do more to learn about the rich history of this land so that we can better understand our roles as residents, neighbours, partners, and caretakers.

2.0 Message from the Mayor

3.0 Acknowledgements

Sincere thank you to the dozens of members of the community that participated on the Stakeholder Advisory Committee (SAC), giving their time and energy over nearly two years. SAC members spent hours learning about Hamilton's energy and emissions profile, as well as climate action best practices. Members shared their expertise to create a Plan for all Hamiltonians.

Hamilton Community Stakeholder Advisory Committee organizations:

- Alectra Utilities
- ArcelorMittal Dofasco
- Bay Area Climate Change Council
- CityHousing Hamilton
- Centre for Climate Change Management at Mohawk College
- Clean Air Hamilton
- Enbridge
- Environment Hamilton
- Faith and the Common Good
- Hamilton Burlington Society of Architects
- Hamilton Chamber of Commerce
- Hamilton Health Sciences
- Hamilton Industrial Environmental Association
- Hamilton Community Enterprisesises Inc.
- Hamilton Oshawa Port Authority
- Hamilton-Wentworth Catholic District School Board
- Hydro One
- McCallumSather Architects
- McMaster University
- Mohawk College
- Neighbour 2 Neighbour Centre
- Smarter Alloys
- Sustainable Hamilton Burlington
- Stelco
- West End Home Builders Association

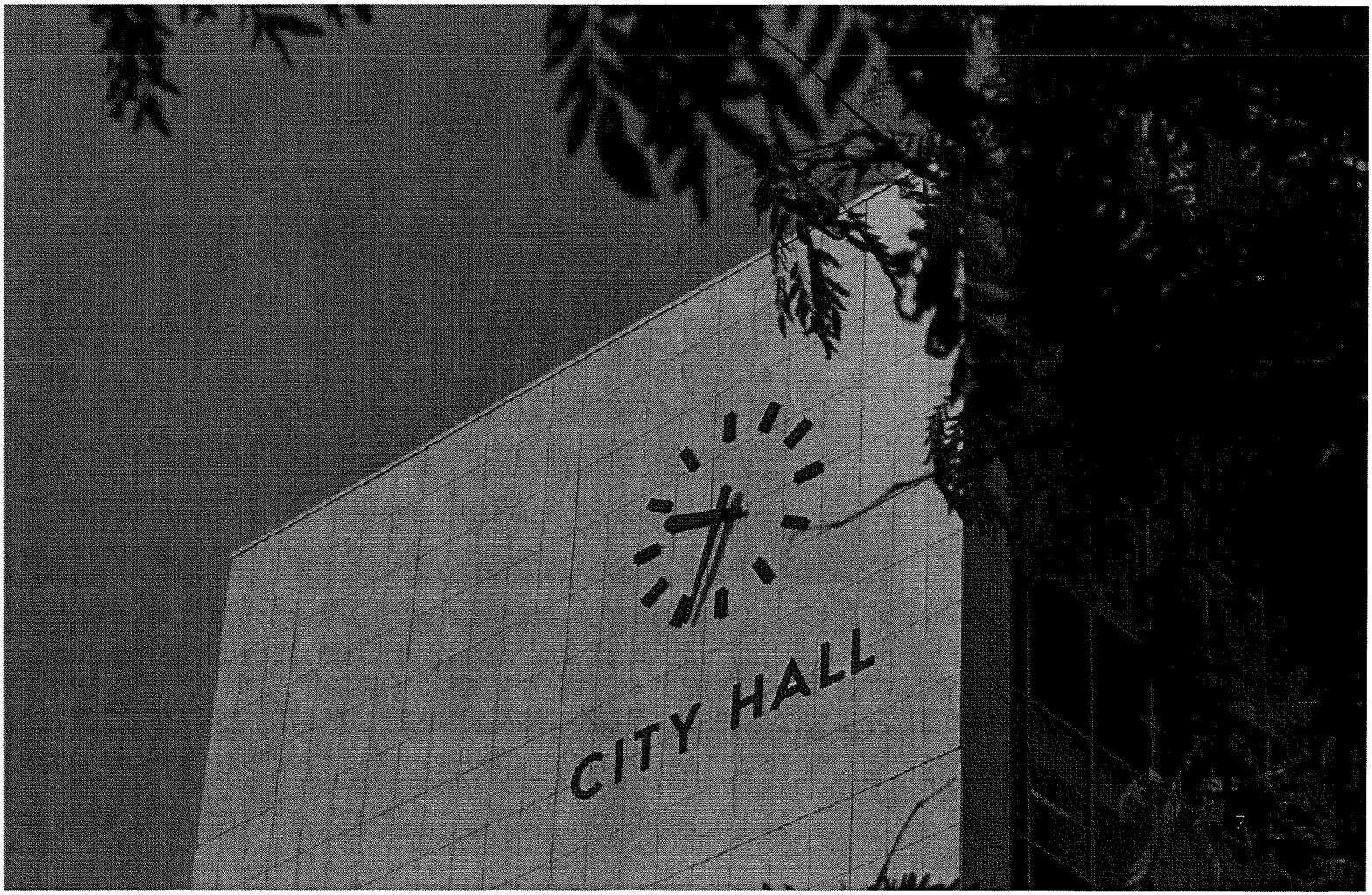
As a major stakeholder in this Community-wide initiative, the City of Hamilton has provided staff resources from the following departments and sections to assist in the development of this Plan:

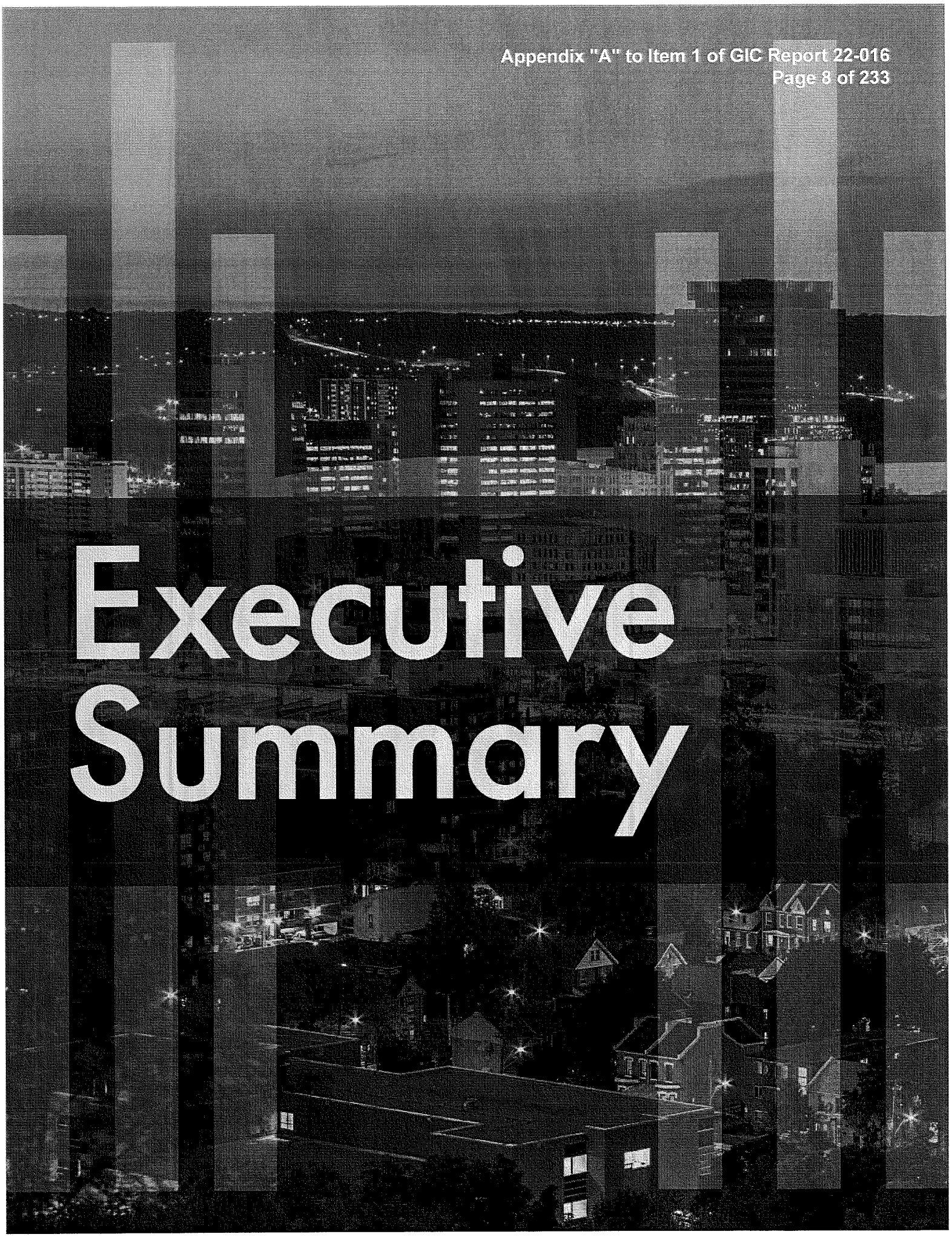
- Planning and Economic Development Department (Transportation Planning, Transit, Planning, Growth Management, Building, and Economic Development Divisions)
- Corporate Services Department (Financial Planning, Administration and Policy Division)
- Public Works Department (Environmental Services, Office of Energy Initiatives)
- Healthy and Safe Communities Department (Health Hazards and Vector Borne Diseases, and Neighbourhood Development Divisions).

In addition, the City would like to thank other organizations that provided their expertise and advice during one-on-one interviews, including:

- NRCan Canmet MATERIALS Lab at McMaster Innovation Park;
- Independent Electricity System Operator (IESO);
- Green Venture;
- the Canadian Steel Producers Association;
- Hamilton Community Enterprises;
- Federation of Canadian Municipalities; and
- The Atmospheric Fund

Acknowledgement also goes to the Province of Ontario, which provided funding support through the Ministry of Energy, Northern Development and Mines Municipal Energy Plan program.





Executive Summary

4.0 Executive Summary

ReCharge Hamilton is a Community Energy and Emissions Plan (CEEP) that lays out a major component of the City of Hamilton's strategy for responding to the climate emergency. With the input of local industry, academia, utilities, local non-profits, and the public this plan aims for Hamilton to achieve net-zero carbon emissions, citywide, by 2050 and become a prosperous, equitable, post-carbon city.

Hamilton will be well on its way to becoming net-zero by focusing on the plan's **5 Low-carbon Transformations**:

1. **INNOVATING OUR INDUSTRY:** Actions focused on supporting the City's industry in decarbonizing and increasing the energy efficiency of their industrial processes.

2. **TRANSFORMING OUR BUILDINGS:** Actions that support the retrofitting of existing buildings to be more energy efficient and to encourage fuel switching. It also includes actions that support improving the energy efficiency and GHG profile of new buildings within the City.

3. **CHANGING HOW WE MOVE:** Actions that focus on increasing the modal split of transit and active transportation and decreasing the number of trips taken in personal vehicles. These actions also focus on decarbonizing the remaining personal and commercial vehicles and the City's vehicle fleet.

4. **REVOLUTIONIZING RENEWABLES:** Actions that promote renewable energy generation. This includes reviewing the City's development policy and regulatory framework to remove any barriers for the development of renewable energy projects. The City and other organizations and community groups can also explore local, alternative ownership structures for renewable energy projects, such as cooperatives. Actions also include leveraging existing renewable energy initiatives in the City such as expanding and decarbonizing existing district energy systems (with the potential to include industrial residual heat), and investigating increasing our household organic waste diversion from landfills to anaerobic digesters to increase biogas and RNG production.

5. **GROWING GREEN:** Actions that promote carbon sequestration through the growth of the City's tree canopy and preserving the City's existing natural heritage features through land use planning processes.

The detailed actions, including timelines and targets, that enable these **5 Low-carbon Transformations** are spelled out in greater detail throughout this report and in the Implementation Strategy attached as Appendix C.

This plan builds on growing climate action momentum across the community, from youth activists to the carbon-intensive steel sector. It is also bolstered by national and international calls to action, including the federal government's decision to cut emissions by 40-45% by 2030 and achieve net-zero by 2050, as well as the International Energy Agency's landmark 2021 report that advises against all new investments in fossil fuels.[1] Policies, programs, funding, and private investment are increasingly focused on net zero. This Plan will help leverage these investments to protect the environment, support the local economy, and promote community wellbeing.

ReCharge Hamilton provides a foundation for a community-wide effort to help prevent the most catastrophic impacts of climate change.

4.1 The Vision

The community was integral in designing the following vision for this Plan:

ReCharge Hamilton identifies a pathway to net zero GHG emissions by 2050 that increases the resilience of the energy system and improves economic prosperity for all. Drawing on a history of work, policies, and initiatives in this area, ReCharge Hamilton builds on Hamilton's historic and current strengths as an industrial leader in the midst of a rich natural environment, and as a caring community.

4.2 An Evidence-Based, Community-Informed Pathway

ReCharge Hamilton is informed by a detailed energy use and greenhouse gas (GHG) emissions model of the City. The sources and amounts of Hamilton's GHG emissions were collected for the year 2016 to build a thorough inventory of the City emissions. Emissions data was then combined with other important data from 2016, like population, number and types of houses, number of cars, and working hours, to create a picture of what Hamilton's activities and emissions looked like in 2016. Using this picture as a base year, the City's GHG emission future was then modelled using current trends out to 2050 in a business-as-planned (BAP) scenario. This business-as-planned scenario illustrates the scope of the problem, i.e. how much carbon Hamilton could emit between now and 2050 if no actions are taken to lower emissions. It's against this possible future that the net-zero scenario—the basis of ReCharge Hamilton—was built.

The industrial sector, primarily steel, is by far the city's largest source of emissions. It represents 64% of emissions in 2016 (the base year), and in 2050 if Hamilton follows the BAP scenario. Transportation represents 19% of emissions in the base year, then reduces to 17% by 2050 in the BAP. Buildings (residential and commercial) together represent about 15% of Hamilton's emissions in the base year, but those increase to 17% by 2050 in the BAP. Figure ES1 shows the City's projected BAP GHG emissions by sector from 2016 to 2050.

[1] International Energy Agency, Net Zero by 2050: A Roadmap for the Global Energy Sector (May 2021).

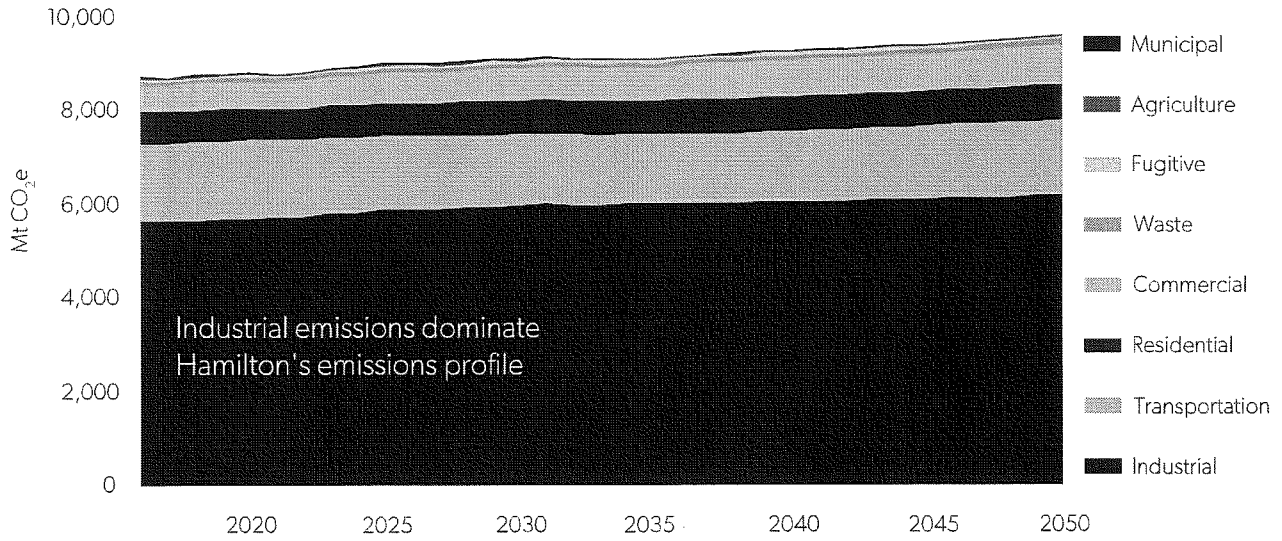


Figure ES1. Projected business-as-planned GHG emissions (Mt CO_2e) by sector, 2016-2050.

Based on best practices and community input, 30 low-carbon targets were modelled to assess how Hamilton could reach its goal of net-zero emissions by 2050. The net-zero scenario prioritizes energy efficiency in order to minimize the societal and environmental costs of the low-carbon transition. As a general rule, a unit of energy saved is less expensive than building another unit of energy production capacity, regardless of fuel source. Only after energy efficiency measures are incorporated is fuel switching to low-carbon/renewable energy sources considered. Figure ES2 shows the GHG reductions (by sector) resulting from the net-zero scenario.

The modelled low-carbon actions still result in positive GHG emissions by 2050. These are primarily from the few remaining combustion engine vehicles on the road and a small amount of industrial emissions. These remaining emissions are called 'the carbon gap.' The carbon gap will need to be addressed in future iterations of the plan using technological or policy innovations, or through carbon offsets.

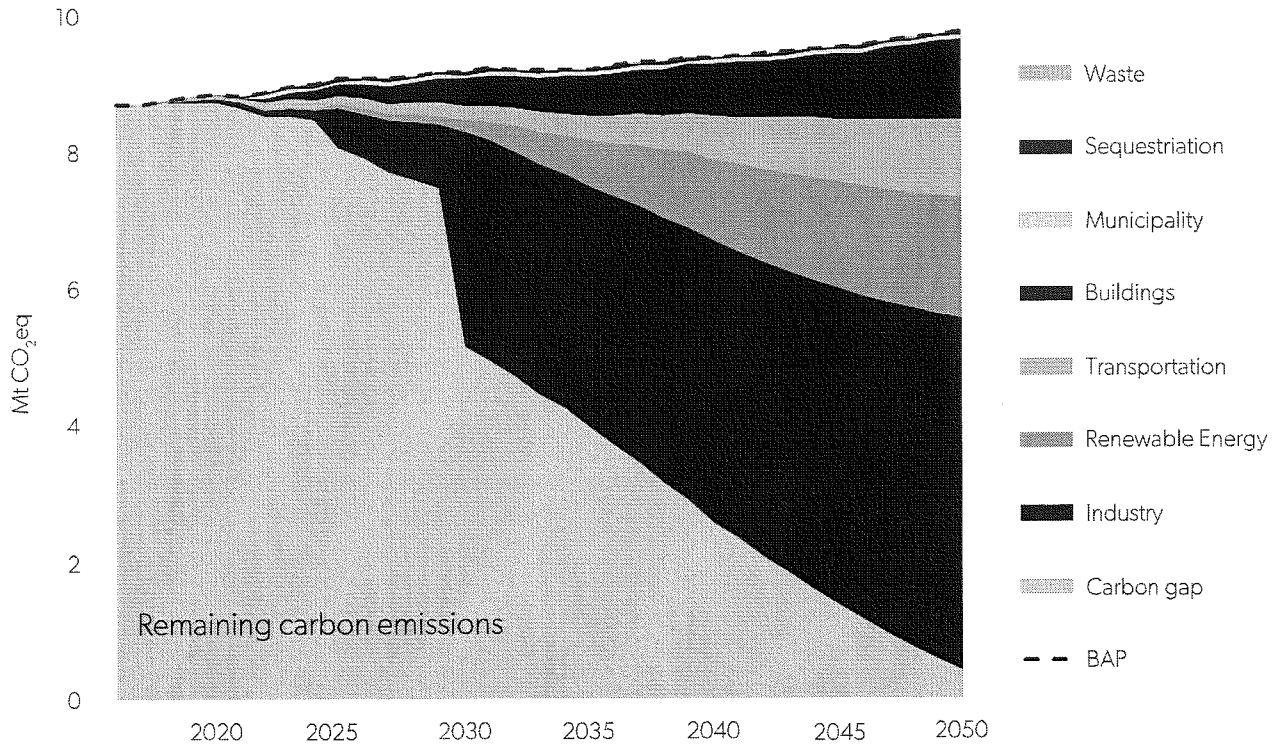


Figure ES2. GHG emissions reductions (Mt CO_2e) in the net-zero scenario. Note: For visual clarity, modelled targets are grouped by sector. A complete list of modelled targets is provided in Appendix A.

4.3 Getting to Net-Zero: Co-Benefits

In addition to reducing GHG emissions, ReCharge Hamilton has the potential to act as an economic catalyst and create about 5,500 full-time jobs within the City, primarily due to the mass industrial process efficiency and building retrofit program at its core.[2] The plan will also create a variety of other co-benefits, or benefits that go beyond greenhouse gas reductions.

Households will see energy bills drop by an average of 50% by 2050 as household comfort increases. Air quality will improve, and there will be less noise from combustion engine vehicles. Biodiversity and protection of wildlife are an additional outcome of protecting and expanding the city's natural areas. Several of the actions proposed within ReCharge Hamilton also have the co-benefit of increasing physical activity through the promotion of active transportation, transit, and e-mobility, which can contribute to an increase in positive health outcomes.

Getting to net-zero emissions provides benefits beyond the borders of Hamilton. The City of Hamilton and neighboring City of Burlington (The Bay Area) are projected to grow significantly by 2050 and a regional low-carbon future requires changes across all aspects of the community, including new and existing buildings, transportation, industry, and waste management. Implementing the actions of ReCharge Hamilton supports and strengthens the ongoing regional collaboration on climate change with the Bay Area Climate Change Council (BACCC) and contributes to reducing regional emissions and creating cross-border co- benefits of economic growth, biodiversity, improved air quality and community health.

[2] The equivalent of about 161 thousand person years of employment from 2022 to 2050.

4.4 The Challenges

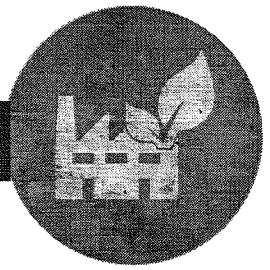
The pathway described in ReCharge Hamilton describes a City that by 2050 uses significantly less energy, switches nearly all of its energy to emission-free sources, and produces more renewable energy by applying practical, feasible, known solutions. Two of the major challenges for Hamilton are decarbonizing the steel industry and retrofitting the City's extensive older building stock.

The technological pathway for decarbonizing the steel industry is still emerging and there are fewer local and international examples of successfully decarbonizing the steel manufacturing process. Recent announcements by the Federal and Provincial governments to assist the Steel industry with funding to decarbonize is a promising move towards overcoming this challenge. Going forward, the City will need to work closely with the steel industry, research partners, utilities, all levels of government, and other stakeholders in order to help facilitate and implement a pathway to decarbonizing Hamilton's steel industry.

Completing mass deep energy building retrofits at scale represents a more common challenge that many municipalities across Canada and globally are trying to understand and resolve. Whereas the technologies to undertake retrofits are clear and established, a successful framework to deliver retrofits at the scale required is still being developed. The City will need to work with all levels of government, the skilled trades, educational establishments, Hamilton homeowners, other municipalities, and industry experts in order to develop a framework that works for Hamilton.

4.5 The Low-carbon Transformations

The actions proposed in this plan have been organized to focus on 5 key low-carbon transformations that will be pivotal in achieving Hamilton's low-carbon future.

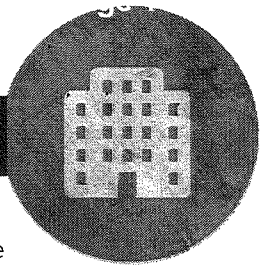


TRANSFORMATION 1: Innovating Our Industry

Hamilton has long been an industrial hub for one of Canada's most carbon-intensive primary industries: steel. This industry represents over half of the City's emissions today.

Supporting and encouraging industrial efforts to decarbonize is key to achieving the City's targets. This means encouraging businesses and industry groups to adopt organizational net-zero targets, tracking progress towards those targets, connecting industry with resources, and engaging other levels of government for support. This includes establishing a net-zero working group for local industry stakeholders, and the creation of a cleantech accelerator to expedite low-carbon technology development and increase industry access to upcoming technology.

For the steel industry, it will mean switching from coal to emission-free alternatives, like sustainably sourced biochar or green hydrogen. For other industries, the focus will be on improving energy efficiency using new and emerging technologies and fuel-switching to clean energy sources.

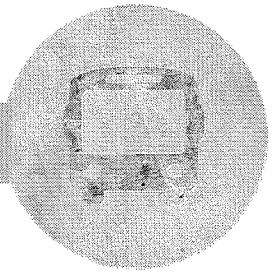


TRANSFORMATION 2: Transforming Our Buildings

By 2050 in the BAP scenario, residential and commercial buildings are projected to represent the second largest source of emissions in Hamilton, primarily from the use of natural gas for space and water heating, particularly in older, more inefficient homes.

This plan features a comprehensive energy efficiency and fuel switching building retrofit program. This fuel switching will primarily serve to replace natural gas furnaces with electric heat pumps. The program will aim to cover most of the City of Hamilton by 2050. This plan also recommends partnering with local institutions, labour associations, and not-for-profits to ensure that appropriate education and training programs are in place to prepare the labour force for the proposed mass building retrofits.

This plan will also recommend the creation of comprehensive sustainable building and development guidelines, which will help increase the energy efficiency and decrease the GHG impact of new development. There are various examples of such guidelines throughout Ontario. This will also limit the need for new buildings to be retrofitted in the future.

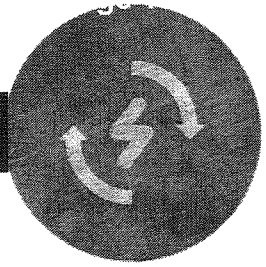


TRANSFORMATION 3: Changing How We Move

Closely following buildings, fossil-fuel combustion in cars, trucks, and buses are estimated to account for about 19% of the City's GHG emissions in 2016, and decline slightly to 17% of Hamilton's emissions in a BAP scenario by 2050.

To achieve net-zero in this sector, the City will play a key role: expanding active transportation, e-mobility and transit networks, decarbonizing their fleet and transit, and by ensuring the City is designed to support electric vehicle adoption by creating a City-wide EV Strategy that will provide a comprehensive overview of how the City can support the uptake of EVs and encourage the private sector to do so as well. The City and it's partners will also work with commercial fleet owners to form a community of best practice to share information, support the setting of fleet net-zero targets, track progress towards them, and help connect businesses with resources.

TRANSFORMATION 4: Revolutioning Renewables



ReCharge Hamilton prioritizes maximizing energy efficiency. Then, the plan relies on fuel switching away from gasoline, diesel, coal, and natural gas to renewable electricity, renewable natural gas, and green hydrogen to achieve net-zero emissions.

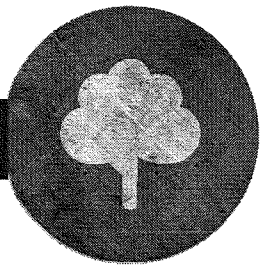
Where possible, the production of local renewable electricity is best, as it helps support local economic development and energy independence. Hamilton has access to a wealth of untapped energy and renewable energy resources. For example, the low-carbon model includes:

- Industrial residual heat;
- Rooftop and ground mount solar energy;
- Wind; and
- Biogas from the decomposition of household organic waste.

These combine to meet about 7% of the City's energy needs. Additional renewable energy capacity is available, for example from large-scale wind (inside or outside the City boundaries) along with agricultural and institutional organic waste.

This plan recommends a review of planning and regulatory documents to remove regulatory and policy barriers to the establishment of renewable energy projects, while also encouraging innovative, local ownership structures for these projects. ReCharge Hamilton will also recommend that the City, with its partners, further investigate renewable sources of energy, such as those originating from industrial residual heat, household organics and green hydrogen. This includes exploring the creation of a "hydrogen hub" in Hamilton.

TRANSFORMATION 5: Growing Green



Green space defines Hamilton; it is a lifeline for local wildlife, water quality, and resident well-being and health. Continuing to protect and expand these natural areas is an important part of achieving net zero, as trees and healthy soil are an important source of carbon sequestration. ReCharge Hamilton will focus on preserving and expanding the City's tree canopy cover, which helps sequester carbon, while providing significant co-benefits such as moderating micro-climates, providing stormwater storage, improving air quality, and enhancing energy efficiency.

This plan proposes to plant 50,000 trees per year across the entire community, Including efforts from the City, local Conservation Authorities, the general public and the private and not-for-profit sectors. The City will also ensure it's land use planning policies and regulations preserve the City's existing tree canopy cover wherever possible.

4.6 Plugging the Emissions Gap

The net-zero scenario modelled for ReCharge Hamilton doesn't quite achieve zero emissions. Remaining emissions come from:

- aviation, rail, and marine sources;
- some remaining natural gas use in homes and industry; and
- gasoline and diesel in the few gas-powered cars.

Much of these emissions are difficult to address and lack current policy and technological solutions. These emissions will be addressed through carbon offsets, technology developments (for aviation, rail and marine sectors), or other emerging strategies.

4.7 Equity in Action

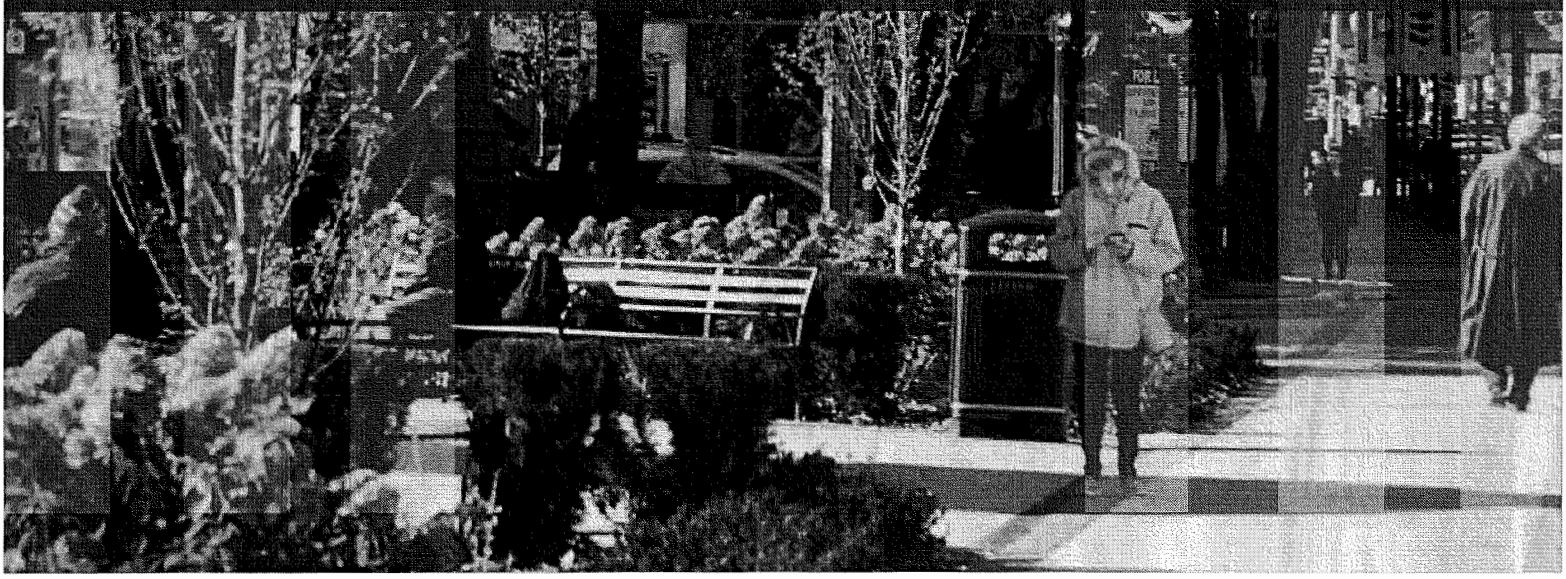
ReCharge Hamilton sets the course for a green, equitable recovery. During the development of the City's Community Energy and Emissions Plan, the COVID-19 pandemic spread across the globe, severely impacting communities throughout Canada and the world. Hamilton was no exception. This pandemic has demonstrated the ability of individuals, communities, and leaders to quickly change and adapt their habits and behavior in a time of crisis to achieve a common goal for the greater good of society. This highlighted people's ability to adapt, change, innovate and problem solve. As we recover from COVID-19, we have the opportunity to "build back better," using this same innovative and creative spirit to address the climate crisis. At the forefront of this approach should be ensuring a just and equitable recovery for all Hamiltonians.

Decarbonization programs will be designed, first and foremost, with low-income and traditionally marginalized communities in mind. For example, home retrofit programs will prioritize residents experiencing energy poverty.[3] Job training for low-carbon industries will prioritize historically under-employed communities. Business owners from historically marginalized communities contributing to the net-zero economy will be supported by the City. Investments in tree planting, as well as cycling and walking infrastructure, will be targeted at historically underserved communities. Consultation with these communities will be a core component of implementation as this plan moves forward.

A core guiding principle in the development of ReCharge Hamilton has been to ensure that equity is a foremost consideration in its implementation, in order to maximize benefits to the City's marginalized communities.

[3] Households that spend more than 6% of their income on their energy needs. ("Energy Poverty in Canada: a CUSP Backgrounder" (CUSP, October 2019) at 2, online: www.energypoverty.ca/backgrounder.pdf; Alternatively, Homelesshub.ca defines energy poverty as those spending more than 10% of their income on energy (see: Homelesshub.ca, "Energy Poverty" (accessed May 2021) online: https://www.homelesshub.ca/povertyhub/basic-needs/energy-poverty.)

Part 1



5.0 Part I: Setting the Scene

5.1 Net Zero by 2050

On March 27th, 2019, Hamilton City Council passed a motion stating that,

> *"[T]he City of Hamilton declares a climate emergency that threatens our city, region, province, nation, civilization, humanity and the natural world.*

As part of this motion, City Council directed Staff to investigate and identify a path for the entire city to achieve net-zero carbon emissions by 2050, including a process for measuring and reporting on progress towards that goal. With support and guidance from a multi-stakeholder advisory committee and input from the broader public, ReCharge Hamilton seeks to do just that.

5.2 What is a Community Energy and Emissions Plan?

ReCharge Hamilton is a community energy and emissions plan (CEEP). A CEEP is a tool that helps municipalities understand their influence on greenhouse gas emissions (GHG), and how to plan their communities so that the goal of reducing GHGs is aligned with other community social and economic goals.[4]

Developing a CEEP enables communities to consider energy and emissions early in the land-use and infrastructure planning process, and identify opportunities to integrate local renewable energy solutions at a building or neighbourhood-scale. The impetus for developing a CEEP is summarized well in a 2015 report on local finance best practices:

Setting GHG Reduction Targets: The Science

Net zero by 2050 aligns with the goals of the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement and the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C.[1] This target increases the likelihood of avoiding catastrophic global climate change.

The IPCC identifies global targets of net zero by 2045 to 2055. UN treaties recognize that rich countries, such as Canada, need to reduce their emissions more quickly. This requires a steep decline in emissions starting as soon as possible.

Moving from targets decades in the future to interim targets (e.g., for 2025, 2030, etc.) and annual emissions targets that can be meaningfully operationalized is an important next step in this City's response to the climate emergency.

[1] C40 Cities, Science-Based Climate Targets, a Guide for Cities (November 2020), online at sciencebasedtargetsnetwork.org/wp-content/uploads/2020/11/SBTs-for-cities-guide-nov-2020.pdf.

[4] Community Emissions Reduction Planning: A Guide for Municipalities (Government of Ontario, December 2017) at 20.

> *"The infrastructure planning and financing decisions made today will determine the world's climate and development outcomes for the next century. Taken together, these decisions will lead to the building of either low-emission, climate-resilient infrastructure that increases economic opportunity or more of what we have already, effectively locking the world into a carbon-intensive pathway with sprawling human settlements, hazardous pollution, and heightened vulnerability to climate change.*[5]

5.3 Building on Community Climate Action

This plan covers GHG emissions from across the community. The effort builds on momentum for energy efficiency, renewable energy production, and emission reductions action already underway across the City energy sector, industry, business, and institutions and within the City of Hamilton itself. The Plan also builds on regional action to address emissions and contribute to a sustainable future for the Bay Area. Some notable examples of action are highlighted throughout Part II of this document.

5.4 Developing the Plan

The Plan was developed using technical models that help quantify the GHG impact of certain actions that can be implemented by the City and broader community. These technical models helped inform what actions, and to what extent, would be included within the Plan to help Hamilton reach net-zero by 2050. Equally as important, however, was the significant public and stakeholder consultation that was completed throughout the development of the Plan. This consultation helped identify what actions should be prioritized, highlight what actions represented community priorities, and inform how these actions should be implemented.

Significant public engagement, with a variety of groups and in a variety of formats, has fed into this Plan. Four multi-disciplinary groups provided their input. These included:

- The City Steering Committee (CSC), a group of representatives from relevant departments across the municipal corporation;
- The Stakeholder Advisory Committee (SAC), a group of representatives invited by the City from relevant Hamilton organizations (see the Acknowledgments section for a list of participating organizations);
- Individual experts; and
- The general public.

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[5] The State of City Climate Finance (Cities Climate Finance Leadership Alliance, 2015) online: http://wedocs.unep.org/bitstream/handle/20.500.11822/7523/-The_State_of_City_Climate_Finance-2015CCFLA_State-of-City-Climate-Finance_2015.pdf.pdf?sequence=3&isAllowed=y.

The CSC and SAC participated in several workshops designed to elicit informed input into the plan. These workshops covered:

- An introduction to the project and the process;
- An overview of the base year and business-as-planned energy use and emissions;
- An overview of the net-zero scenario pathway and the associated costs and benefits; and
- An overview of the Implementation Strategy.

Through these workshops, the CSC and SAC helped shape the project's Visions and Goals and define the sectoral energy efficiency and GHG-reduction targets, as well as key short-term implementation actions. These groups also had an opportunity to provide feedback on a draft version of this Plan.

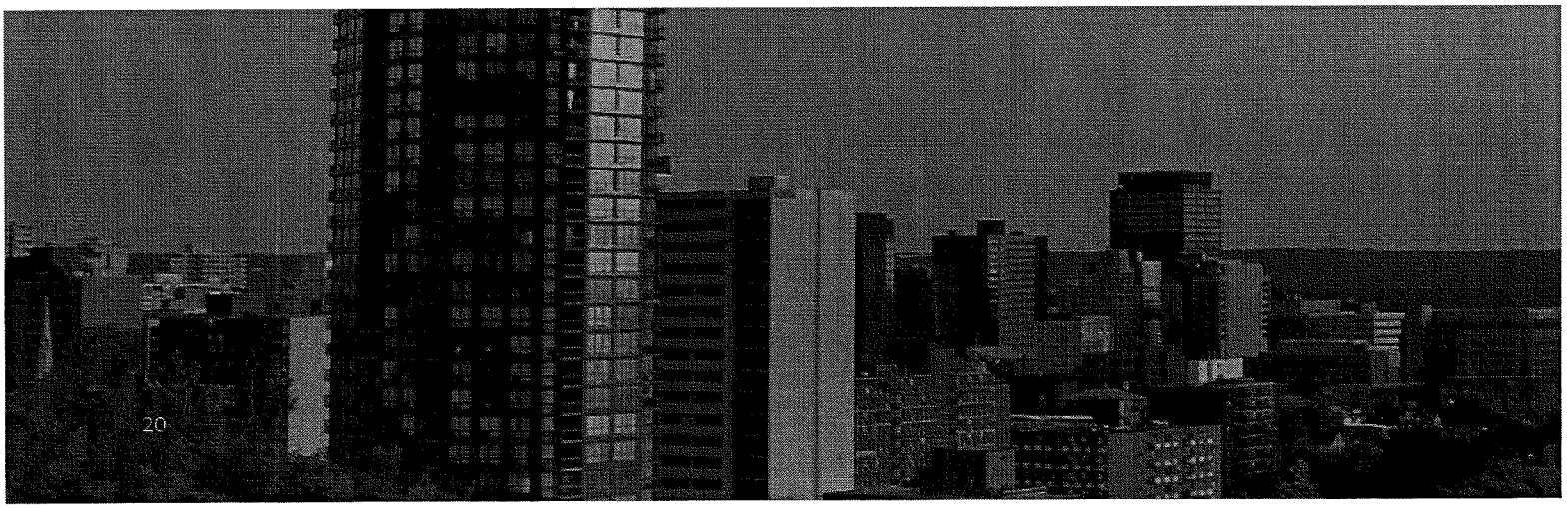
Individual experts, like those at the Natural Resources Canada's CanmetMATERIALS Lab at McMaster University and the Canadian Steel Producers Association, provided critical context on the state of knowledge and best practice relating to the low-carbon transition pathways for Hamilton's steel producers and manufacturers.

The public provided their input through a series of online surveys and a public information session. Some of the responses from these surveys are highlighted throughout this Plan.

5.5 The Pathway: A Collection of Targets

Hamilton is home to a large and growing population, a major industrial sector (most notably steel), impressive academic institutions and healthcare services, a major port, and diverse neighbourhoods—all of this, and much more, contribute to its current energy use and GHG emissions. These features are also sources of potential energy savings, renewable energy, climate innovation, and other climate solutions.

Based on a series of assumptions regarding existing plans and policies that are likely to be in place through to 2050 ('business-as-planned' or BAP scenario), overall GHG emissions for the city are projected to increase by 10% (see Figure 1). However, on a per person basis, energy use and GHG emissions will decline by 28%, as Hamilton's population is projected to increase by 53% over the period. In a BAP scenario Hamilton's 2050 GHG emissions will be far from its net-zero GHG emission target. In 2050, each Hamiltonian will represent the equivalent of 11.2 tonnes of GHGs. As a whole, the City will emit 9.6 Mt CO_2e, up from 8.7 Mt CO_2e in 2016.



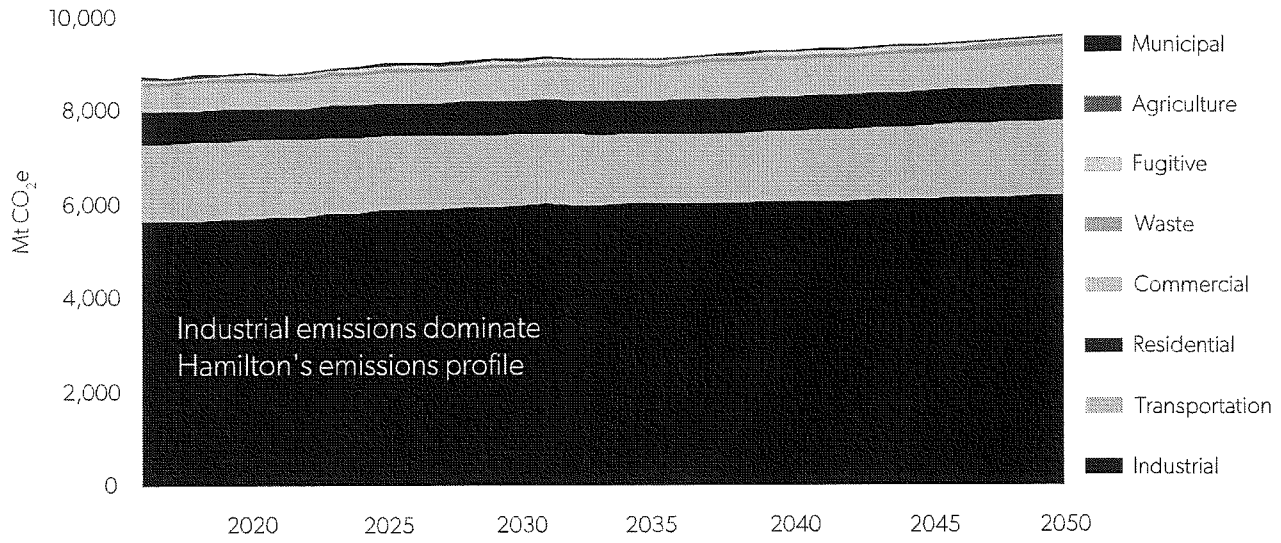


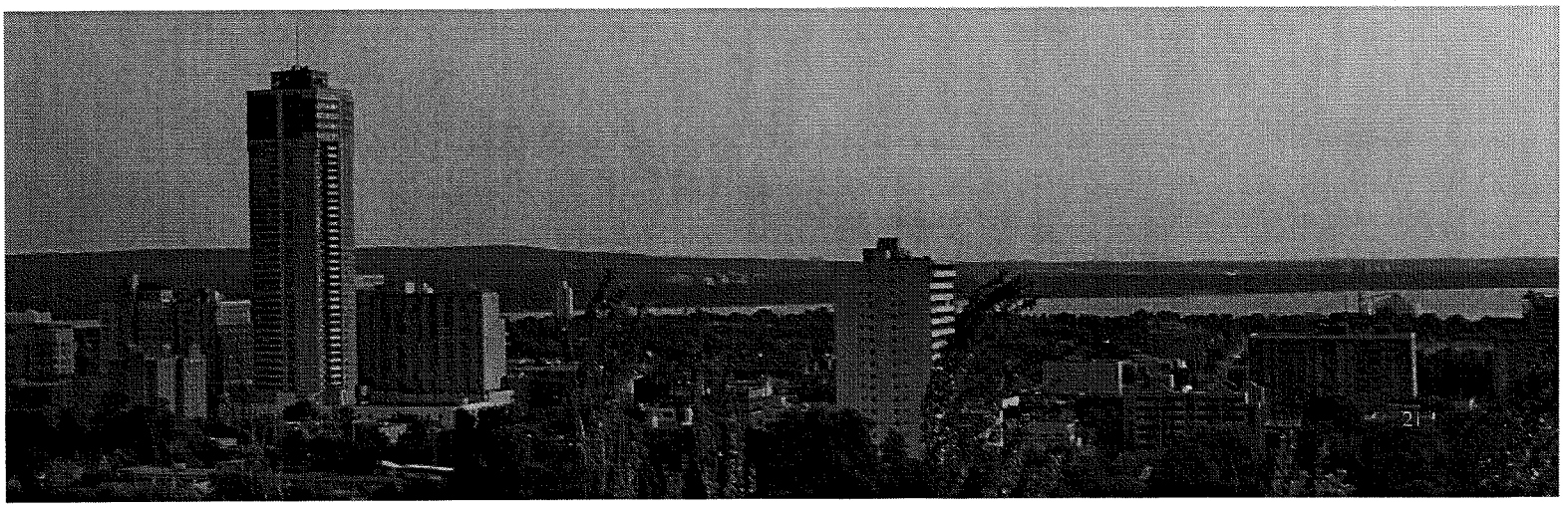
Figure 1. Projected business-as-planned GHG emissions (Mt CO_2e) for the city of Hamilton, by sector, 2016-2050.

What is unique about Hamilton's current emissions profile is the proportion of emissions that are attributed to industry (primarily steel): 64%. Transportation is a distant second at 17% of the City's emissions, followed by commercial buildings (9%) and then by residential buildings (8%). For a more detailed analysis on the City's base year (2016) and business-as-planned (2050) emissions, please refer to the Base Year and Business-As-Planned 2016-2050 Energy and Emissions Report attached hereto as Appendix D.

Based on a detailed study of the community's current and projected energy uses and emissions in a BAP scenario out to 2050, the City and stakeholders were able to develop a pathway for Hamilton to achieve net zero by 2050.

The wedges diagram in Figure 2 show the 30 low-carbon targets that were modelled to reduce the 2050 BAP emissions by 96%, bundled by sector. (A comprehensive table of modelled targets is provided in Appendix A.)

While accommodating a projected increase in the city's population of 53% by 2050, the net-zero pathway models a reduction of per capita GHG emissions from over 11 tonnes in a BAP scenario to less than 1 tonne.



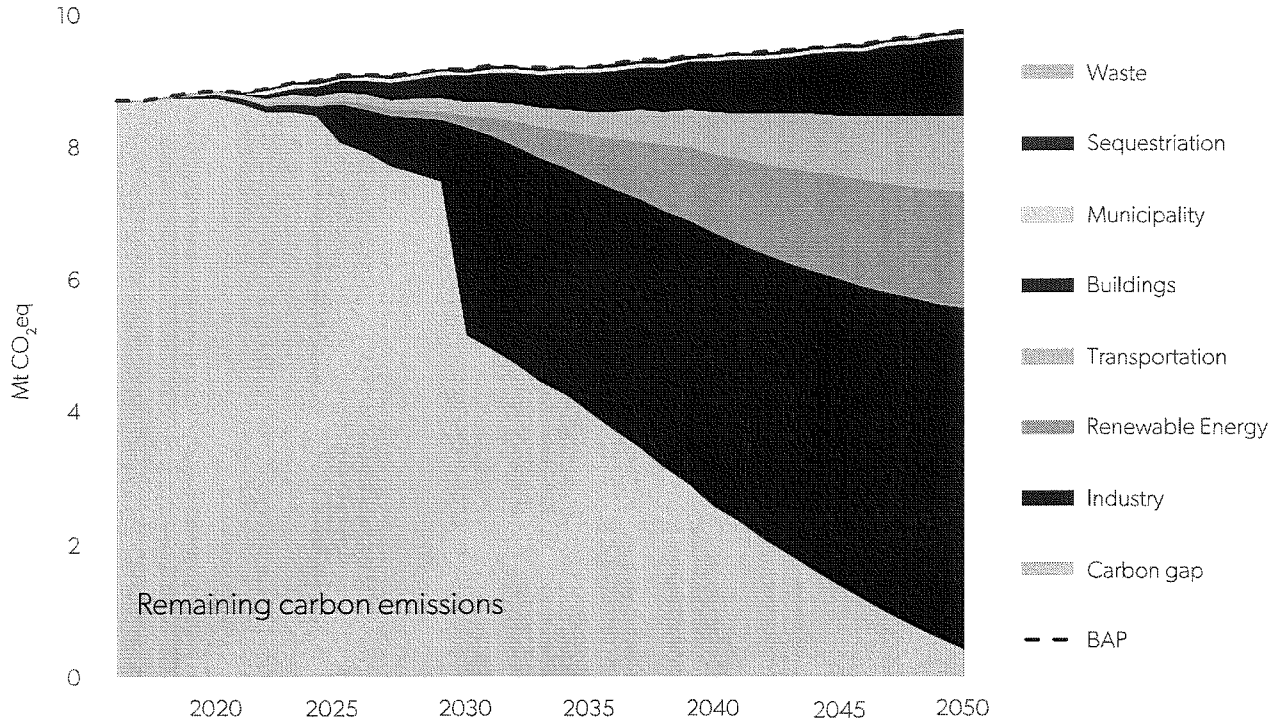


Figure 2. GHG emissions reductions (Mt CO_2e) in the net-zero scenario. Note: For visual clarity, modelled actions are grouped by sector. A complete list of modelled actions is provided in Appendix A.

In order to achieve net-zero emissions by 2050, the remaining carbon gap will need to be addressed via the purchase of offsets or in future CEEP iterations via new technological developments, regulations, or policies.

It is very important to note that the modelled pathway represents only one of many possible community-informed, evidence-based GHG-reduction pathways for the City of Hamilton. This pathway was selected based on community and stakeholder input, City advice, and consultant research on best practices. The pathway assembled and presented in this Plan is ambitious and will not be without challenges. Moreover, the pathway is dynamic and will change as new technologies, opportunities, and challenges arise over the coming decades.

» This Plan includes 30 targets, outlined in tables at the beginning of the section on each sector. Together, they are designed to achieve maximum energy efficiency, avoid waste-related GHG emissions, switch to local renewable energy sources, and maximize natural carbon sequestration.

5.6 The Cost of Action and Inaction

The net-zero scenario offers many direct financial and economic benefits to the city, including new jobs, a positive return on investment, and reduced household and business energy costs. All low-carbon actions included in the net-zero scenario with publicly-available financial data were evaluated in a financial analysis (see Appendix B).

The net-zero scenario requires an estimated $367 million/year of investment, excluding the cost of changes to the steel and marine sectors, and the expansion of active transportation infrastructure. This investment will have a marginally net-positive return for the community of $1 per tonne of GHG reduced, or $63 million dollars, over the life of the investments.[6] These annual investments, which amount to just over a third of the City's annual tax operating budget, will not be the sole responsibility of the City, but rather will be shared across the community and various levels of government in a manner that has yet to be determined. For example, a mass home energy retrofit program is contingent on the investment of homeowners to improve the efficiency of their homes; however, it is assumed that there will be low-interest financing and grants available from various levels of government to improve the business case and return on investment, while also reducing the burden of the large up-front capital cost on the homeowner.

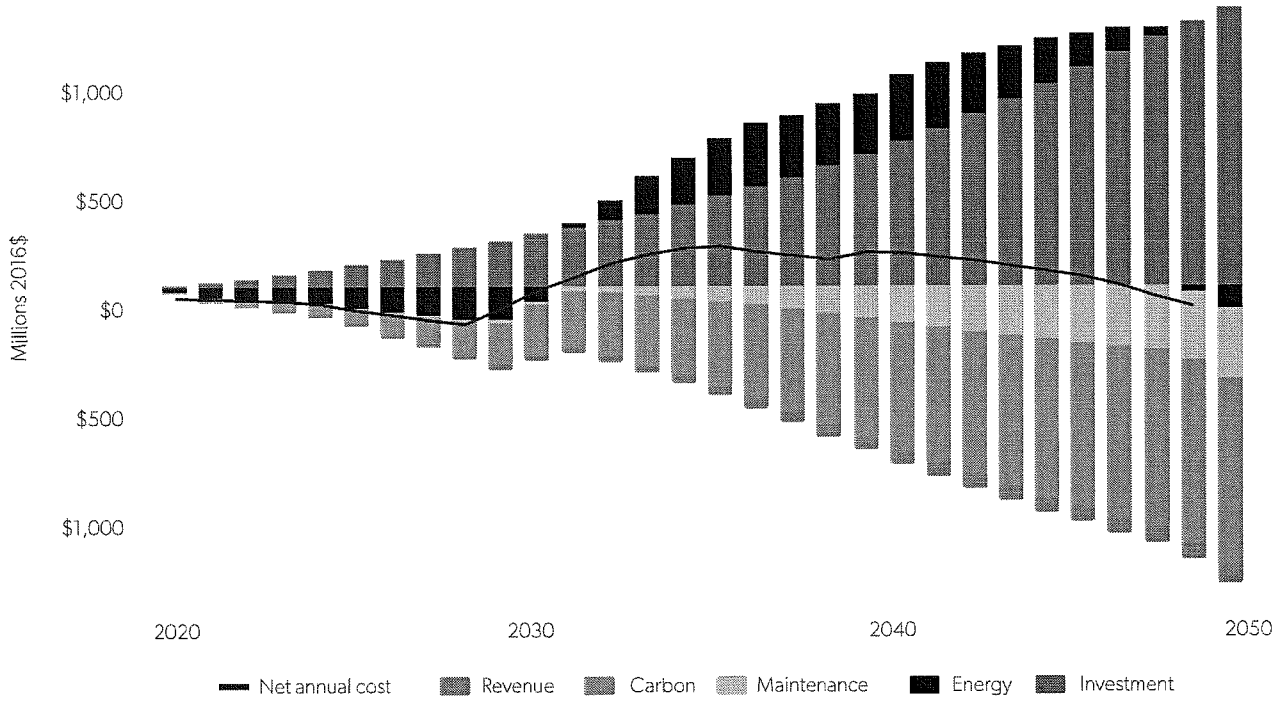


Figure 3. Capital expenditures vs. savings and revenues from the net-zero scenario, 2021-2050.

In addition, most elements of the net-zero pathway also offer co-benefits—which are benefits additional to the reduction of GHG emissions—including positive health outcomes and improvements in social wellbeing and equity.

[6] This number does not account for a few low-carbon actions where defensible cost and savings data was not available: namely steel sector decarbonization, active transportation infrastructure expansion, marine fuel efficiency improvements, and water use reduction.

A financial and economic risk facing Hamilton is failing to engage in the global transition to a low-carbon economy. Though impossible to quantify this risk, some have made valiant attempts. For example, the global re-insurer Swiss Re estimates the global GDP will drop by 18% if no climate action is taken.[7] A second risk is if the transition further entrenches social inequalities. Residents that are already marginalized face the brunt of extreme weather and other climate-related social impacts (e.g., food price shocks). If they are not financially supported in the transition to a net-zero economy, they face being left further behind, and becoming even more vulnerable to the impacts of climate change.

» The tables at the beginning of each low-carbon transformation provide the cost or savings associated with reducing each tonne of GHG emissions per action (this is referred to as the marginal abatement cost), where defensible data was available.

5.7 Co-benefits: Vision and Purpose

At the outset of the project, the community Stakeholder Advisory Committee (SAC) established the following visions and principles for Hamilton's net-zero pathway, that it:

- Supports an equitable energy transition;
- Helps improve the City's resilience to climate change;
- Is community-led;
- Involves a public education campaign;
- Promotes the development and use of clean energy;
- Protects and supports biodiversity;
- Encourages local economic development; and
- Promotes practical climate mitigation and adaptation actions.

The following is a statement that summarizes these principles:

ReCharge Hamilton identifies a pathway to net zero GHG emissions by 2050 that increases the resilience of the energy system and improves economic prosperity for all. Drawing on a history of work, policies and initiatives in this area, ReCharge Hamilton builds on Hamilton's historic and current strengths as an industrial leader in the midst of a rich natural environment, and as a caring community.

[7] "World economy set to lose up to 18% GDP from climate change if no action taken, reveals Swiss Re Institute's stress-test analysis" (Zurich, 22 Apr 2021) Swiss Re, online: www.swissre.com/media/news-releases/nr-20210422-economics-of-climate-change-risks.html.

These principles and vision helped guide the identification of actions and the design of the implementation framework to maximize co-benefits, such as enhancing equity. Opportunities for improved social equity will be realized during implementation. For example, in designing a residential retrofit program, low-income communities experiencing energy poverty would be targeted. In designing improved transit, those communities that do not have the luxury of owning a personal vehicle would be prioritized. Similarly, in designing urban tree planting projects, neighbourhoods with less access to green space and lower existing canopy cover would be targeted. Throughout the implementation of every action the equity lens will be applied in order to maximize the co-benefits of the Plan.

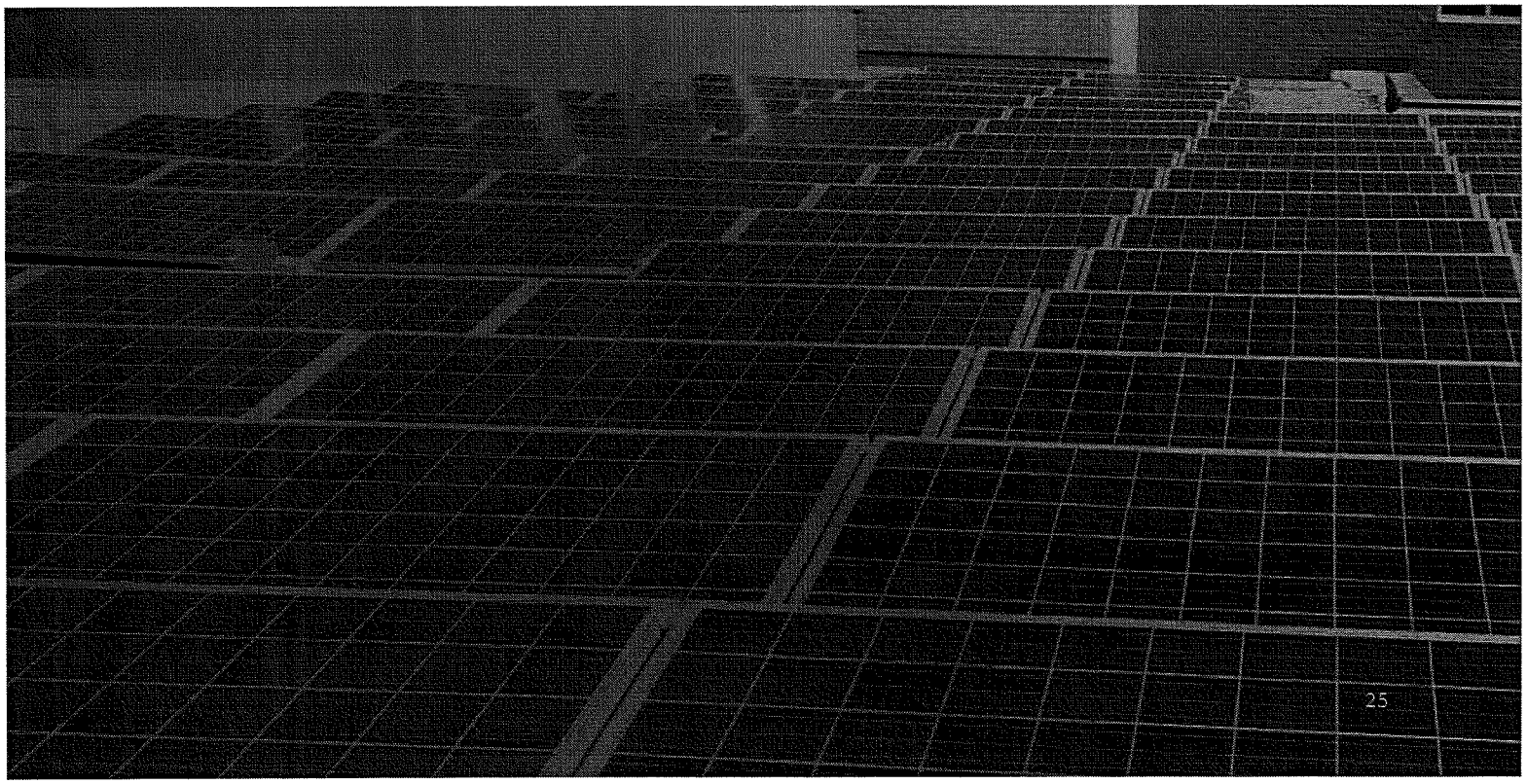
» Throughout this Plan, the co-benefits section for each low-carbon transformation outlines how the sectoral targets support this vision and purpose.

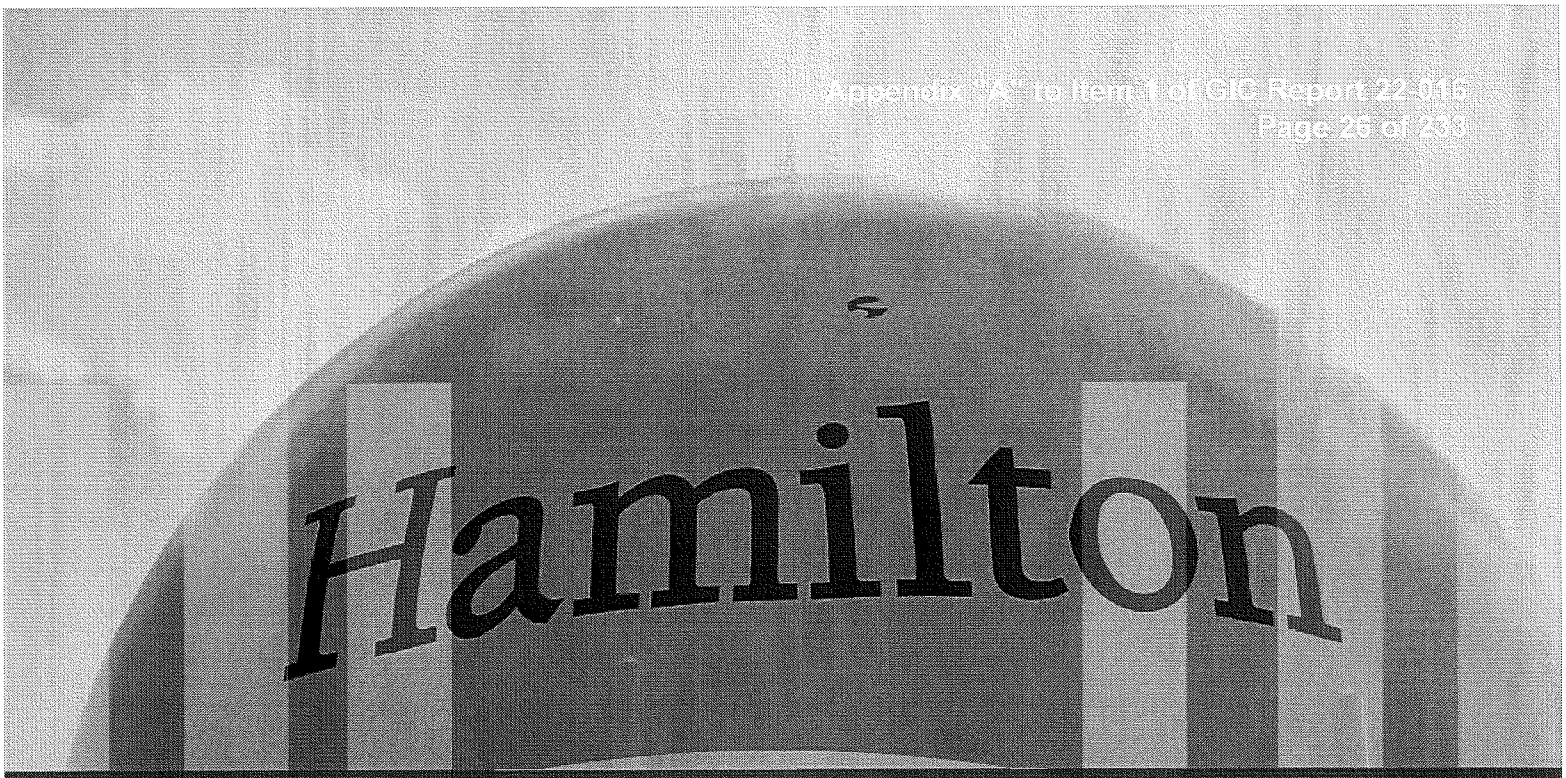
5.8 Turning to Action

Time is of the essence. For this reason, key short-term actions and their potential delivery partners, funding, and financing solutions have been identified throughout this plan. These were determined based on consultations across the City Corporation, the SAC and the public.

The City will play a leadership role by committing to net-zero emissions ahead of 2050 and supporting community-wide implementation with it's partners.

» Throughout this Plan, the implementation section for each sector outlines key actions that will need to be taken in the next five years in order for the GHG reduction targets to be achieved. Each action is numbered to correspond with the appropriate action in the Implementation Strategy attached as Appendix C.





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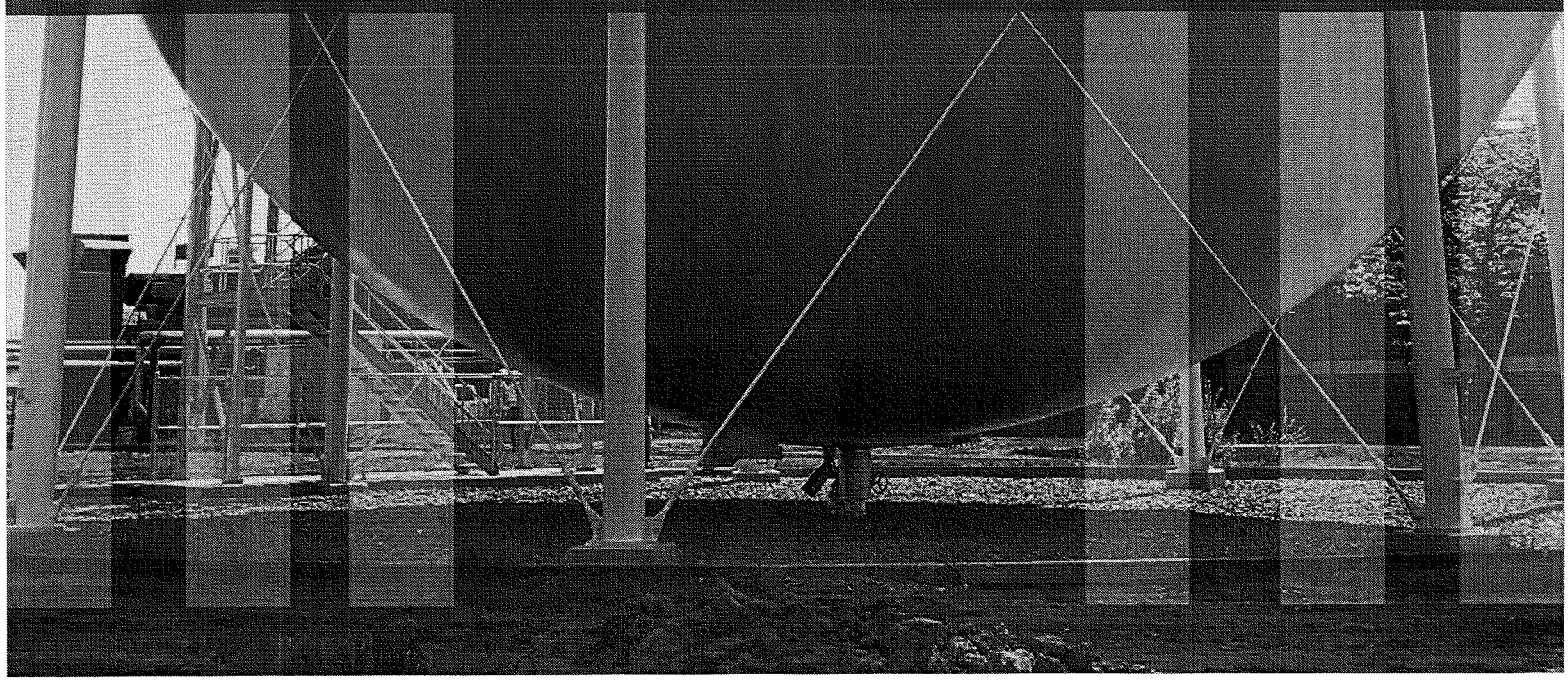


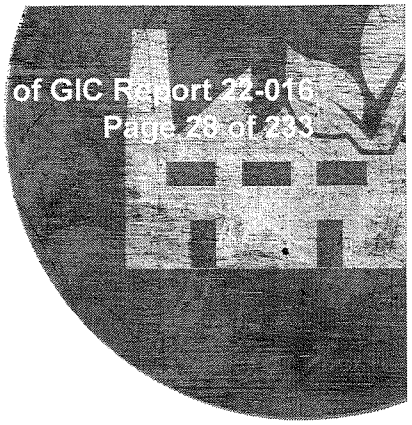
6.0 Part II: The 5 Low-carbon Transformations

It's 2050, our major industrial emitters have adopted new, low-carbon technologies to power their processes, reducing the City emissions by over 50% from business-as-planned (BAP). Most homes and businesses have been retrofitted to use less energy, many have rooftop solar, and all heating is produced by clean electricity, renewable natural gas or green hydrogen. As a result, energy bills are lower and comfort is higher. More people are taking transit and active modes of transportation and almost all cars on the road are electric, which reduces noise and air pollution and cuts our City's emissions by over 10% from BAP. The City has more trees, producing cleaner air, providing shelter and food for animals, recreational space for residents, and stormwater management capabilities. Finally, the City is producing much more of its own energy, from the sun, industrial residual heat, and from food and other organic waste. This renewable energy supports the local economy and the City's energy independence and resilience.

This future is the result of implementing the 5 Low-carbon Transformations of ReCharge Hamilton:

1. Innovating our industry;
2. Transforming our buildings;
3. Changing how we move;
4. Revolutionizing renewables; and,
5. Growing Green.

Each transformation is described below, which includes the targets modelled including their impact on BAP emissions, cost per tonne of GHG reduced (a.k.a. marginal abatement cost or MAC), their major co-benefits, and the proposed implementation actions associated with each transformation. The modelled targets represent the low-carbon scenario model that, if achieved, can reduce City-wide GHG emissions by 96% by 2050. The Taking Action section within each low-carbon transformation will discuss immediate and near-term actions that can be taken to work towards our low-carbon future. A more detailed implementation framework can be found in Appendix C, including examples of key performance indicators proposed for monitoring each proposed action.



6.1 Innovating Our Industry

The industrial sector is the main energy consumer and GHG emitter in Hamilton, representing 64% of the City's emissions in the base year and out to 2050 in the BAP scenario. The majority of these emissions are from the coal used at the steel mills. Hydrogen, biochar, and electric arc technologies, all of which are low-carbon alternatives, are likely to be able to replace coal well before 2050. Recent announcements from the Federal and Provincial governments to support decarbonization of the steel sector locally with funding is a promising development for reducing and eliminating emissions from steel production.

For the remaining industry emissions, 50% energy efficiency targets were modelled based on measures identified in the Ontario 2019 Conservation Achievable Potential Study, undertaken on behalf of the province's energy regulator.

MODELLED TARGET	GHG REDUCTION NET ZERO VS. BAP 2050	MARGINAL ABATEMENT COST $/TCO$_2$E (BRACKETS) REPRESENT SAVINGS
Increase industrial energy efficiency (other than steel mills) by 50% from 2016 levels by 2050.	8%	$268
At the steel mills, reduce GHG emissions by 50% from 2016 levels by 2035 and achieve net-zero emissions by 2050.	45%	Not modelled[8]

6.1.1 CO-BENEFITS

Reducing industrial GHG emissions vastly will improve local air quality and, as a result, local public health. Emissions reductions will support will support industry in participating in the growing global low-carbon economy, which will create the potential for Hamilton to become an industry leader and attract global clean-tech investment and avoid carbon leakage into other jurisdictions. Hamilton's industry must change to be competitive in a future economic climate where innovative climate pricing frameworks (such as the European Union's proposed Carbon Border Adjustment Mechanism) will become more prevalent and will place additional economic pressures on the low-carbon production of goods.

6.1.2 TAKING ACTION

In order to achieve the modelled reduction in industrial GHG emissions, the below short-term (0-5 year) implementation actions are recommended. For a more detailed breakdown of the industrial implementation pathway, please see Table 5 of Implementation Strategy, attached as Appendix C.

[8] This action was not financially modelled as at the time of modelling, there was no reliable financial data nor certainty on the specific net-zero pathway that will be adopted by the steel industry.

1 & 1a → Industrial Energy Efficiency and Decarbonization Working Group

The City and it's partners will convene an industrial energy efficiency and decarbonization working (or "net-zero") group. This group will share information, support business or industry groups in setting organizational net-zero targets, track progress towards them, help connect industry with resources, and lobby higher levels of government for support.

In parallel and in conjunction with existing industrial sustainability-themed groups (e.g., Hamilton Industrial Environmental Association and City-led Bayfront Industrial Strategy efforts). This working group will focus explicitly on coordinating and fast-tracking GHG reductions in alignment with the City's GHG targets.

2 → Establish a Clean-tech Accelerator

Building on the skills and expertise available at the City's multiple post-secondary institutions, the City and it's partners, with support from the Provincial and Federal governments, can support the development of a clean-tech accelerator to prioritize and accelerate the development of technologies necessary for the decarbonization of the steel and other local industries.

3 → Expand Local Industrial Energy Management Training Programs

The City and it's local partners, including the Canadian Colleges to Resilient Recovery and other institutions and not-for-profits can work to expand local industrial energy management training programs. This will help build capacity and expertise in the labour force for the decarbonization of the City's industrial sector.

What excites you about this plan?

"Hamilton can be a leader and an example of a rust belt city [embracing] climate action to enhance the local economy, environment and quality of life."

"The potential to collaborate on a plan to move to a low-carbon steel industry based in Hamilton. This is crucial to Canada's long-term competitiveness in steel production [...]."

» *From responses to an online community survey for ReCharge Hamilton.*

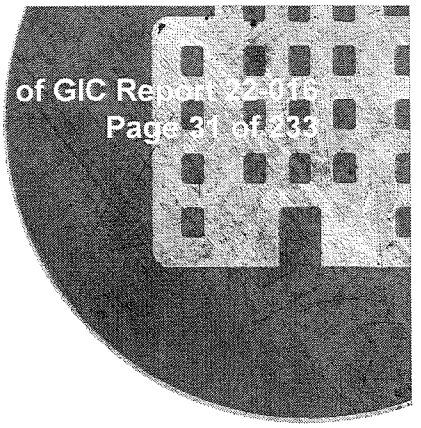
Community Momentum

» In 2020, Canadian Steel Producers Association set a net-zero-by-2050 target.

» In 2021, ArcelorMittal Dofasco (AMD) in Hamilton and the Federal and Provincial government announced funding for an initiative to transition AMD's Hamilton operation to electric arc furnace and direct reduced iron technologies. This could cut City-wide emissions by up to 30%.

» Stelco is planning a 65 megawatt cogeneration plant and has developed a technology to reduce coke consumption using waste railway ties. Another Stelco project plans to capture 6,300 tonnes of CO_2 to produce algae for fish feed and bioplastics.

» Hamilton Oshawa Port Authority has a goal of being carbon neutral for its own operations by 2025.



6.2 Transforming Our Buildings

In the base year (2016), commercial and residential buildings in Hamilton now account for almost a quarter of the city's energy consumption and 14% of its GHG emissions, primarily due to natural gas use for space and water heating. Hamilton's older and more inefficient homes are a particular issue. The majority of Hamilton's current building stock was built before any energy efficiency requirements existed (i.e., before 1990). Newer dwellings are built in accordance with the current Ontario Building Code which is more energy efficient. Older and typically more inefficient homes are an important target in order to reduce Hamilton's GHG emissions from residential buildings.

Energy efficiency is the main priority in tackling GHG emissions in the building sector. Significant improvements in energy efficiency can be achieved via implementing energy performance standards and guidelines for new buildings and deep energy retrofits of existing buildings. It is anticipated that through future updates to the Ontario Building code, greater energy efficiencies will be achieved in new buildings. Building retrofit programs will be necessary to accelerate emissions reductions in this sector.

MODELLED TARGET	GHG REDUCTION NET ZERO VS. BAP 2050	MARGINAL ABATEMENT COST $/TCO$_2$E (BRACKETS) REPRESENT SAVINGS
Retrofit 100% of commercial buildings, increasing energy efficiency by 50% by 2050 relative to 2016 levels.	2.7%	($257)
New commercial buildings are 60% lower in energy use intensity than 2016 levels by 2050.	1.4%	($320)
Retrofit 100% of existing homes to achieve 50% energy efficiency savings relative to 2016 by 2050.	2.8%	$139
Post-retrofits, switch buildings to heat pumps for space and water heating by 2050.	4.3%	$451
By 2031, new dwellings are 60% more energy efficient relative to 2016. Only 20% of new dwellings are single detached by 2050.	0.4%	($460)
By 2050, all new municipal buildings achieve net-zero emissions.	0.5%	($290)
By 2050, all municipal buildings are retrofitted to achieve 50% energy efficiency relative to 2016.	0.04%	$53

6.2.1 CO-BENEFITS

Hamilton's deep energy retrofit program will create an estimated 1,600 full time jobs and leverage local expertise in energy-efficient buildings. The benefit of these jobs can help redress

inequities if they are targeted at historically marginalized and under-employed communities, for example by providing subsidized training and retraining programs.

Energy efficiency can also help alleviate energy poverty, which is a persistent issue in Hamilton.[9] According to the 2016 Census, about 15% of Hamilton residents (more than 1 in 6) live below the after-tax low-income cut off, and struggle to pay their energy bills.

Social equity can be improved by targeting low-income residents with the proposed home energy retrofit program, such as by prioritizing the delivery of retrofits to social housing and subsidizing retrofits for low-income residents in other types of housing. Energy efficiency retrofits have the potential to reduce household energy bills by over 80% by 2050 (see Figure 4)., thereby resulting in more discretionary income for lower income households for basic needs (e.g. food) or other household purchases.

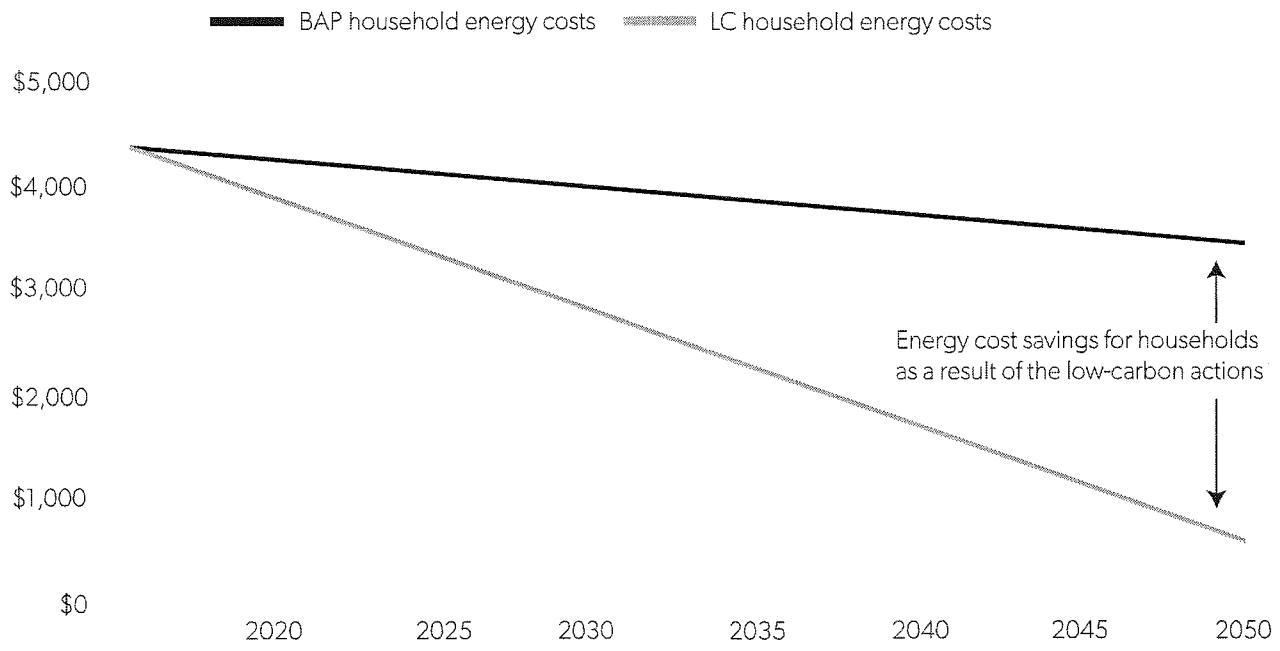


Figure 4. Average annual household energy costs (including transportation fuels) in the business-as-planned (BAP) and net-zero scenarios, 2016-2050.

6.2.2 TAKING ACTION

In order to achieve the modelled buildings GHG emissions reductions, the below short-term (0-5 year) implementation actions are recommended. For a more detailed breakdown of the buildings implementation pathway, please see Table 6 of the Implementation Strategy in Appendix C.

This plan recommends the development of a comprehensive energy retrofit program that will aim to improve energy efficiency and enable fuel switching to low-carbon sources in most of Hamilton's homes and businesses by 2050.

[9] Households that spend more than 6% of their income on their energy needs. ("Energy Poverty in Canada: a CUSP Backgrounder" (CUSP, October 2019) at 2, online: www.energypoverty.ca/backgrounder.pdf; Alternatively, Homelesshub.ca defines energy poverty as those spending more than 10% of their income on energy (see: Homelesshub.ca, "Energy Poverty" (accessed May 2021) online: https://www.homelesshub.ca/povertyhub/basic-needs/energy-poverty.)

4 → Green Standards for New Buildings/ Moving toward Net Zero Buildings

Hamilton is projected to grow by approximately 100,000 households in the 2021- 2051 time period, generally from 200,000 to 300,000 households. Although new buildings are projected to represent a relatively low share of GHG emissions in the City, new development represents long-term infrastructure that will establish patterns of energy use and GHG emissions for decades. The municipality will enact net-zero-aligned building and development standards, guidelines, or policies as soon as possible in order to avoid the need to retrofit new buildings in the future. This will involve working closely with the development community to develop and implement the guidelines. The City can also take on an advocacy role in asking the Provincial government to update the Ontario Building Code to reflect incremental changes towards net-zero construction for new buildings.

5 → Encourage Solar PV on New Buildings

In addition to the proposed Sustainable Development Guidelines, the City can review it's zoning and policy framework to remove barriers for the uptake of roof-mounted solar pv systems. This includes reviewing building height and side-yard requirements for solar PV related mechanical equipment. This also includes reviewing policies and regulations related to shadowing and solar access.

6 6a, 6b, & 6c → Retrofitting Existing Buildings

Many cities are exploring how to bring down the cost of mass deep energy retrofits, such as by revisiting the current utility-led delivery model, as well as ordering equipment (e.g., heat pumps) and undertaking retrofits in bulk. Building and business owners also have a central part to play in building retrofits.

City Council approved staff to apply for available funding through the Federation of Canadian Municipalities. If successful, the City will retain the Centre for Climate Change Management (CCCM) at Mohawk College to complete a detailed design of a Home Energy Retrofit Program to accelerate home energy retrofits across the City. This will be paired with a Home Energy Retrofit Delivery Centre to drive the uptake of retrofits.

The below four key short-term steps are recommended to prepare for a mass deep Home Energy Retrofit Program:

2022: Undertake a detailed design study for a Home Energy Retrofit Program to enable accelerated retrofitting across the City.

2022-onwards: Ensure local skilled labour is being trained or retrained to prepare the local workforce for when the program design is complete and implementation begins. Hamilton's post-secondary institutions (i.e., Mohawk College, McMaster University, and Redeemer University) will be key partners in

How will you contribute to building-related GHG reductions?

"Installing solar panels on my property."

"Undertaking an energy audit at my home or work."

"Switching to electric appliances."

"Reducing my water use."

"Installing additional attic insulation."

"Establishing a work-from-home policy at my office."

» *From responses to an online community survey for ReCharge Hamilton.*

this initiative. This will enable the program to be deployed and implemented seamlessly.

2022-2023: Undertake a small scale retrofit implementation to test the business case model and address potential kinks in the concept. Target low-income households or social housing.

2024-onwards: Expand the program, with particular attention to portions of the population that would stand to benefit the most from reduced energy costs and improved comfort and air quality (among other benefits).

What excites you about this plan?

"The possibility of creating a regulatory and financial support system to transition to renewable, net-zero homes and buildings as soon as possible."

"Buildings and houses built with self-sustaining renewable energy as the default."

"Greater efficiency, reduced heating (and potentially reduced cooling costs)[...]"

» *From responses to an online community survey for ReCharge Hamilton.*

Community Momentum

The Bay Area Climate Change Council is advising on the design and development of a building retrofit program and "delivery centre" to help the Bay Area achieve a low-carbon future.

In 2018, local architectural firm McCallumSather was recognized by the Hamilton Burlington Society of Architects for its work on the Joyce Centre for Partnership & Innovation at Mohawk College—the first institutional building in Canada to be certified as a Zero Carbon Building.

In 2020, McMaster University published a plan to reach net-zero carbon emissions by 2050 on its main campus.

6.3 Changing How We Move

In the base year (2016), gas- and diesel-powered cars, trucks, and buses account for 19% of Hamilton's emissions, which is second only to industrial emissions. A challenge to scaling up to electric vehicles is lifespan of existing internal combustion engine (ICE) vehicles (greater than 20 years). It will take a generation to retire these existing vehicles. This plan addresses these emissions by supporting alternatives to personal-use vehicles (PUV) through increased active transportation infrastructure (i.e., bike lanes and trails), expanded emissions-free transit, and decarbonizing personal and commercial vehicles.

MODELLED TARGET	GHG REDUCTION NET ZERO VS. BAP 2050	MARGINAL ABATEMENT COST $/TCO$_2$E (BRACKETS) REPRESENT SAVINGS
100% of new PUV sales are electric by 2040.	6.6%	($621)
By 2050, 100% of heavy-duty vehicles are green-hydrogen based and light-duty commercial vehicles are electric.	4.0%	($464)
Private vehicle trips decline by 9% relative to 2016 per person by 2050. Vehicular trip length declines by 6% from 2016 levels by 2050.	0.9%	($424)
Increase marine energy efficiency by 50% by 2050 relative to 2016.[10]	0.2%	Not modelled
100% of new municipal small and light-duty vehicles are electric by 2040. 100% of new municipal heavy-duty vehicles switch to clean hydrogen by 2040.	0.04%	($1,521)
Decarbonize the transit fleet by 2035.	0.1%	$268
By 2050, 10% of short trips are completed by e-mobility or EV car-share.	0.1%	$1,697
Increase transit use to 15% of trips by 2050 in the urban area.	0.02%	($3,908)
By 2050, 50% of short trips in the urban area take place through walking or cycling.	0.00%[11]	Not modelled

[10] This is an existing International Maritime Organization target.

[11] This action follows electrification of vehicles in the model, which explains why it shows no reductions of GHGs.

6.3.1 CO-BENEFITS

Research indicates that air pollution was responsible for about 90 deaths in Hamilton in 2012.[12] The exhaust emissions from cars, trucks, and buses are a leading source of poor air quality in the city.[13] Switching from internal-combustion vehicles to zero-emissions vehicles will improve health outcomes for Hamilton residents, particularly those living, going to school, or working within 100 metres of an arterial major road or 500 metres of a controlled access highway.[14] From 2013 to 2018, Hamilton recorded the highest particulate matter rating of the 10 largest cities in Ontario.[15] Zero-emission vehicles will reduce tail pipe emissions components of particulate matter, leaving non-emissions components such as dust to be addressed through other means.

By increasing the number of trips that are taken using an active mode of transportation, Hamilton residents will benefit from improved cardiovascular health and equitable.

Equitable outcomes are achieved when mobility (transit, active transportation, and e-mobility) is prioritized for historically marginalized communities. Mechanic training and retraining programs to service the next generation of vehicles can also target low-income and underemployed individuals, further improving social equity outcomes.

By increasing the amount of trips that are taken using an active mode of transportation, Hamilton residents will benefit from improved cardiovascular health, as well as quieter, less stressful streets.

Equitable outcomes are achieved when mobility (transit, active transportation, and e-mobility) is prioritized for historically marginalized communities. Mechanic training and retraining programs to service the next generation of vehicles can also target low-income and under-employed individuals, further improving social equity outcomes.

How do you see yourself contributing to transportation GHG reductions?

"Taking transit/walking/cycling to work."

"Switching to an electric vehicle."

"Setting up an EV charging station at work."

"Carpooling for my commute."

"Limiting my driving."

"Not idling."

» *From responses to an online community survey for ReCharge Hamilton.*

6.3.2 TAKING ACTION

In order to achieve the modelled GHG emissions reductions, the below short-term (0-5 year) implementation actions related to transportation are recommended. For a more detailed breakdown of the transportation implementation pathway, please see Table 7 of the Implementation Strategy in Appendix C.

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[12] 2018 Hamilton's Air Quality Trends Appendix "B" to Report BOH19039, at 14 of 15, online: pub-hamilton.escribemeetings.com/filestream.ashx?DocumentId=210129.

[13] Anthony Ciccone and Janya Kelly, "Hamilton Airshed Modelling System: Sub-Regional Analysis" (Golder Associates, March 30, 2021) at slide 23.

[14] Public Health Ontario, Traffic-Related Air Pollution: Avoiding the TRAP zone (n.d.) online: www.publichealthontario.ca/-/media/documents/O/2016/ohp-trap.pdf?la=en.

[15] City of Hamilton, Epidemiology and Evaluation Healthy and Safe Communities, Health Check: Assessing the local burden of disease in the City of Hamilton, 2nd edition (July 2018) at 27, online: www.hamilton.ca/sites/default/files/media/browser/2018-08-02/health-check-report-2018-edition2-v2.pdf.

The following are near-term transportation actions that are designed to first reduce vehicle kilometres traveled and then switch remaining vehicle kilometres travelled (VKTs) to low and/or zero emission vehicles.

7 → Expand Active Transportation Networks

Increasing active transportation is a priority for reducing transportation emissions; it offers many co-benefits, including improved physical health and increased social well-being. The City can expedite the roll out of its Cycling Master Plan and update future iterations of the Cycling Master Plan to align with the net-zero scenario active mode share targets.

8 → Decarbonize Transit

The City has recently committed to transitioning its buses to CNG, while also piloting an RNG powered bus; however, as the following section on renewable energy highlights, there is a limited supply of sustainable RNG.

Electrification is a preferred option, as the technology is available and emission-free buses don't emit pollutants that contribute to poor air quality.

9 → Expand Transit and E-mobility Services

Expanding transit helps reduce the need for personal-use vehicles and also offers an important means of transportation for those who are not able to drive or access personal vehicles. The City should also focus on developing higher-order transit in order to attract new transit riders.

To address those trips that are not suited to transit or active transport, the City can support the establishment of local e-mobility services, such as e-car, e-bike, and e-scooter share businesses.

10 → Establish a City-wide EV Strategy

To encourage the adoption and increase uptake of EVs, an extensive EV charging network needs to be in place. The City can continue to situate charging stations on City-owned lands through the implementation of the Parking Master Plan, as well as partner with businesses and multi-unit residential buildings to install charging stations in appropriate locations. The City can also require EV infrastructure through the development process for new development within the City. These efforts, among others, can be consolidated and integrated through the development and implementation of a City-wide Electric Vehicle Strategy.

11 → Commercial Fleet Decarbonization Working Group

The City can accelerate the transition of private fleets by convening a working group to coordinate activities and share insights from implementing the City's net-zero-aligned Green Fleet Strategy, support

What excites you about this plan?

"That we might begin to eliminate cars as a primary mode of transportation and actually become a progressive, green city."

"Less cars on roads."

"Cleaner air and more/safer bike lanes."

"The thought of breathing clean air, not polluted with carcinogenic matter."

» *From responses to an online community survey for ReCharge Hamilton.*

fleet net-zero targets, track progress towards them, and help connect businesses with resources.

12 → Support the Transition of Automotive Mechanics

The projected increase in EVs will require a new and/or retooled labour force. The City, local colleges (e.g., Mohawk College), and professional trade associations will work together to develop a plan to train and retrain the mechanic workforce using an equity lens to shift from ICE vehicles to EVs although both share common mechanical elements..

13 → Limit Parking and Incentivize EVs

The City can continue its efforts to reduce and manage parking requirements for developments in strategic locations, such as along transit corridors and throughout the Downtown. Where parking spots are required, the City can incentivize EV access through differentiated fee structures and exploring options through legislation for enforcement. The City can also incorporate EV parking requirements into the Zoning by-law for certain types of development.

Regional Collaboration

In 2017, the Mayors of Burlington and Hamilton vowed to work together on a regional approach to climate action. Both Cities came together with Mohawk College to open the Bay Area Climate Change Office and established the Bay Area Climate Change Council (BACCC). In 2019, the BACCC commissioned the first regional greenhouse gas (GHG) inventory. The Hamilton and Burlington Low-Carbon Scenario and Technical Report 2016 – 2050 provides information on the leading sources of emissions in the Bay Area to identify actions with the highest potential for reducing these regional emissions. The report identifies five potential program areas where regional collaborations on emissions reductions and energy planning could occur: building retrofits, renewable energy generation, electric vehicle strategies, low carbon new buildings, and education and outreach.

Community Momentum

In 2021, McMaster University, with support from its industry partners, announced the establishment of a green automotive, aerospace, and advanced manufacturing hub, called iHub.

The Canada Excellence Research Chair in Hybrid Powertrain Program at McMaster is pioneering sustainable energy-efficient solutions from advanced power electronic converters and electric motor drives to electric, hybrid electric, and plug-in hybrid electric vehicles, and working to alleviate the loss of performance of lithium ion batteries over time.

In May 2021, the City Council approved its Green Fleet Strategy which includes converting 89 fossil fueled cars to electric vehicles reducing GHG emissions by 18% in 3 years (not including police, fire and transit vehicles). The Strategy also includes a long-range target of achieving net zero across the municipal fleet by 2050.

In March 2021, the City partnered with Enbridge to fuel Ontario's first carbon-negative transit bus as part of the HSR's fleet.

6.4 Revolutionizing Renewables

As a final step to achieving net zero by 2050, remaining fossil fuel energy use needs to be replaced with renewable energy. Due to the expected increased reliance on fossil fuels by the provincial electricity grid, the switch to renewable energy will require directly generating renewable energy or purchasing renewable energy from outside of City boundaries to offset remaining emissions.

The City has strategic opportunities to increase production of renewable energy via wind turbines, rooftop and ground mount solar energy, renewable natural gas (RNG) from local organic waste, and capturing residual heat from the industrial sector. The low-carbon scenario modelled for the city of Hamilton included a combination of these sources that amounted to 7% of the City's energy needs by 2050.[16] There is potential to produce much more, for example via large-scale wind and solar installations inside or outside of the city limits, as well as RNG produced from the city's commercial and agricultural organic waste. Ample renewable energy will be crucial in order to produce the green hydrogen that is vital in the pathway to decarbonizing Hamilton's industrial sector, including steel production.

The City is home to extensive district energy systems, local energy generation that powers multiple buildings at a time. This is an important local resource that can be leveraged to expand local renewable energy generation.

If the Provincial grid decarbonizes by 2050, then the purchase of renewable energy certificates outlined in the table below will not be required.

MODELLED TARGET	GHG REDUCTION NET ZERO VS. BAP 2050	MARGINAL ABATEMENT COST $/TCO$_2$E (BRACKETS) REPRESENT SAVINGS
In 2050, for each MWh of central electricity demand remaining after local renewable energy production, purchase a Renewable Energy Certificate (REC).[17] (This action includes the modelled wind capacity)	6.1%	$51
In order to replace the remaining natural gas in the City, green hydrogen (produced via renewable energy) is pumped into the natural gas distribution system.	5.0%	$816

[16] As a result of approximately 830 GWh of wind, 560 GWh of rooftop solar, 400 GWh ground mount solar, 5 GWh of RNG, and 130 GWh of industrial residual heat.

[17] Renewable Energy Certificates (RECs) are a market-based instrument that certifies the bearer owns one megawatt-hour (MWh) of electricity generated from a renewable energy resource. Once the power provider has fed the energy into the grid, the REC received can then be sold on the open market as an energy commodity. RECs earned may be sold, for example, to other entities that are polluting as a carbon credit to offset their emissions.

MODELLED TARGET	GHG REDUCTION NET ZERO VS. BAP 2050	MARGINAL ABATEMENT COST $/TCO$_2$E (BRACKETS) REPRESENT SAVINGS
By 2050, Installation of 280 MW of ground mount solar PV, inside or outside the City boundary.	0.3%	($1,254)
Expansion of the downtown district energy network powered by industrial residual heat.	0.1%[18]	$192[19]
By 2050, Installation of rooftop solar PV capacity to power, on average, 50% of building electric load, before the introduction of heat pumps.	0.2%	($959)
Starting in 2031, all new homes have 30% annual load coverage by solar PV, before the introduction of heat pumps.	0.2%	($1,343)
Starting in 2026, all new commercial buildings include rooftop solar PV panels.	0.2%	($654)
By 2050, 50% of municipal buildings will add rooftop solar PV, covering 30% of the building's electrical load.	0.01%	($494)
By 2050, 95% of organic waste is sent to anaerobic digestion for local energy use. Purchase remaining RNG needed to replace all remaining natural gas demand by 2050, starting in 2025.	5.8%	$74

6.4.1 CO-BENEFITS

Local energy generation helps ensure local energy resilience and keeps energy dollars and jobs within the community. For Hamilton, increasing local renewable energy generation will also decrease energy waste. For example, the residual heat from industrial smoke stacks could be captured to heat buildings, instead of using natural gas, and organic waste decomposing in the landfill could be captured, processed, and then used instead of natural gas to power waste disposal trucks or the City's transit vehicles.

Switching away from fossil fuel-based sources of energy and towards renewable sources of energy will also contribute to a reduction in airborne particulate, and ultimately better air quality.

6.4.2 TAKING ACTION

Renewable electricity and renewable natural gas are essential to the City achieving its target of net zero by 2050. In terms of electricity, either the provincial electricity grid will have to

[18] Further work by Hamilton Community Enterprises and its partners on their industrial residual heat harvesting project has identified a potential to reduce GHG emissions by 200,000 tCO2e which translates to ±2.3% in the above table

[19] This expanded opportunity would further reduce the marginal abatement costs to $12/tCO2e

decarbonize by 2050 or the City will need to increase local sources of renewable electricity. The remaining natural gas supply will need to be replaced with renewable natural gas or green hydrogen (produced by renewable electricity). For a more detailed breakdown of the revolutionize renewables implementation pathway, please see Table 8 of the Implementation Strategy in Appendix C.

14 → Advocate for and Build an Electricity Grid for the Future

To achieve greater resilience and flexibility in the electricity grid, the City will coordinate with Alectra, Hydro One, the IESO, and the Province to streamline connections for solar PV, electric vehicles, and energy storage. Strategies can include targeted investments in the grid, streamlined application/permitting, and low-interest financing.

Furthermore, building on its November 2020 resolution calling on the Province to phase-out the use of natural gas in its electricity grid by 2030, the City can partner with other municipalities to highlight the imperative for a zero-emissions Provincial grid.

15 → Encourage Local, Alternative Renewable Energy Ownership Structures

To maximize local economic benefits, the City can support alternative renewable electricity ownership structures, such as co-operatives that maximize community benefits. A regional approach to energy planning can also be taken through municipal collaborations on energy generation in the Bay Area.

16 → Ensure Land Planning Policies Support Solar Array Installations

The City can establish land planning by-laws and policies that support the development of solar arrays in a manner that maximizes the beneficial uses of lands while protecting lands that have other values, for example, on appropriate rural lands or above parking lots, commercial and industrial buildings. These regulatory and policy changes should have the effect of making it easier to establish local solar energy generation. The City, in coordination with Alectra, Hydro One, and the IESO can identify strategic lands for the development of solar energy installations.

17 & 20 → Organic Diversion and AD Systems

In order to reach net zero, as much organic waste as possible should be diverted from the landfill and used as feedstock for anaerobic digester (AD) systems. Ideally, the City needs a centralized system for multiple local organic waste streams to achieve economies of scale.

What excites you about this plan?

"The idea of decentralized energy networks."

"[I]mproving organics recovery is very exciting to both reduce emissions and move towards the circular economy."

» *From responses to an online community survey for ReCharge Hamilton.*

AD systems produce biogas that can be used onsite or refined into renewable natural gas and used locally (e.g., in buses, dump trucks, district energy systems) or injected into the natural gas system as a source of City revenue. The City should complete a technical review and analysis of increasing organics diversion to anaerobic digesters for energy production.

18 → Technical Analysis of Green Hydrogen

Green hydrogen is key in the pathway to decarbonizing the City's industrial sector, including primary steel production. Green hydrogen also has enormous potential when it comes to other applications such as transportation, energy generation and storage, and building heating.

Building on the Hydrogen Strategy for Canada released in December of 2020, Hamilton needs to explore the creation of a hydrogen hub. This may include a technical analysis of the potential opportunities and challenges for green hydrogen in Hamilton, along with potential costs of green hydrogen and actions to increase green hydrogen deployment throughout the City.

19 → Decarbonize and Expand District Energy

With its partners, the City can work towards decarbonizing and expanding the downtown district energy system, drawing on RNG and industrial residual heat. Over time, this project would represent at least a thirty-two fold increase of building space served by net-zero carbon district energy, as well as many co-benefits including local revenue, jobs and energy cost-savings. This project would represent a powerful way to leverage the planned urban intensification of the downtown.

The Hamilton Chamber of Commerce along with several local partner organizations, recently released its report on the industrial waste heat recovery project in Hamilton. This report began the assessment of the feasibility of industrial waste heat in Hamilton and identified 11 project recommendations for advancing waste heat and smart energy systems in Hamilton19. Based on this work, HCE has initiated an Energy Harvesting Project to use industrial residual heat as a low-carbon energy source for district energy. The City of Hamilton should work closely with the Hamilton Chamber of Commerce and HCE & its partners to implement the recommendations of this report.

Please refer to the Large-Scale Renewable Energy Planning Practices Memo for more details on renewable energy technologies, policies, and best practices attached as Appendix F.

Community Momentum

» Hamilton Community Enterprises (HCE) is working with the Hamilton Chamber of Commerce and other partners to harness industrial residual heat – an ample local source of low cost, emissions-free energy to modernize and expand its downtown district energy systems.

» Since 2010, HCE and McMaster Innovation Park have been developing and implementing an innovative low-carbon district energy system at their research and innovation campus.

» McMaster's Mechanical Engineering Department has been undertaking research on Integrated Community Energy and Harvesting (ICE-Harvest) systems, that embed integrated thermal and electrical generation, as well as storage, within communities, so they can be powered, heated and cooled in a way that's cost effective and carbon-reduced.

6.5 Growing Green

Growing 'green' requires the protection and expansion of the City's green infrastructure (natural areas and urban forest) to maintain and increase carbon sequestration. Growing green also requires a focus on land use planning patterns and policies to ensure that future growth patterns support and enable related low carbon actions and behaviours such as promoting transit and active transportation, and achieving low carbon development.

In December 2021, Hamilton City Council adopted a 'no urban boundary expansion' pattern for future growth to 2051. While the final approval of Council's decision has yet to be received from the Provincial government, the City is already on its way to strengthening its land use planning policy framework to support the significant increase in intensification development required to accommodate projected growth. Continuous review and revision of the City's Urban Hamilton Official Plan and Rural Hamilton Official Plan to ensure the city is 'growing green' will need to occur to support the pathway to a net zero City.

6.5.1 TREE PLANTING

The Niagara Escarpment and its associated features that run through the City defines Hamilton; it is a lifeline for local wildlife, water quality, and resident well-being and health. Continuing to protect and expand these green spaces is an important part of achieving net-zero emissions, as trees and healthy soil are an important source of carbon sequestration.

MODELLED TARGET	GHG REDUCTION NET ZERO VS. BAP 2050	MARGINAL ABATEMENT COST $/TCO$_2$E (BRACKETS) REPRESENT SAVINGS
Planting 50,000 trees a year through to 2050	0.75%	($2)

6.5.2 CO-BENEFITS

Land-use patterns can enable people to adopt low-carbon behaviours such as walking or cycling. Many of the factors that facilitate active transportation and reduce GHG emissions also contribute to positive equity outcomes. These changes tend to reduce household transportation costs and utility bills, which can increase affordability.

Increased sequestration from tree planting results in a relatively small reduction in GHG emissions; however, trees offer co-benefits including reduced air pollution, improved well-being, regulated temperature, shade, reduced stormwater runoff, and more.

6.5.3 TAKING ACTION

In order to achieve the modelled GHG emissions reductions, the below short-term (0-5 year) implementation actions related to land use are recommended. For a more detailed breakdown of the growing green implementation pathway, please see Table 9 of the Implementation Strategy in Appendix C.

21 → Review and Update Official Plan(s)

The City has committed to applying a climate change lens to population and employment intensification targets, which will align GHG targets with future land-use policies. The City is already reviewing it's Official Plans to ensure supportive climate change and energy policies, which includes policies that support the acceleration of the development of low carbon buildings and communities, the reusing and retrofitting of existing buildings and the circular economy, enhancing the City's natural environment as a carbon sink, building community resilience, and accelerating the adoption of low-carbon transportation options.

22 → Community Energy/Climate Action Policy Into Secondary Plans

The City can require the integration of community energy/climate action policy directions into secondary plans. New greenfield areas that might be added to the City's boundary in future or redeveloped areas, should require their own community energy system planning process. Relevant considerations, such as design for passive heating and cooling, shadow studies for solar PV, embodied carbon in materials, dwelling size, connectivity of roads, proximity to and mix of destinations, consideration of district or community energy systems, and others, can be addressed at the level of the secondary plan.

23 → Carbon Sequestration and Tree Planting

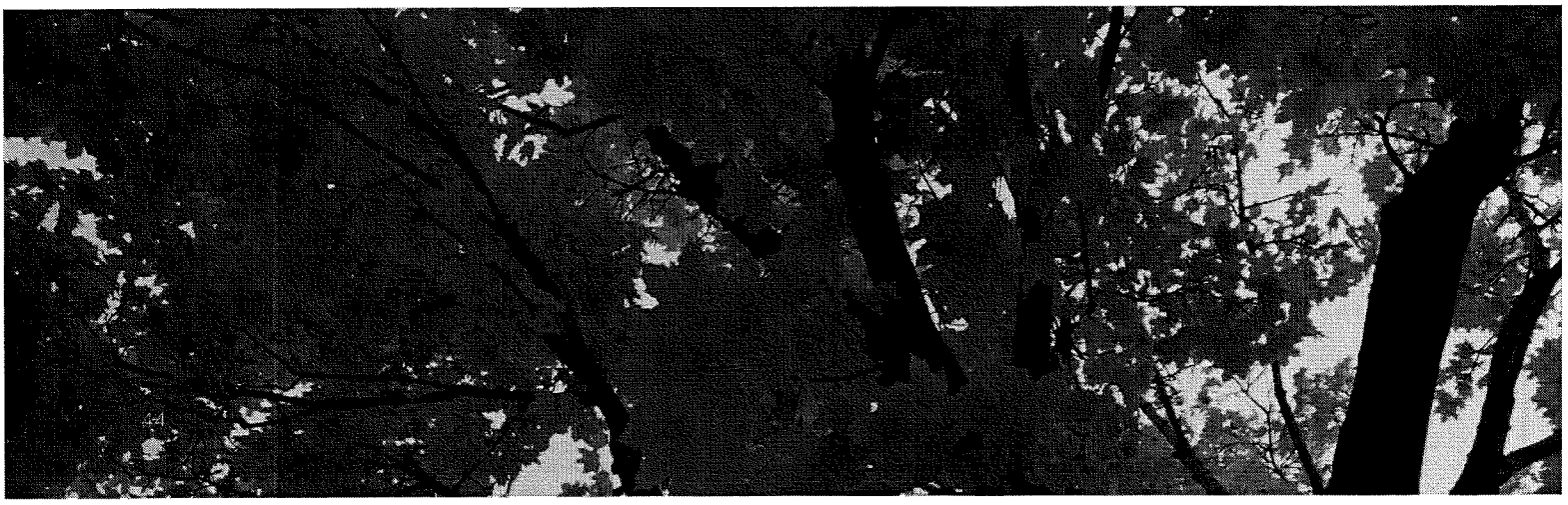
The City can create an ambitious tree planting program that builds on existing City efforts, including the draft Urban Forest Strategy, as well the efforts of the local Conservation Authorities' and other institutional and not-for-profit organizations. The goal of the program will be to plant a total of 50,000 trees annually throughout the City.

Improved agricultural soil management practices is another opportunity for carbon sequestration that can be examined in future CEEP updates.

Best Climate Practices For Greenfield Development

In order to minimize environmental impacts, it is best to avoid greenfield development where possible and maximize urban intensification. At the same time, intensification can increase well-being and social equity if it is undertaken in a way that maximizes resident access to green space, improves air quality, lowers noise levels, and ensures widespread access to municipal and community services.

Intensification will help improve the City's energy-use profile by reducing reliance on personal-use vehicles and lowering building square footage per person. Improved energy efficiency is critical to enabling the net-zero target, as it reduces overall costs to the energy system. Furthermore, increased intensification can help reduce embodied carbon emissions, as well as the loss of ecosystem services associated with greenfield development.



How do you see yourself contributing to natural carbon sequestration?

"Supporting the planting of native trees."

"Carbon sequestration by rebuilding a deep, rich humus layer on degraded suburban soil."

"Moving away from wood heating to cleaner methods."

"Supporting the establishment of treed pedestrian malls."

"Selecting trees and vegetation that are appropriate for our area and goals and gardening to provide some of our own food to reduce the need to transport."

» *From responses to an online community survey for ReCharge Hamilton.*

What excites you about this plan?

"I really like the idea about greening the urban core with tree planting/rewilding."

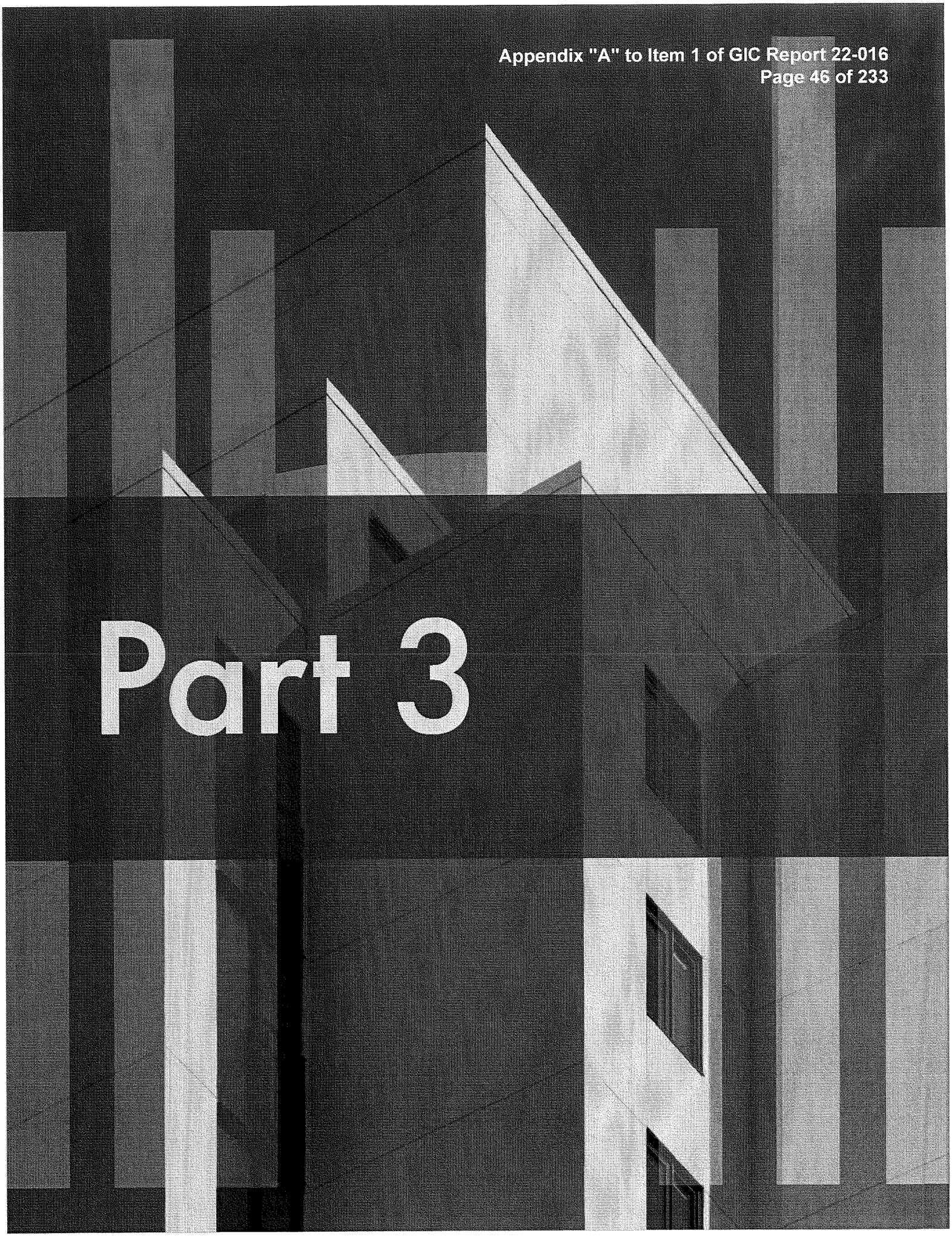
» *From responses to an online community survey for ReCharge Hamilton.*

Community Momentum

» The Just Recovery Hamilton Coalition was created, which is a coalition of Hamilton community member organizations with a focus on policy development to address a more equitable COVID-19 recovery.

» The Centre for Climate Change Management at Mohawk College is a regional hub for collaboration on climate action. As an applied research arm of the College, the Centre is a model for how colleges can support their region's transition to a low-carbon economy by partnering with municipal, industry, and community partners to catalyze climate change interventions.

» As a result of the City's Corporate Energy Policy, the City has reduced its GHG emissions at City-owned facilities by 42% (as of 2018) when compared to the base year (2005).



Part 3

7.0 Part III: Towards Implementation

7.1 Monitoring, Oversight, and Adaptive Management

In order for Hamilton to get on track to meet its net-zero carbon emissions target by 2050 and respond to its climate emergency declaration, the City must implement this plan as soon as possible.

Effective implementation will require oversight and coordination. This effort will be led by the City and a properly resourced and skilled non-governmental organization working hand-in-hand with the City. Key components of the coordinating framework would be:

ANNUALLY REPORTING GHGs: the primary data to track progress towards the net-zero target. It should include community-wide and sector-specific energy and emissions reporting on established key performance indicators.

COORDINATING ADAPTIVE MANAGEMENT: regular reviews (for example, every 5 years) of ReCharge Hamilton programs based on predetermined metrics, as well as trends in overall energy use and GHG emissions, updates in policy best practice, and technological innovation.

MAINTAINING TRANSPARENCY: by ensuring that all reporting and reviews are made easily accessible to the public.

COMMUNITY ENGAGEMENT AND OVERSIGHT: via a formal body representing a cross-section of the community.

This plan recommends a three-pronged implementation framework that consists of:

1. City of Hamilton Centralized Climate Office

A centralized entity within the City Corporation should act as a hub for coordinating the implementation of the City-led CEEP actions across the municipal corporation, as well as reporting on corporate and community-wide progress on the implementation of CEEP actions of GHG reductions. The proposed Climate Office would also be the stewards of the proposed Climate Impact Adaptation Plan, currently under development , and would be responsible for leading updates to the City's climate change related documents such as the Community Energy and Emissions Plan and the Community Impact Adaptation Plan. The Climate Office will also partner with the Community Climate Advisory Committee to design and undertake community engagement throughout the implementation of the plan.

2. Community Climate Advisory Committee

The Community Climate Advisory Committee is an independent external committee of community stakeholders that operates as an independent body to review the City's corporate and community wide targets, actions, and progress on same. The Community Climate Advisory Committee will also serve as a liaison between the broader community and the proposed City Climate Office and coordinate the implementation of community-led actions, data collection, education and awareness, and reporting.

3. Multi-Departmental Climate Change Working Group

This plan also proposes the creation of a City Multi-departmental Climate Change Working Group, with Staff resources available from each City department. The Multi-departmental Climate Change Working Group will play an important role in monitoring and reporting on targets for City-led actions. These departmental representatives will serve as a liaison to the centralized Climate Office and will be part of a Multi-Departmental Climate Change Working Group to report on actions, progress and monitor implementation and targets associated with their respective departments.

7.2 Municipal Role

Although the Municipal Corporation's GHG emissions account for less than 1% of the total City emissions, it plays a leadership role in the community. From its fleet to its buildings, the municipality can and should be a leader in reaching net zero.

In the short-term, to ensure public tax dollars are not working at cross-purposes to this Plan, the City will implement a climate lens on all budget decisions and investigate the establishment of an annual carbon budget—an emerging best practice—to ensure Council decisions align with GHG targets. The City will also develop a procurement strategy that accounts for embodied carbon emissions

In addition, the municipality will also support broader community implementation in partnership with the proposed Community Climate Advisory Committee, as outlined in the implementation sections within each key low-carbon transformation, above.

When it comes to its fleet and buildings, the City is already on a net-zero trajectory based on its most recent Green Fleet Strategy. The City has also recently updated its Corporate Energy and Sustainability Policy (formerly Corporate Energy Policy) to ensure its buildings are on the same path. Implementation and compliance with these corporate policies will be important.

Finally, the City can mobilize financial resources using tools, such as the issuance of green bonds, an expanded revolving fund that is administered by the City's Office of Energy Initiatives, and allocating a sustainable source of funding to the City's existing Climate Change Reserve fund in support of this plan.

Setting a Carbon Budget

Point-in-time carbon emissions reduction targets, like this CEEP's target of net-zero emissions by 2050, are only aligned with the Paris Agreement target of limiting global warming to well below 2.0°C and preferably 1.5°C, if they also limit cumulative emissions. Remaining within the threshold for global cumulative emissions, or rather the global carbon budget, is what will significantly reduce the risk of catastrophic climate change.[1]

City-level carbon budgets are an emerging best practice that involve setting annual caps on how much communities can emit leading up to their target year(s).[2] Staying within the world's carbon budget generally requires a steep decline in emissions starting as soon as possible.

In setting its carbon budget, the City needs to determine its fair share of the global carbon budget. This question requires the City to consider its current per capita wealth and emissions as compared to those of other local and global jurisdictions. For example, C40 recommends that cities set their interim targets based on an average per capita emissions target.[3] Per this method, Hamilton would have to limit emissions to 3.2 tCO_2e per capita by 2030, assuming a goal of keeping global warming below 2°C; to remain below 1.5°C, the budget would be even lower.

[1] Ibid.

[2] IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

[3] C40, Deadline 2020, How Cities Will get the Job Done (n.d.) at 102, online at: resourcecentre.c40.org/resources/deadline-2020#:~:text=Deadline%202020%20identifies%20C40%20cities,tCO2e%20per%20capita%20by%202030.

7.3 Community Role

7.3.1 ENGAGING THE COMMUNITY

Going forward, there will be many ways for individuals and businesses to participate in Hamilton's path to net zero, from participating in policy and program development, to partnering in program implementation, to participating in community programs. This is why developing and delivering a public education and engagement campaign is one of the main features of the CEEP's near-term Implementation Strategy (Appendix C). As specific community based programs are developed and implemented, opportunities for further public involvement will be highlighted. This may include home energy retrofit opportunities, tree planting initiatives and participating in renewable energy project cooperatives, among many others.

How do you see yourself contributing to GHG reductions?

"I would like to join a committee or board to support this plan."

"Calling for collaboration on low-carbon steel production."

"Calling for closing compact business districts to vehicle traffic."

» *From responses to an online community survey for ReCharge Hamilton.*

What excites you about this plan?

"It is a bold vision for reductions, and has concrete ideas to achieve them."

"That it exists!"

"That we are finally beginning to see small steps after years of lip service to the global climate emergency. I will only really be excited when I see real progress and measurable [progress]."

"I think climate change is the most important issue we face and it's very good to see the City taking action on it."

"It will have very tangible effects on life in the city, not just reducing emissions but also making the city healthier, safer, and more human-friendly."

"It seems to be very comprehensive and full of great ideas that hopefully will be implemented."

"The opportunity to tackle our problems together for a better future, and for me to have a channel to provide input."

» *From responses to an online community survey for ReCharge Hamilton.*

8.0 Acronyms

AD	Anaerobic digester
BAP	Business-as-planned scenario
CEEP	Community Energy and Emissions Plan
GHG	Greenhouse Gas
EV	Electric vehicle
IPCC	Intergovernmental Panel on Climate Change
PUV	Personal-use vehicle
PV	Solar photovoltaic
RE	Renewable energy
RNG	Renewable natural gas
UNFCCC	United Nations Framework Convention on Climate Change
VKT	Vehicle kilometres travelled

9.0 Glossary

Base year: The starting year for energy or emissions projections.

Biogas: Methane captured from bacterial decomposition of sewage, manure, waste, plant crops, or other organic waste products. If refined, it can be used as a natural gas replacement.

Business-as-planned (BAP): A scenario illustrating expected energy use and greenhouse gas emissions if no additional plans, policies, programs, and projects are implemented between the present and 2050.

Carbon dioxide equivalent (CO_2e): A measure for describing the global warming potential of a greenhouse gas using the equivalent amount or concentration of carbon dioxide (CO_2) as a reference. CO_2e is commonly expressed as million metric tonnes of carbon dioxide equivalent ($MtCO_2e$).

Co-benefits: Benefits that are additional to the primary objective of the CEEP (i.e., to energy efficiency and emissions reductions).

Deep energy retrofit: A whole-building analysis and construction process minimizing building energy use by 50% or more compared to base year energy use.

District energy system: A centralized system that heats and/or cools multiple buildings.

Emissions: In this report, the term "emissions" refers exclusively to greenhouse gas emissions, measured in metric tonnes (CO_2e), unless otherwise indicated.

Emissions intensity: The ratio of emissions released per unit of electricity generated, measured in gCO_2e/kWh.

Energy efficiency improvement: An improvement in the ratio of energy consumed to the output produced or service performed. This improvement results in the delivery of more services for the same energy inputs or the same level of services from less energy input.

Electric vehicles (EVs): An umbrella term describing a variety of vehicle types that use electricity as their primary fuel source for propulsion or as a means to improve the efficiency of a conventional internal combustion engine.

Green bonds: Bonds whose proceeds are issued to climate-related projects, such as public transit expansions or low carbon infrastructure

Green revolving funds: Pools of money used to finance emissions reductions projects, whereby resulting savings are paid back and re-loaned for other emissions reductions projects

Greenhouse gases (GHG): Gases that trap heat in the atmosphere by absorbing and emitting solar radiation, causing a greenhouse effect that unnaturally warms the atmosphere. The main GHGs are water vapour, carbon dioxide, methane, nitrous oxide, and ozone.

Heat pump: A device that transfers heat energy from a source of heat to a target area using mechanical energy.

Low-carbon action: An action or policy to reduce emissions.

Marginal abatement cost (MAC): The cost of an action or policy compared to its potential GHG reduction, measured in tonnes CO_2e per dollar spent/saved. A negative MAC indicates an

action results in a positive net return (i.e., savings or revenue).

Renewable energy: Energy that comes from resources that are naturally replenished on a human timescale, such as sunlight, wind, moving water, and geothermal heat.

Solar photovoltaic (PV): Also known as solar electric systems or solar panels, these are systems that convert sunlight into electricity. Any excess electricity produced that a building does not use can be sold to the utility through a process called net-metering.

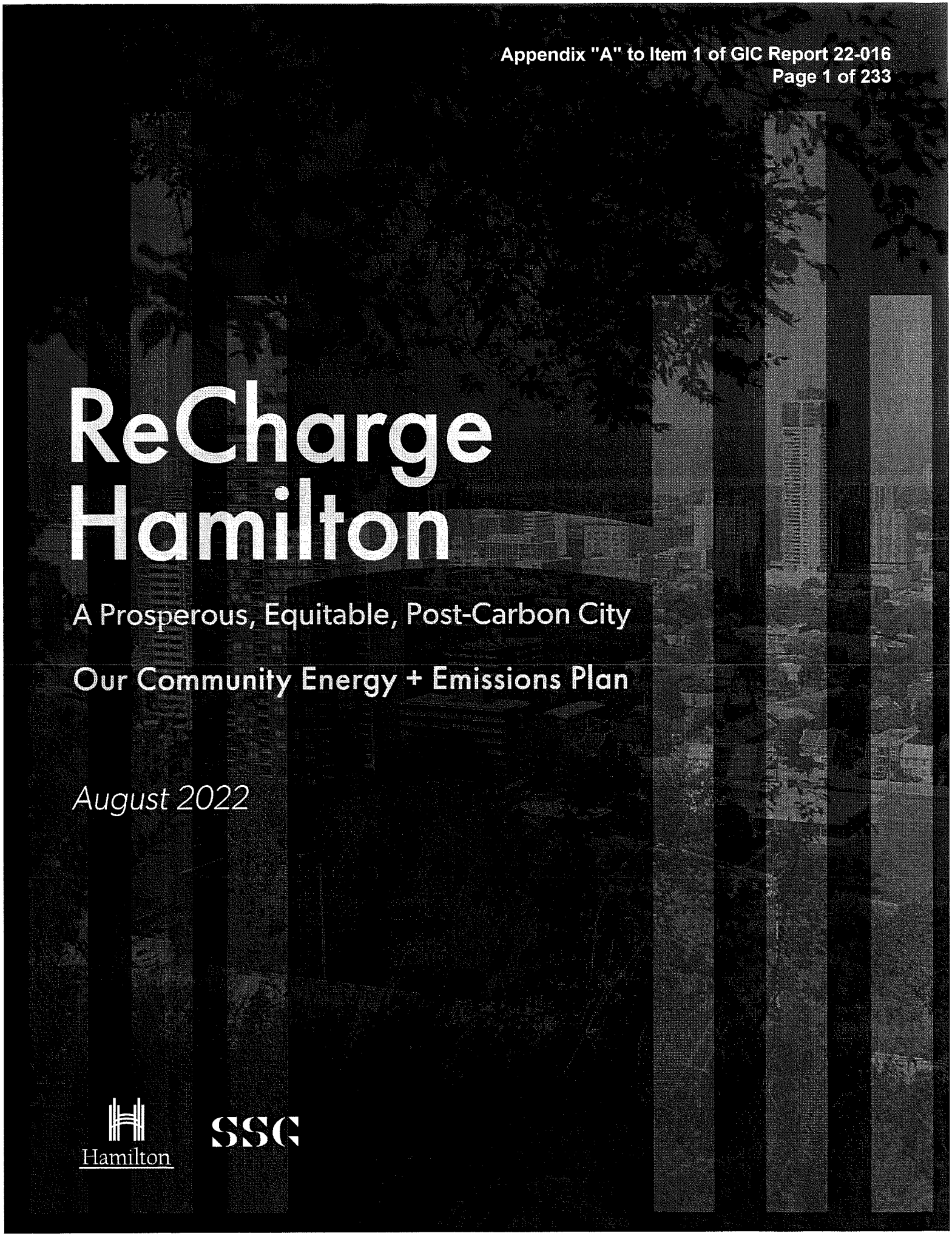
Vehicle kilometres travelled (VKT): Distance travelled by vehicles within a defined region over a specified time period.

GHG emissions

1 $ktCO_2e$ =	1,000 tCO_2e
1 tCO_2e =	1,000 $kgCO_2e$
1 $kgCO_2e$ =	1,000 gCO_2e

Energy

1 MWh =	1,000 kWh
1 MWh =	3.6 GJ
1 GJ =	278 kWh
1 GJ =	1,000,000 J
1 MJ =	0.001 GJ
1 TJ =	1,000 GJ
1 PJ =	1,000,000 GJ



ReCharge Hamilton

A Prosperous, Equitable, Post-Carbon City

Our Community Energy + Emissions Plan

August 2022

Hamilton

SSG

Contents

Disclaimer

Greenhouse gas emissions modelling for the Baseline, Business-as-planned and Low-carbon Scenarios was completed between the fall of 2020 and the summer of 2021 and does not reflect low-carbon initiatives within the community that have been announced since the modelling was completed.

APPENDIX A: Table of Business-as-Planned and Low-Carbon Actions

June 2021

Purpose

This document provides a table of low-carbon actions designed to address all sources of greenhouse gas emissions identified in the base year and business-as-planned (BAP) report prepared by the Consultant. The table also provides a summary of some of the key criteria that informed each action.

These low-carbon actions form the basis of the energy and emissions modelling undertaken for Hamilton's Community Energy and Emissions Plan (CEEP) to achieve net-zero carbon emissions by 2050.

The process for designing low-carbon actions

The primary criteria for designing the following table of low-carbon actions is that they enable Hamilton to achieve its target of net-zero carbon emissions by 2050 and reflect an adequate response to the City's climate emergency declaration. These actions are based on the consultants' research of best practices and experience modelling net-zero energy and emissions pathways for dozens of other communities, and less ambitious pathways for dozens more. These actions were further refined by the Stakeholder Advisory Committee's (SAC) feedback and community input.

SAC feedback was gathered during a June 2020 BAP webinar and workshop as well as through dozens of individual stakeholder meetings undertaken from June through to October 2020.

Community input was received via two online surveys, one discussing what actions residents thought should be prioritized (124 unique respondents as of October 20, 2020) and the other highlighting the criteria they felt should be prioritized in designing the net-zero pathway (67 unique respondents as of October 20, 2020).

Please note:

- Wherever the term 'efficiency' is used, it is always occurring pre-electrification.
- The energy and emissions base year is 2016 for all actions, unless noted otherwise.
- BAP actions were developed throughout 2020, and the low-carbon actions were developed throughout 2020-2021, and therefore do not include policy or other developments that took place subsequently.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
LAND-USE			
1. Spatial distribution	• Population and employment per zone, as per City projections through to 2041. • 2041-2050: population and employment trends per zone are projected linearly (based on 2031-2041 data from City).	• Population and employment distribution by zone to be consistent with the most recent projections provided by the City through to 2041. • Projections from 2031-2041 are draft not yet Council approved. • Trends provided by the City for 2031-2041 are linearly extrapolated through to 2051.	Stakeholder input: Based on data and feedback from the City planning department

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
BUILDINGS			
New buildings - buildings codes & standards			
2. Building use energy intensity	• Starting in 2017: 15% energy improvement from the 2016 base year for residential, and 13% for MURBs, C&I. • As of 2019: new construction is 10% more efficient every 5 years.	• Only 20% of new dwellings to be single-detached by 2050 (a steady decline from rates in 2016). • Average floor space stays constant from the base year.	**Note:** 50% of dwellings were single-detached in 2016, compared to 71% in 1951. Historical analysis indicates that average floorspace per Hamilton dwelling has increased slightly from 1990 to 2016. **Research:** According to US research, average home sizes have almost doubled since 1950, and family sizes have decreased (see 2012 *Oregon Department of Environmental Quality's presentation on the environmental benefits of smaller housing and related policies to achieve smaller housing*; See also *best practice advice on Encouraging Development of Smaller Homes from USDN*, municipal experts from across the US & Canada)
3. New residential housing targets	• Starting in 2017: 15% energy improvement from the 2016 base year for residential, and 13% for MURBs, C&I. • As of 2019: new construction is 10% more efficient every 5 years.	• In 2026, new buildings are 30% more efficient, with similar efficiency improvements in 2031, resulting in new buildings being a total of 60% more efficient. • As of 2031, all new homes have 30% annual load coverage by solar PV (not including additional electricity demand due to fuel switching in space and water heating).	**Energy efficiency standards:** Applying Toronto Green Standard-equivalent (i.e. Passive House/ Net Zero) energy efficiency improvements -- though starting 5 years later. This is despite the fact that the City of Hamilton does not have the legislative authority to supersede the Ontario Building Code with building requirements. As such, innovation in policy design and/or lobbying higher levels of government would be required to achieve this. • Stakeholder feedback: this level of ambition was just right • Survey response: 74% felt this should be a priority action **Solar PV:** Internal analysis, as well as Google Environmental Insights Explorer, indicates that about 15% of current Hamilton building load could be provided by rooftop solar PV; the 30% in this action reflects the reduced electricity demand of more efficient new buildings (this share does not include additional electricity demand due to fuel switching in space and water heating).

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
4. Commercial - New commercial development targets	• Starting in 2017: 15% energy improvement from the 2016 base year for residential, and 13% for MURBs, C&I. • As of 2019: new construction is 10% more efficient every 5 years.	• In 2026, new buildings are 30% more efficient, with similar efficiency improvements in 2031, resulting in new buildings being a total of 60% more efficient. • including roof-top PV	**Best Practice:** Applying Toronto Green Standard-equivalent (i.e. Passive House/ Net Zero) energy efficiency improvements--though starting 5 years later. This is despite the fact that the City of Hamilton does not have the legislative authority to supersede the Ontario Building Code with building requirements. As such, innovation in policy design and/or lobbying higher levels of government would be required to achieve this. **Stakeholder feedback:** this level of ambition is just right. **Solar PV:** see Action 3
Existing buildings - retrofitting			
5. Retrofit homes built prior to 1980	• Starting in 2020, retrofit existing building stock exponentially until in 2050 a total of 6% achieve 10% electricity and 10% heating savings	• Starting in 2022, by 2050, on average, all existing dwellings built before 1980 achieve thermal savings of 50%; electrical savings of 50% (not including electrification of space and water heating) • Applied exponentially to homes. • 90% of all pre-1980 dwellings switch to heat pumps	**Research:** Windsor, Ontario had a business case presented to Council in February 2020 for a City-sponsored retrofit program to cover 80% of Windsor's 60,000 homes by 2041. **Stakeholder feedback:** Retrofit 90% of homes, built before 1980, by 2050 is just the right level of ambition, but will be tough. **Survey:** 70% of respondents felt retrofitting existing homes should be a priority action **Note:** The intensity of this action was increased from initial stakeholder consultation due to the limitations on green hydrogen and RNG supply available to replace remaining natural gas demand in the City. In the model, we have defaulted to ASHPs over ground source heat pumps (GSHPs) (due to lower capital costs and ease of installation, however, GSHPs are more efficient). In implementation efforts, the selection of ASHPs vs GSHPs should be assessed on a case-by-case basis, and future model revisions should be reconsidered as technology and experience evolve.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
5a. Retrofit homes post 1980	• Starting in 2020, retrofit existing building stock exponentially until in 2050 a total of 6% achieve 10% electricity and 10% heating savings	• Starting in 2035, retrofit 100% of all dwellings built between 1980 and 2016, exponentially, by 2050 (following pre-1980 dwellings) • Achieve on average thermal savings of 50%; electrical savings of 50% (not including electrification of space and water heating) • 100% for all post-1980 dwellings switch to heat pumps	See notes for Action 5 above.
6. Retrofits of commercial	• Starting in 2020, retrofit existing building stock exponentially until in 2050 a total of 6% achieve 10% electricity and 10% heating savings	• Starting in 2022, increase efficiency for 100% of commercial buildings by 50% by 2050 (linearly)	**Stakeholder feedback** (Re: Retrofit 90% of institutional, commercial, and industrial (ICI) buildings, greater than 50,000 ft2 by 2050): is just the right level of ambition. **Surveys:** almost 70% of survey respondents felt that retrofitting commercial buildings should be a priority action for the community. **Note:** The intensity of this action was increased from initial stakeholder consultation due to the limitations on green hydrogen and RNG supply available to replace remaining natural gas demand in the City.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
7. Industry - (processes, motive, lighting, space cooling, plug load) other than coal use in primary steel	• Assume energy use intensity and emissions profile stays constant from 2016-2050.	• Starting in 2022, increase efficiency by 50% by 2050 (linear)	**Surveys:** Industry is a major source of community GHG emissions and air quality issues, which are a top community criteria for action design. **Research:** According to the *2019 Achievable Potential Study* (for natural gas and electricity conservation) undertaken by the IESO and Ontario Energy Board, the difference between the reference case and technically achievable efficiency potential for the industrial sector is nearly 30 GWh to just over 100 GWh (over 230% increase in efficiency). **Stakeholder feedback:** May be challenging
7b. Industry - Primary steel	• Assume energy use intensity and emissions profile stays constant.	• 50% reduction in emissions by 2035, net zero emissions by 2050 • Steel industry commitment to using newly developing technologies of biochar, carbon capture and/or alternative renewable energy sources to reduce and replace coal	**Research:** Based on *July 2020 Hamilton AMD community environmental liaison ppt*; *Arcelor Europe's May 2020 climate action plan (p.4)*; *Sept. 30, 2020 Globe and Mail article* confirms the company's net-zero by 2050 target and the technological pathway and timeline selected. **Stakeholder:** emphasized the importance of mitigating primary steel industry emissions. Meetings with the Canadian Steel Producers Association and NRCan also helped inform this action.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
ENERGY GENERATION			
Renewable energy generation (on-site, building scale)			
8. Solar PV - rooftop	• 0 MW	• Starting in 2022, install solar PV on pre-2016 buildings, achieving on average 30% of building electric load (not including any potential increased electricity load from fuel switching to electric space and water heating) • Solar PV scales up to 50% of these buildings by 2050.	**Research:** According to our internal analysis, solar PV has the potential to supply just over 15% of existing building electricity load. Google Environmental Insight Explorer indicates 14%. In both cases, this is before undertaking our building retrofit action outlined above, which calls for reducing electrical load by 50%.
Low- or zero-carbon energy generation (community scale)			
9. Solar PV - ground mount	• 0 MW	• Install a total of 280 MW, 10 MW/yr from 2022 to 2050, inside or outside city boundary (prioritizing inside)	**Stakeholder feedback (re: 5MW/yr 2022-2050):** behind-the-meter/net meter has less red tape than grid supply/export permitting, but technology is there. **Note:** The community will need to use 100% clean electricity in order to achieve net zero. **Research:** 4 ha / 1 MW = 1,120 ha (11.2 km^2) (Kirby Calvert, Mapping opportunities for land-based renewable energy generation in Ontario, 2019)
10. Expand downtown district energy system-decarbonize	• 15 MW of natural gas hot water and reciprocating natural gas engine for heating capacity • -3.1 MW of absorption and electric chillers for cooling capacity • Serves ~ 232,000 m^2 of residential and ICI space	Downtown DE system: • Additional 25.4 MW of industrial waste heat for heating • Additional of 7.1 MW of industrial waste heat for cooling • Corresponding expansion of the downtown DE network to service an additional 232,000 m^2 of commercial floor space	**Stakeholder feedback (re: by 2050 all district energy systems are fuelled by renewable energy sources):** could be more impactful if there were an expansion plan **Stakeholder meetings:** with HCE Inc. and Chamber of Commerce Research: Based on data provided by HCE Inc. and Chamber of Commerce, as well as internal analysis.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
11. Wind	• 0 MW	• Install 250 MW by 2050 inside or outside the city, starting in 2022 (50 MW installed every 4 years, starting in 2030)	**Stakeholder Feedback (re: 300 MW of wind by 2050):** level of ambition is too low, but there is a real issue with NIMBYism and cost of land in the GTHA is high **Note:** The community will need to use 100% clean electricity in order to achieve net zero. **Research:** 1ha/ 3MW = 83 ha (Kirby Calvert, Mapping opportunities for land-based renewable energy generation in Ontario, 2019).
12. Renewable Natural Gas	• 50,000 GJ	• Replace remaining NG in the system post-retrofits and heat pumps with available supply of RNG (maximizing local RNG feedstock) (see Action 23)	**Research:** The Ontario Energy Board and Enbridge are actively exploring increased RNG integration; A *2019 Ontario Biogas and RNG Market Potential study* conservatively projects the potential for 5x growth in RNG energy production in the province by 2029, the most important source of supply being organic waste diverted from landfill; communities in Ontario are increasingly diverting their organic waste to anaerobic digestion facilities (e.g. Toronto and Peel, and Stratford is finalizing its AD plans). **City input:** Income generating opportunity is of interest.
13. Hydrogen	• 0 MW	• In order to replace remaining natural gas in the city (post action 12), starting in 2030, hydrogen (produced via renewable energy) is pumped into the natural gas distribution system	**Research:** A major UK project (*"H21"*) is working on transitioning Northern UK's natural gas system to 100% hydrogen; Enbridge is running a *pilot project in Markham*, Ontario involving hydrogen storage **Note:** 2030 start date for this action is in order to allow time for the technology to evolve. All green hydrogen is produced from local renewable energy in excess of what is needed to replace electricity grid demand.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
TRANSPORTATION			
Transit			
14. Increase transit mode share	• Incremental increase in bus service from 2016 transit service to keep up with population growth through to 2050. Mode share assumed to stay constant to 2016-2050.	• Increase transit mode share from 7% in 2019 linearly to 12% by 2031, then linearly increase to 15% by 2050 (reflects installing BRT or LRT for the urban area).	**City input:** The City's Transportation Master Plan sets a transit mode share target of 12% for 2031 based on the adoption of a BRT or LRT system along the major East-West transit corridor (from McMaster to EastGate), though transit expansion will only occur in urban areas, that is also where the majority of population growth will be. A small increase in modeshare through to 2050 is possible. **Stakeholder feedback:** improving modeshare in rural areas will be challenging **Note:** The impacts of Covid-19 during the modelling process cannot be understated. Transit ridership saw a steep decline, and as a result, stakeholders felt plans for future expansion were more difficult to justify.
15. Electrify transit system	• Fleet turnover reflects increasing transition to CNG and electric. 50% electric and 50% CNG by 2050 (diesel stock completely phased out by 2050)	• Existing CNG fleet transitioned to RNG by 2025 • All other buses to be electric by 2035	**Notes:** Because an average bus life span is about 12 years, if starting in 2022 all new buses that are purchased can be emissions free. Emission free buses have major public health benefits, and cities globally are showing that this transition is possible. **Research:** Many places in Canada are targeting 100% electrification of their transit fleets (Montreal: by 2040; Toronto: by 2040; BC: by 2040), internationally we are seeing even more ambitious targets (Oslo: by 2020; Amsterdam: by 2025; Antelope Valley, Cal: by 2025; Los Angeles: by 2030) **Stakeholder feedback:** Even by 2050, this action is too ambitious, the City is currently on track to transition fleet to CNG, infrastructure would need to be put in place now **City input:** 100% electrification by 2050 is reasonable per City Transit Department. Bus fleet expansion numbers provided by the City for 2014-2024.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
Active Transportation and Car Sharing			
16. Home Based Work/ Transportation marketing & individual planning	• Held constant	• Private vehicle trips decline by 9% per person and vehicular trip lengths declined 6%. • All areas of Hamilton are affected. Implement smart commute / home-based work	**Research:** A 2010 UK study of 3 towns over a 5-year period, found that travel planning, increasing active transportation, and transportation marketing reduced individual car trips by 9%, and trip length by 6% (Sloman L, *et.al.* The Effects of Smarter Choice Programmes in the Sustainable Travel Towns: Summary Report, UK Department of Transport, 2010). COVID-19 has also led to the acceleration of home based work. Many large employers are now switching to hybrid or full-time remote work for employees.
17. Increase/ improve cycling & walking infrastructure	• Active transportation mode share is held constant to 2050.	• By 2050, mode shift 50% of up to 2km trips to walking and up to 5km to cycling in the urban and whitebelt zones	**Research:** *City of Vancouver cycling trips increased by 32% between 2014 and 2015 following investments in cycling infrastructure* (May 2016, presentation to Vancouver City Council). This shows the potential for the scale of short-term changes possible when the right infrastructure is put in place.
18. E-bikes & EV car-share	• Active transportation mode share is held constant to 2050.	• By 2050, 10% of trips up to 10km are complete by E-Bike or EV Car-Share in the urban zones	**Research:** (Re: e-bikes) A 2015 Norwegian study indicates more is feasible (Fyhri, et al. Effects of e-bikes on bicycle use and mode share, **Transportation Research Part D:** Transport and Environment, 36: 2015) where participants have access, 28% of all trips up to 10.5 KM are taken by E-Bike, 18% reduction in transit and 10% in vehicle use (low estimate from the study).
Private/personal use			
19. Zero-emissions municipal fleet	• 25% of new vehicle sales are electric by 2030.	• 100% of new small and light-duty vehicles are electric by 2040 • 100% of new heavy-duty vehicles switch to clean hydrogen (or similar emissions-free technology) in 2040	**Research:** this is 10 years more ambitious than the City's current plan (per March 13, 2020, Information Update to Council); *Seattle has a target of a 100% electric fleet by 2030.* **Stakeholder feedback:** electrifying the municipal fleet by 2030 was too ambitious/ just right; suggest acting immediately on light duty and support/ monitor heavy-duty (or pilot) for options in coming years.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
20. Electrify personal vehicles	• Starting in 2020, 14% new sales by 2030; share holds constant to 2050	• Zero-emission vehicles targets of 10% of light-duty vehicles sales per year by 2025, 30% by 2030 and 100% by 2040	**Stakeholder feedback (re: 90% of sales are EV by 2040):** "Need to be more specific on the technology to identify feasibility; High impact and tough; battery range and infrastructure need to be improved; need for advocacy to higher level of government to provide clear direction (e.g. Sweden and Norway identifying no imports and/or manufacturing of combustible vehicles)" **Research:** The federal government set a target of 100% new passenger vehicles sales being electric by 2040 (per. IEA, Global EV Outlook 2019, p. 67.) **Note:** average lifespan of an EV is about 13 years (per CanESS model).

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
21. Low-Carbon Commercial Transport Activities	• 25% of new commercial vehicle sales are electric by 2050.	By 2050, • all heavy-duty vehicles are green-hydrogen based • Light-duty commercial vehicles are 100% electric	**Stakeholder feedback (re: 50% of commercial vehicles are EV by 2050):** In between just right & too low; Vehicles will likely electrify more quickly/ or introduce hydrogen; The challenge could be the distribution system; the Hamilton Port Authority has a net zero by 2050 target; the International Maritime Organization has a 50% GHG reduction by 2050, by exploring fuels such as bio LNG. **Research:** Global EV Outlook 2019 pg 67.; Hydrogen is seen as being the most viable fuel source for heavy haul trucks (see: *CBC How Ottawa hopes to supercharge Canada's hydrogen fuel sector, Sep.9, 2020*); for a review of the state of the international, Canadian, and Ontario fuel cell markets, see this *Electric Autonomy May 28, 2020 article; BNEF (2020) Hydrogen Economy Outlook* predicts that green hydrogen could meet 24% of energy world demand by 2050; EC, *A hydrogen strategy for a climate-neutral Europe* (8 July 2020) "this Communication sets out a vision of how the EU can turn clean hydrogen into a viable solution to decarbonise different sectors over time, installing at least 6 GW of renewable hydrogen electrolysers in the EU by 2024 and 40 GW of renewable hydrogen electrolysers by 2030." (This would focus first on industrial processes, then heavy duty transport.) 1)
22. Marine	• Held constant	• Reduce GHGs by 50% by 2050	The International Maritime Organization has set a goal of 50% GHG reductions by 2050.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
WATER AND WASTE			
23. Water and Waste	• Held constant, growing proportionate to population	• (1) By 2050, 95% organic waste sent to anaerobic digestion - Reroute from compost to AD • (1a) Maintain existing waste diversion target (55% by 2021), then increase to 70% in 2025, 85% by 2030, 95% by 2040 • (2) By 2050, 25% reduction in water / wastewater consumption (behaviour change, leak detection system, greywater reuse) (modelled as the following step changes: 15% improvement in 2030, another 10% improvement in 2035)	**Stakeholder feedback (re: 95% organic waste diversion):** The level of ambition is too low; scale it up by including human/sewage as well as organic waste; (re: 25% reduction of water consumption) the level of ambition is just right **Research:** Ontario is considering a ban on organic waste from landfills as well as associated resource recovery (see: *Food and Organic Waste Framework*); An expanded wastewater anaerobic digestion facility (to accept food waste, is being considered in Stratford Ont.); see generally ECO's Every Drop Counts 2016/2017 (chap. 5: water conservation; chap. 8: energy from sewage); see also *A Handbook for Co-digestion Projects at Municipal Wastewater Treatment Facilities* (revised March 2020) **Note:** 95% (vs. 100%) is based on assumed contamination rates
24. Wastewater Process Efficiency	• Held constant	• Increase efficiency by 30% by 2050 (modelled as the following step changes: 10% in 2025, 10% in 2035, 10% in 2045)	**Research:** see generally chap 2 of ECO's *Every Drop Counts* 2016/2017 for a description of the significant process efficiency opportunities that exist in most wastewater processes.
25. Decarbonize pelletizer	• In 2030 introduce natural gas powered pelletizer	• In 2030, switch fuel source to RNG	**Research:** City has advised of this new contract for a natural gas pelletizer, in order to avoid sunk costs, recommend switching fuel source to locally produced RNG

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
Municipal Buildings			
25. Municipal buildings	• Starting in 2020, reduce energy intensity in all corporate facilities by 60% by 2050, with an interim goal of 45% by 2030 (against a 2005 base year, retrofits assumed to be implemented linearly)	• In addition to the EUI improvements modeled for the residential and commercial buildings, 50% of municipal building square footage achieves (on average) net-zero emissions by 2030 -- of this, solar PV is added to 50% of rooftop area, covering 30% the related building area's electrical load • Applied linearly, starting in 2024, though to 2030 • From 2030, linearly to 2050, this action is applied to the remaining 50% of municipal building square footage	**Stakeholder feedback:** The level of ambition of this action is just right. City input: Reflects current City plans to assess and install solar PV on municipal building rooftops. **Note:** Corporate Energy measures its energy and emissions against a 2005 base year (see Appendix to the Nov. 2020 BAP report for the conversion process).
Sequestration and Land Accounting			
26. Tree Planting	• Held constant	• Add 50,000 trees in Hamilton by year, by 2050 (total 30 years x 50, 1.5 million)	**Research:** Wellington, NZ Has been planting a tree every five minutes, on average, for the past 15 years–more than 1.5m in total. Wellington is New Zealand's greenest city, and one of the few cities in the world where biodiversity is increasing. About 40% of the city's emissions are now mitigated by so-called land use, land use change and forestry (LULUCF) activities. **Context:** the City of Hamilton planted 10,000 trees per year between 2013 and 2018.

ACTION	BAP	LOW-CARBON	NOTES ON LOW-CARBON ACTION
Renewable Energy Procurement			
27. Purchases of Renewable Energy Certificates	• None	• In 2050, for each MWh of central electricity demand remaining after local renewable energy production, purchase a Renewable Energy Certificate (REC).	**Note:** Each REC represents the environmental benefits of 1MWh of renewable energy generation. When you purchase RECs, renewable energy is generated on your behalf. When you purchase RECs it is guaranteed that renewable energy has been generated on your behalf and sent to the electrical grid, which is the network that delivers electricity from suppliers to consumers. However, once it enters the grid, it is impossible to distinguish where or how that electricity is being delivered. (per *RenewableEnergyWorld.com (8.24.15)*, and *US EPA*)
28. Purchases of Renewable Natural Gas	• None	• First, switch to local RNG (from wastewater and organic waste, see Action 22), undertake analysis of other sustainable local sources, then purchase remaining → starting in 2025, ramp up exponentially to 2050 in order to replace all natural gas demand	**Stakeholder meeting:** Enbridge explained that it is currently enabling transactions between its clients where one buys RNG that is produced and consumed outside of its borders, but is able to account for the reductions in their emissions.

APPENDIX B: Economic and Financial Analysis

July 2021

Purpose of this Document

This document provides a summary of the projected costs, revenues, and savings represented by the net-zero pathway modelled for Hamilton's Community Energy and Emissions Plan. The pathway's financial impacts are assessed as a whole and on an action-by-action basis.

A detailed analysis of the net-zero scenario modelled as the basis of the CEEP is provided in Appendix E.

Contents

Disclaimer

Reasonable skill, care and diligence have been exercised to assess the information acquired during the preparation of this analysis, but no guarantees or warranties are made regarding the accuracy or completeness of this information. This document, the information it contains, the information and basis on which it relies, and the associated factors are subject to changes that are beyond the control of the author. The information provided by others is believed to be accurate but has not been verified.

This analysis includes strategic-level estimates of capital investments and related revenues, energy savings, and avoided costs of carbon represented by the proposed Community Energy and Emissions Plan (CEEP). The intent of this analysis is to help inform project stakeholders about the potential costs and savings represented by the CEEP in relation to the modelled business-as-planned scenario. It should not be relied upon for other purposes without verification. The authors do not accept responsibility for the use of this analysis for any purpose other than that stated above and do not accept responsibility to any third party for the use, in whole or in part, of the contents of this document.

This analysis applies to the City of Hamilton and cannot be applied to other jurisdictions without further analysis. Any use by the City of Hamilton, its sub-consultants or any third party, or any reliance on or decisions based on this document, is the responsibility of the user or third party.

Acronyms

AD	anaerobic digester
BAP	business-as-planned
CEEP	community energy and emissions plan
EUI	energy use intensity
GHG	greenhouse gas
NPV	net present value
MAC	marginal abatement cost
MACC	marginal abatement cost curve
PUV	personal use vehicles
PV	photovoltaic
RNG	renewable natural gas

Overview

The following table highlights the key findings from the financial analysis of the net-zero scenario modelled for Hamilton's Community Energy and Emissions Plan (CEEP). When reviewing the results, it is useful to put them in context of the City's current annual:

- GDP ($34.7 billion);[1]
- expenditures on fuel and electricity ($2.1-2.4 billion, $1.7 billion if the heavy industry is excluded);[2] and
- investment in buildings alone in Hamilton ($3.6 billion).[3]

Details about what is captured in each financial estimate are provided in the report's body, as indicated in the right-hand column.

The following modelled actions were not included in this financial analysis due to limited financial data:

- Primary industry (i.e. steel sector transition),
- Marine sector greenhouse gas reductions,
- Active transportation, and
- Water efficiency.

Table 1. Summary of high-level financial analysis of Hamilton's CEEP.

FINANCIAL ESTIMATE	KEY RESULTS (PRESENTED IN TODAY'S DOLLARS, ASSUMING A 3% DISCOUNT RATE, A.K.A. 'NET PRESENT VALUE')	WHERE TO FIND FURTHER DETAILS
Net benefit of the CEEP investments, 2021-2089	≈ $63 million (≈ $7 million without avoided carbon costs)	Part 2, Table 3
Total incremental capital investment, 2021-2050	≈ $11.4 billion ≈ $370 million/year	Part 2, NPV and MAC Values
Total savings, 2021-2089 (incl. avoided maintenance, carbon, and energy costs,)	≈ $10.6 billion (≈ $3.7 billion without avoided carbon costs)	Part 2, Cash Flow Analysis
Total revenue, 2021-2089	≈ $840 million	Part 2, Cash Flow Analysis
Average cost to reduce each tonne of GHG	≈ $1 in savings	Part 2, Table 3

[1] Statistics Canada, Table 36-10-0468-01, Gross domestic product (GDP) at basic prices, by census metropolitan area (CMA) (x 1,000,000), online: www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610046801.

[2] Consultant calculation, multiplying base year numbers for energy by NRCan's posted energy prices by fuel and sector.

[3] Statistics Canada, Table 34-10-0175-01, Investment in Building Construction, 2019 data, including new buildings and renovations for residential and commercial buildings, online: www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3410017501.

FINANCIAL ESTIMATE	KEY RESULTS (PRESENTED IN TODAY'S DOLLARS, ASSUMING A 3% DISCOUNT RATE, A.K.A. 'NET PRESENT VALUE')	WHERE TO FIND FURTHER DETAILS
Most cost-effective GHG-reduction action ($/ tonne CO_2e)	1. Transit Expansion: ≈ $4,000 in savings 2. Electrify municipal fleet: ≈ $1,500 in savings 3. Ground mount solar and new residential roof solar PV: ≈$1,300 in savings 4. Personal use vehicle electrification: ≈ $600 in savings 5. Commercial fleet electrification: ≈$500 in savings	Part 2, Table 3
Household savings on energy	$2,900 avg/year in 2050	Part 2, Cost Savings for Households

Part 1. Key Financial Analysis Concepts

The direct financial impacts of Hamilton's Community Energy and Emissions Plan (CEEP) provide important context for local decision-makers. However, it is important to note that the direct financial impacts are a secondary motivation for undertaking actions that reduce greenhouse gas (GHG) emissions. First and foremost, GHG reductions are a critical response to the global climate emergency. In addition, most measures included in the CEEP also provide social goods to the community, such as net job creation and positive health outcomes, which are only marginally captured in this financial analysis via the cost of carbon. Similarly, the cost of inaction is not captured. Quantifying the financial costs of each tonne of GHG emissions produced is extremely complicated, they include the impacts of tailpipe emissions in individual health and economic productivity, as well as the infrastructure costs associated with extreme weather events, to name just two.

The following are key concepts that are used to analyze the financial impacts of the CEEP.

COSTS ARE RELATIVE TO THE BUSINESS AS PLANNED SCENARIO (BAP)

This financial analysis tracks projected costs and savings associated with net-zero measures that are above and beyond the assumed 'business-as-planned' costs.

DISCOUNT RATE

The discount rate is the investor's baseline growth value on their investment dollar. A project is considered financially beneficial by an investor if it generates a real rate of return equal to or greater than their discount rate.

An investor's discount rate varies with the type of project, duration of the investment, risk and the scarcity of capital. The social discount rate is the discount rate applied for comparing the value to society of investments made for the common good and as such it is inherently uncertain and difficult to determine. Some argue that in the evaluation of climate change mitigation investments a very low or even zero discount rate should be applied. In this analysis, investments are valued based on a 3% future discount rate. This is the social discount rate used by the Federal Treasury Board. Governments typically use more conservative discount rates than the private sector, especially when the value of a public good is being assessed.

NET PRESENT VALUE (NPV)

The NPV of an investment is the difference between the present value of the capital investment and the present value of the future stream of savings and revenue generated by the capital investment. This means that if an investment is made in 2049, the benefits associated with that investment's expected life would be included in the NPV of the measure and the overall plan.

Five aggregate categories are used to track the financial performance of the net-zero actions in this analysis: capital expenditures, energy savings (or additional costs), carbon cost savings (assuming the carbon price reaches $170/tonne CO_2e in 2030 and is held constant thereafter), operation and maintenance savings, and revenue generation (associated with renewable energy production facilities and some transit actions). Administrative costs associated with implementing programs, as well as any energy system infrastructure upgrades that may be required (e.g., transmission line upgrades) are not included.

ABATEMENT COST

The abatement cost of an action is the estimated cost for that action to reduce one tonne of greenhouse gas emissions ('GHG') and is calculated by dividing the action's NPV by the total GHG emissions it reduces (tCO_2e) over its lifetime. For example, if a project has a net present value of $1,000 and generates 10 tCO_2e of savings, its abatement cost is $100 per tCO_2e reduced.

AMORTIZATION

The costs of major capital investments are typically spread over time (e.g. a mortgage on a house commonly has a 25-year mortgage period). Amortization refers to the process of paying off capital expenditures (debt) through regular principal and interest payments over time. In this analysis, we have applied a 25-year amortization rate to all investments (no interest cost was associated with future payments).

INDUSTRIAL EMISSIONS

Financial analysis of the industrial sector includes only the low carbon investments for secondary manufacturing. Primary industry (e.g., steel manufacturing) comprises about 80% of industrial gas and electricity sales in Hamilton and emission reduction costs for that sector have not been estimated in this analysis. As the technological pathway for reaching net-zero is uncertain and specific to the individual steel manufacturing plants in Hamilton, the associated costs cannot be determined.

ENERGY AND CARBON COST PROJECTIONS

The energy cost projections displayed in Figure 1 underlie the financial analysis. These projections were derived from:

- the Independent Electricity System Operator's Long-Term Energy Plan (electricity),
- the US Energy Information Administration (propane), and
- the National Energy Board (all other fuels).

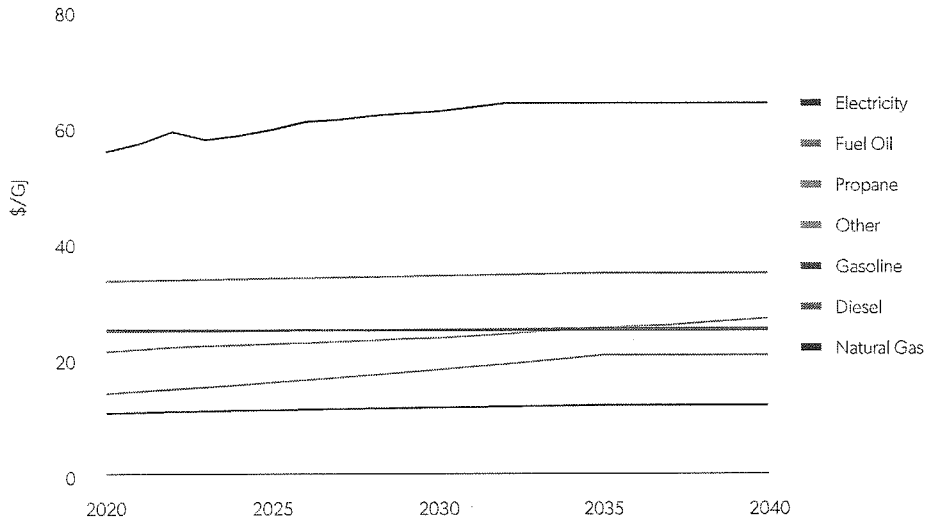


Figure 1. Projected energy costs.

The financial analysis is sensitive to electricity and natural gas costs. Electricity costs are projected to increase more rapidly than natural gas; if natural gas costs increase more rapidly, then the financial benefit of many of the actions increases.

An escalating cost of carbon, based on federal regulation, was applied out to 2030, then held constant.

Part 2. Hamilton's CEEP Financial Analysis Results

ABATEMENT COSTS

As outlined in Table 2, the investments included in the net-zero pathway yield a positive return for each tonne of carbon reduced; that is, the net savings and revenues the reductions generate yield a positive financial return that translates to a weighted average benefit of $1/tonne of CO_2e reduced.[4] The values for the individual measures are also included in Table 2.

Measures with a positive net present value are highlighted in green (i.e. where the investment has a positive return of at least 3%) will therefore have a negative abatement cost, which is also highlighted in green (i.e. they would be worth doing even without consideration of the carbon benefits). Whereas measures with a negative net present value are highlighted in red and have a positive abatement cost (i.e., these are measures with returns less than the discount rate of 3%).

Reviewing the following table action-by-action requires understanding the action's sequencing in the model (i.e., what is it offsetting), and what is bundled in each action. For example, "Waste diversion and Renewable Natural Gas with Anaerobic Digester (RNG with AD)" includes not only organic waste diversions and RNG production at an anaerobic digestion facility, but it also includes all RNG procurement in the CEEP. If RNG procurement was not included in this action, the waste diversion and AD action would have likely had negative abatement costs (meaning each tonne reduced would save money). On the other hand, heat pumps are assessed

[4] The net present value of the measures includes credit for the avoided costs of carbon ($170/tonne CO_2e); if that credit were excluded, the net savings per tonne of GHG mitigated would be correspondingly lower.

individually and have a positive marginal abatement cost (meaning each tonne reduced costs money), but if they were bundled with the new building and retrofit actions, as would be the case in implementation, the outcome may be more favourable

These interdependencies mean that the most important lens is the abatement cost for the entire plan.

Table 2. Net present value and abatement costs by action.

	CUMULATIVE EMISSIONS REDUCTION (KT CO_2EQ)	NET PRESENT VALUE	MARGINAL ABATEMENT COST ($ / T CO_2 EQ)
New dwelling EUI	578	$266,175,503	-$460
New res solar PV	257	$345,652,988	-$1,343
New non-res EUI	3,196	$1,022,701,898	-$320
New municipal EUI	1,430	$414,230,877	-$290
New non-res solar PV	218	$142,798,467	-$654
Retrofit dwellings	1,829	-$253,658,148	$139
Retrofit non-res	4,578	$1,176,624,425	-$257
Retrofit municipal	70	-$3,740,479	$53
Existing buildings solar PV	292	$280,551,392	-$959
Existing municipal buildings solar PV	22	$10,920,507	-$494
Heat pump	6,619	-$2,985,962,167	$451
Industrial efficiency	12,438	-$3,332,733,052	$268
Ground mount solar PV	473	$592,878,707	-$1,254
District energy expansion	372	-$71,505,124	$192
Transit expansion	19	$73,627,043	-$3,908
Electrify transit	263	-$70,569,449	$268
Trip reduction	1,361	$577,082,595	-$424
Electric shared mobility	80	-$136,119,997	$1,697
Electrify municipal fleet	43	$65,878,667	-$1,521
PUV electrification	6,494	$4,030,231,161	-$621
Commercial fleet electrification	6,224	$2,887,986,366	-$464
Waste diversion and RNG with AD	9,629	-$715,191,054	$74
Wastewater efficiency	50	$16,317,070	-$326
Green electricity procurement (i.e., renewable energy certificates)[5]	8,655	-$438,330,924	$51
Tree planting	1,126	-$2,500,054	$2
Hydrogen	4,692	-$3,829,930,585	$816
TOTAL	70,631	$63,416,635	AVERAGE: -$1

[5] The wind action modelled in the net-zero scenario was included in this category.

MARGINAL ABATEMENT COST CURVE

Figure 2 shows the marginal abatement cost curve (MACC) for measures included in Hamilton's CEEP.

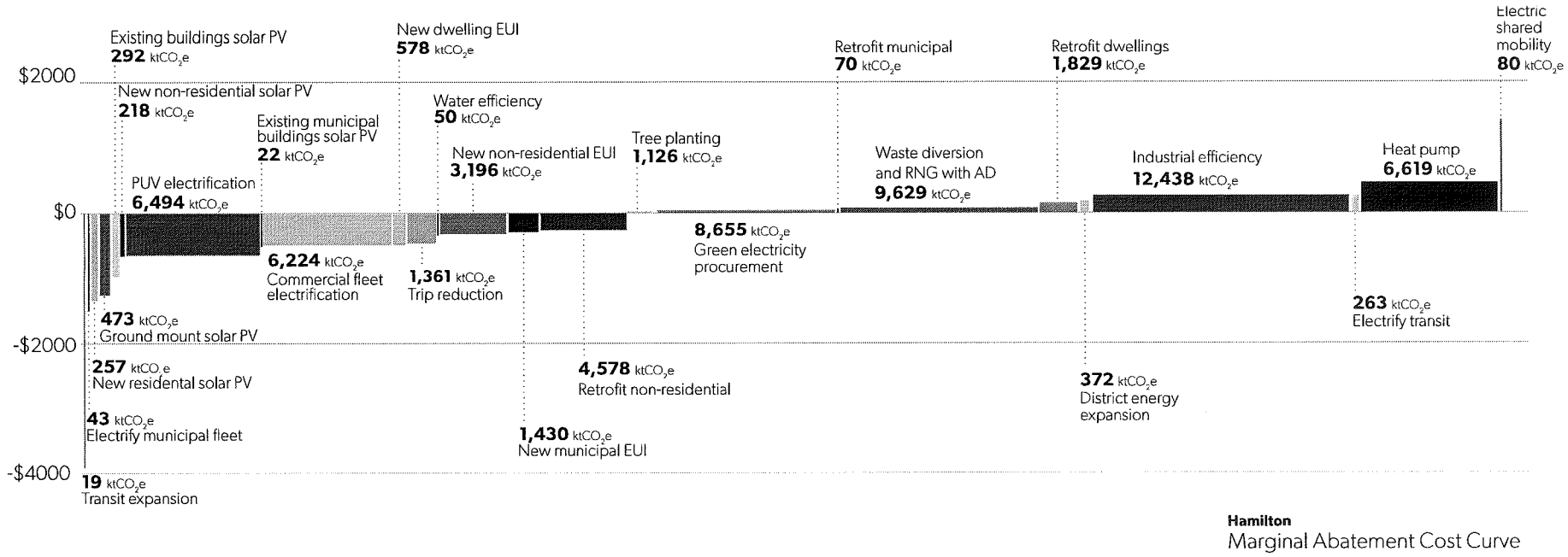


Figure 2. The marginal abatement cost curves for key actions in Hamilton's CEEP.

While a MACC illustrates the financial profile of the suite of actions, it is an imperfect indicator. The presentation of the MACC implies that the actions are a menu from which individual actions can be selected. Many of the actions are dependent on each other, for example, the district energy cost increases without retrofits. Another important message is that to achieve the City's target all the actions need to be undertaken, as soon as possible. While there can be a tendency to wait for technological improvements, this has the effect of reducing the value of the savings that can be achieved for households and businesses, and the new employment opportunities that can be created.

In Figure 2, the wider the action is, the greater the GHG emissions reduction. The higher above the middle horizontal axis the more costly the action, while the lower below the line, the more cost effective it is.

The MACC provides useful insights that guide implementation planning, for example:

- Can high cost and high savings actions be bundled to achieve greater GHG emissions reductions?
- How can the City help reduce the costs of the high-cost actions by supporting innovation or by providing subsidies?
- Which actions both save money and reduce the most GHG emissions? These can be considered the big moves.
- Which actions are likely to be of interest to the private sector, assuming barriers can be removed or supporting policies introduced?

These are exemplified in a sample Figure 3 MACC.

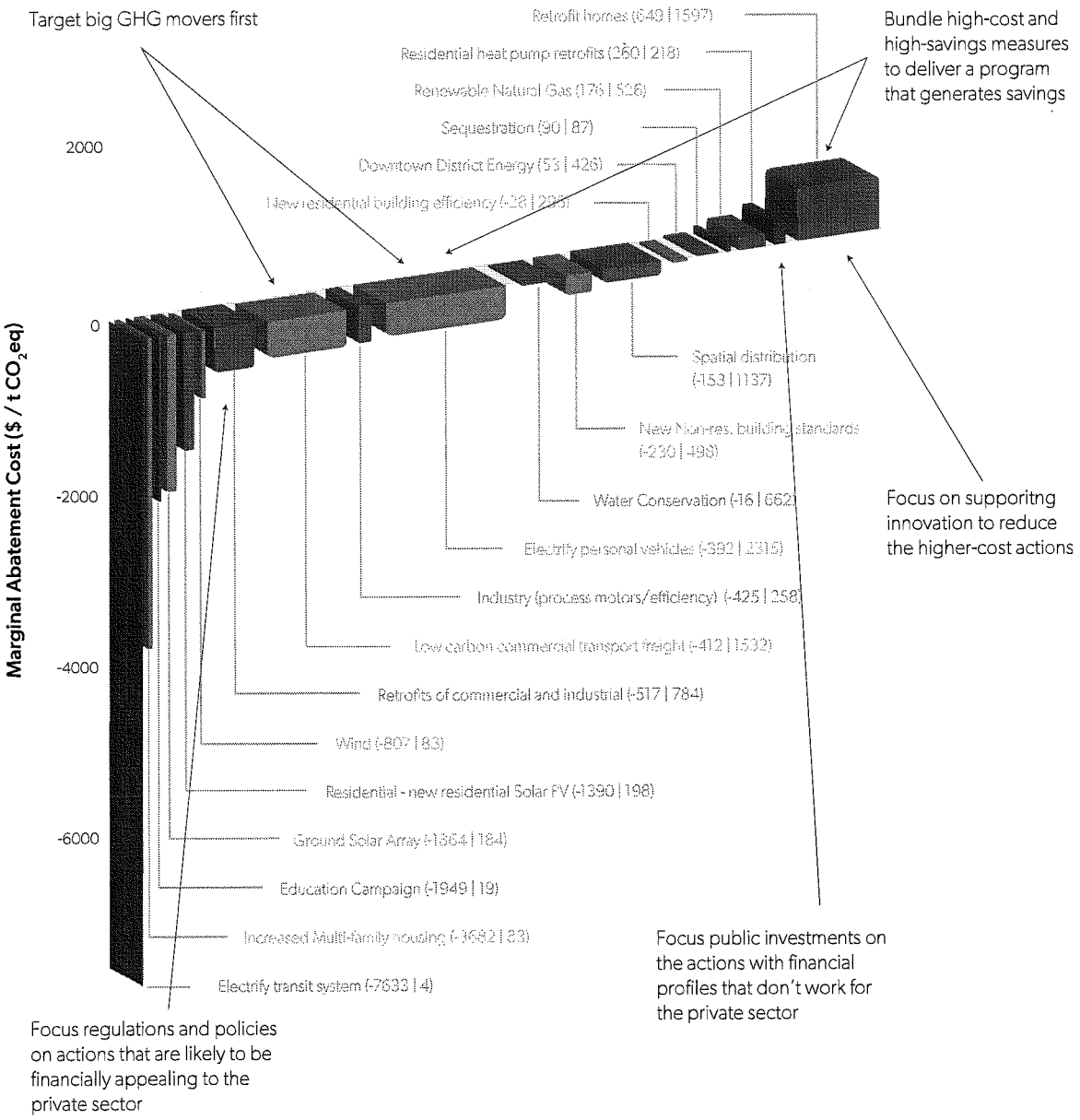


Figure 3. Examples of the strategic uses of a marginal abatement cost curve analysis.

Present and Net Present Values

As noted in the previous section, most of the actions in the net-zero scenario have positive net present values, as does the program of investments taken as a whole. Figure 4 shows the present value of the major components of CEEP: investments, operations and maintenance savings, fuel and electricity savings, avoided costs of carbon, and revenue from transit and local energy generation. After discounting at 3%, the investments in the program have a present value of $11.4 billion and the savings and revenue have a present value of $10.6 billion, for an NPV of the whole scenario of $63 million.

It is important to highlight the fact that capital investment for the plan ends in 2050, however, the NPV includes the energy, maintenance, and carbon costs savings as well as revenue projected over the full life of the measure, which in some cases extend as far as 2089 (for example a building built in 2050).

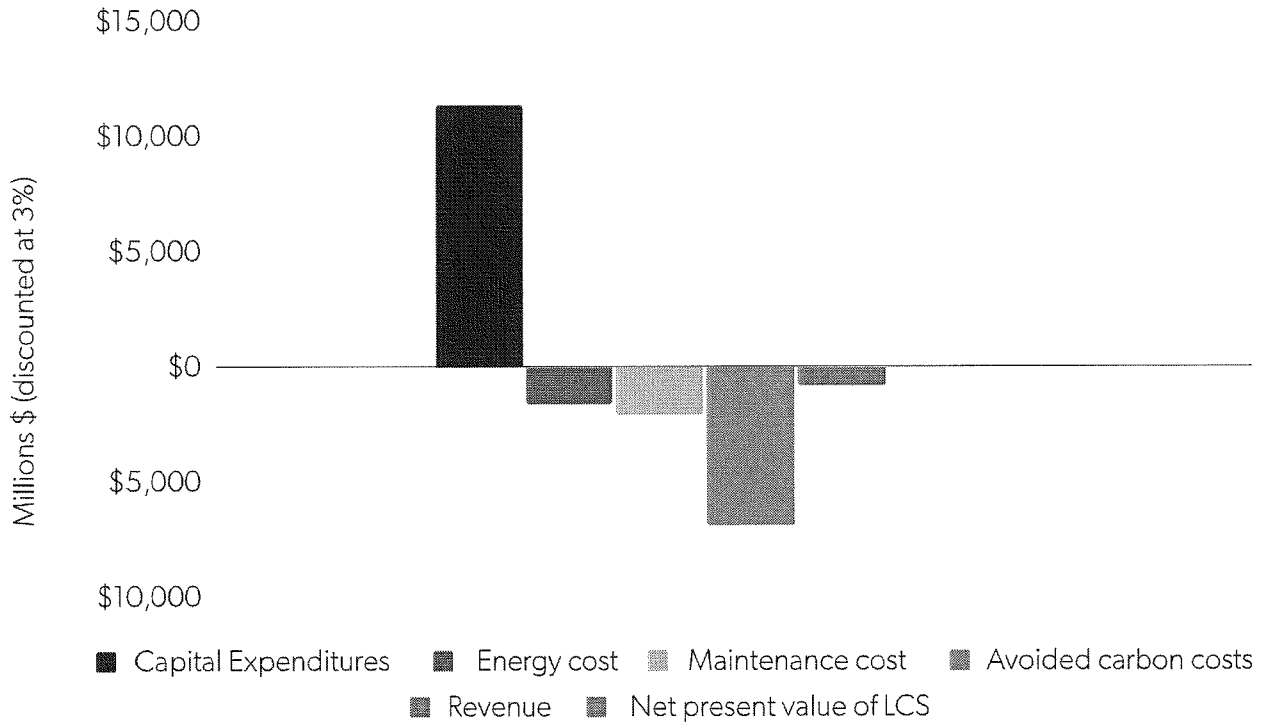


Figure 4. Present values of net-zero scenario costs, savings, and the net present value of the scenario (costs are positive, revenue and savings are negative).

Cash Flow Analysis

The annual costs, savings and revenue associated with fully implementing the actions in the CEEP are shown in detail in Figures 5, with capital expenditures shown in full in the years in which they are incurred. As is characteristic of net-zero transitions, the capital expenditures in the early years of the transition are significantly greater than the savings and revenues generated, but by the mid-2030s the annual benefits increase steadily until they nearly match the annual investments by 2050.

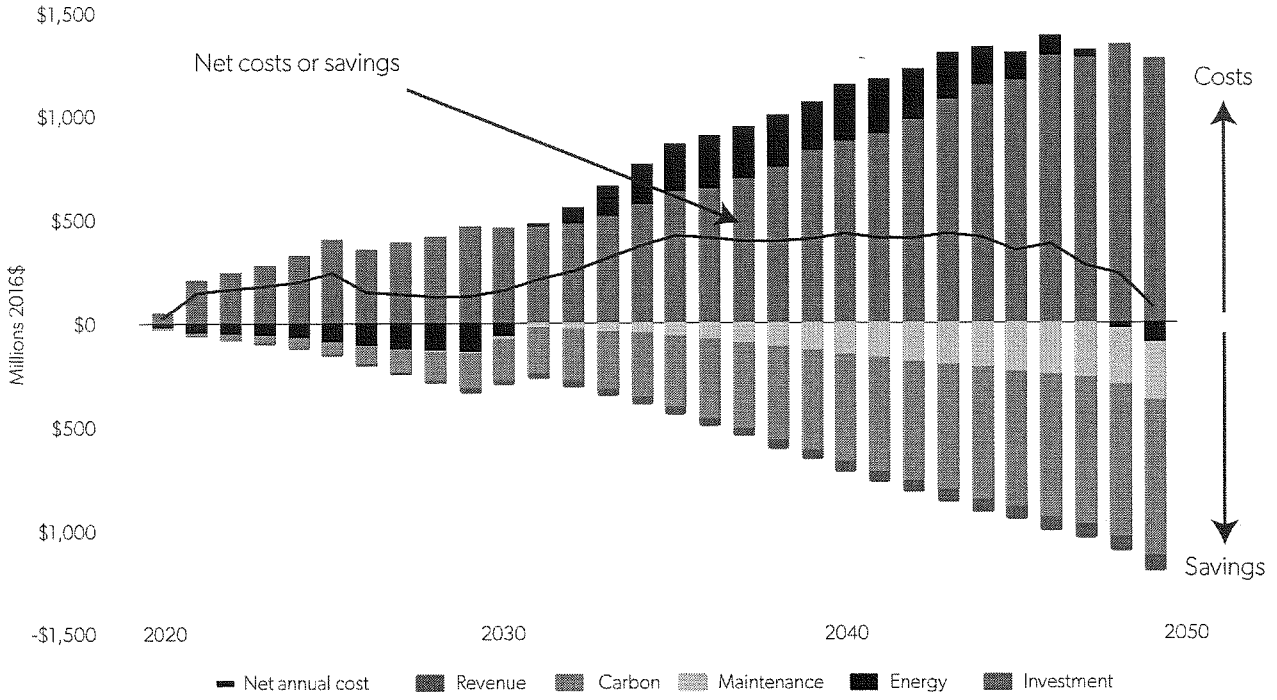


Figure 5. Capital expenditures vs. savings and revenues from the net-zero scenario, 2021-2050.

Figure 6 presents the same costs and benefits, but with the capital expenditures amortized over 25 years at 3% (no additional interest rate was applied). With this approach, which presumably would reflect actual approaches for financing the transition, the annualized capital payments are about equal to the savings and revenue generation, right from the beginning of the program. On an annual basis, the program never has a significant annual deficit. By 2050, the annual net benefit is over $63 million. After 2050, the amortized investment payments continue to taper off, reaching zero by 2075, while the benefits and revenues continue, resulting in continuous growth in the net annual benefit in the post-2050 period.

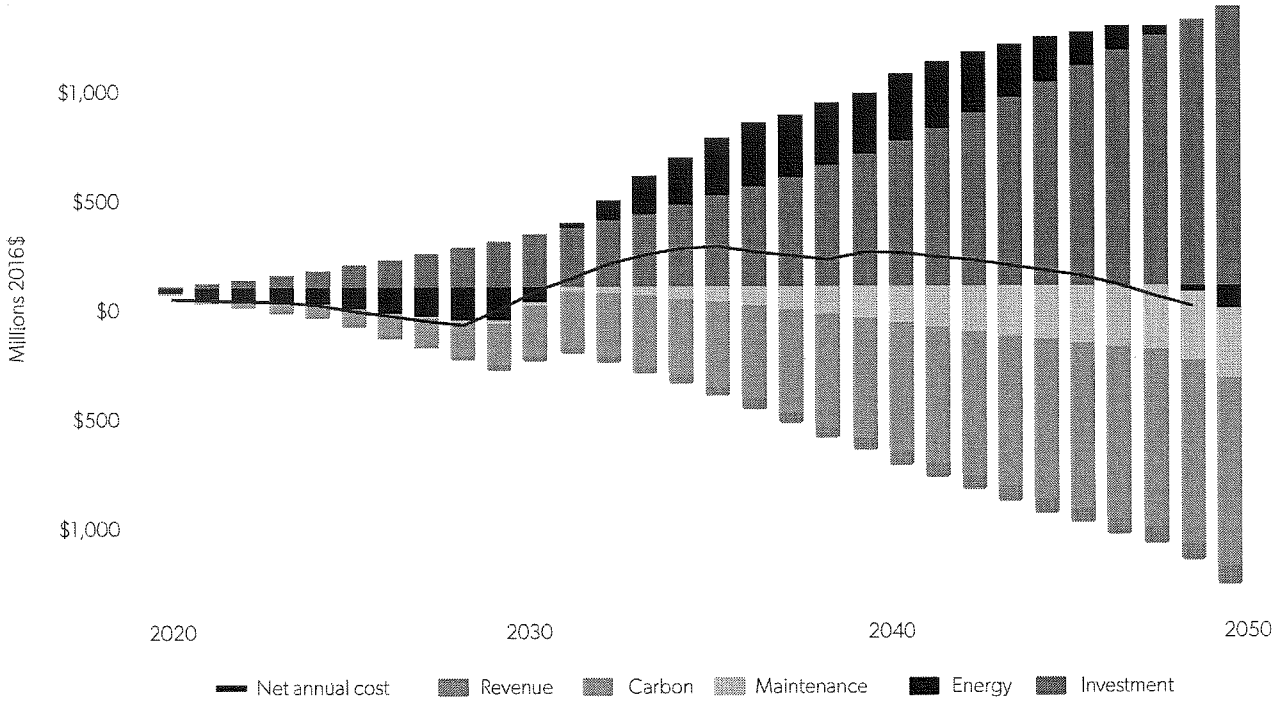


Figure 6. Annualized capital expenditures vs. savings and revenue from the net-zero scenario, 2021-2050.

Cost Savings for Households

Household expenditures on energy—natural gas, electricity, gasoline and diesel—are projected to increase in the BAP and decline in the net-zero scenario. In the BAP, household energy expenditures are relatively flat because vehicles become more efficient due to national fuel efficiency standards and because of decreased heating requirements as the climate becomes milder due to climate change. The net-zero scenario involves shifting away from natural gas and gasoline to electricity, a more costly energy source. The increased cost of electricity is partially offset by the increased efficiency of homes and electric vehicle motors. The carbon price also adds to the cost of using fossil fuels for heating and transport.

In the net-zero scenario, an average Hamilton household in 2050 spends $2,873 less on fuel and electricity (household energy and transportation expenditures) than they would have in a BAP scenario, over 84% less than what people will spend in the 2050 BAP scenario (see Figure 7). Between 2021 and 2050, the net-zero scenario saves the average Hamilton household about $37 thousand on fuel and electricity expenditures (this does not include any capital costs of energy efficiency improvements). Depending on the business, policy and financing strategies used in the implementation of the actions, these savings will be partly offset by the incremental capital expenditures required.

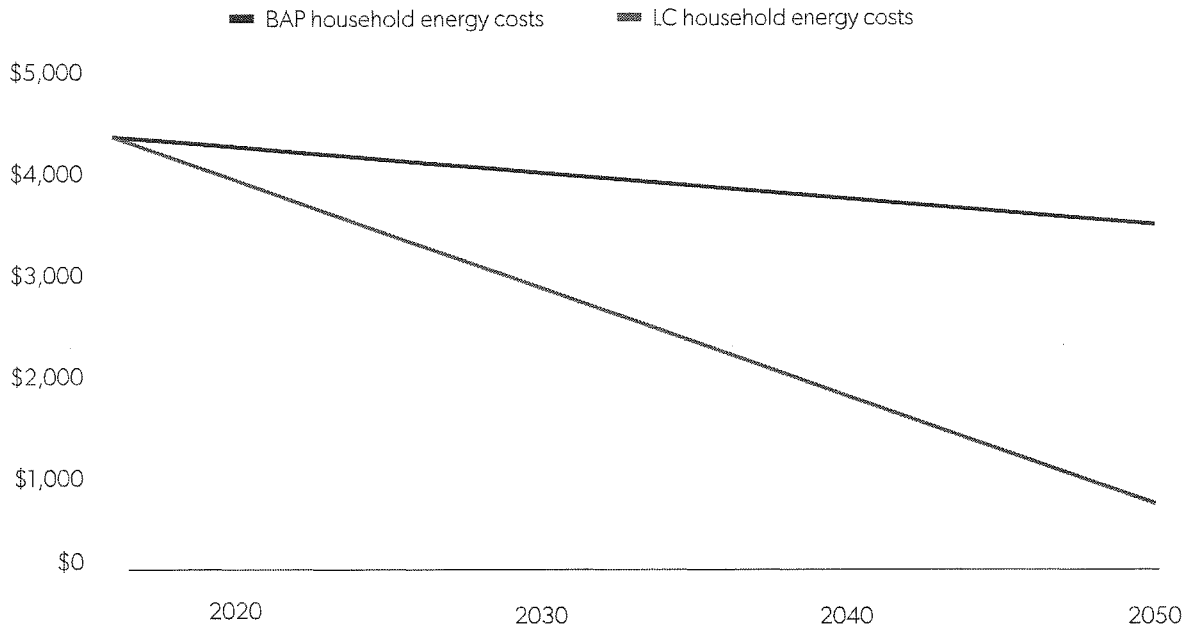


Figure 7. Average annual household energy costs in the net-zero and business-as-planned scenarios, 2021-2050.

New Job Opportunities

Transitioning to a low- or zero-carbon economy is expected to have four categories of impacts on labour markets: additional jobs will be created in emerging sectors, some employees will be shifted (e.g., from fossil fuels to renewables), certain jobs will be reduced and transitioned (e.g., combustion engine vehicle mechanics), and many existing jobs will be transformed and redefined.

From 2022 to 2050, the investments associated with the NZS are estimated to produce a total of about 160 thousand person years of employment. If these job hours were equated to full time jobs, they would total an average of 5,500 full time jobs a year (not cumulative). Implementation planning will help ensure these are local jobs.

What is evident in Figure 8 is the significant number of jobs that are expected from the industrial process efficiency action, as well as the residential and commercial retrofit actions modelled in the CEEP. Some job losses are also expected from vehicle electrification (personal and commercial) due to the reduced maintenance associated with these vehicles.

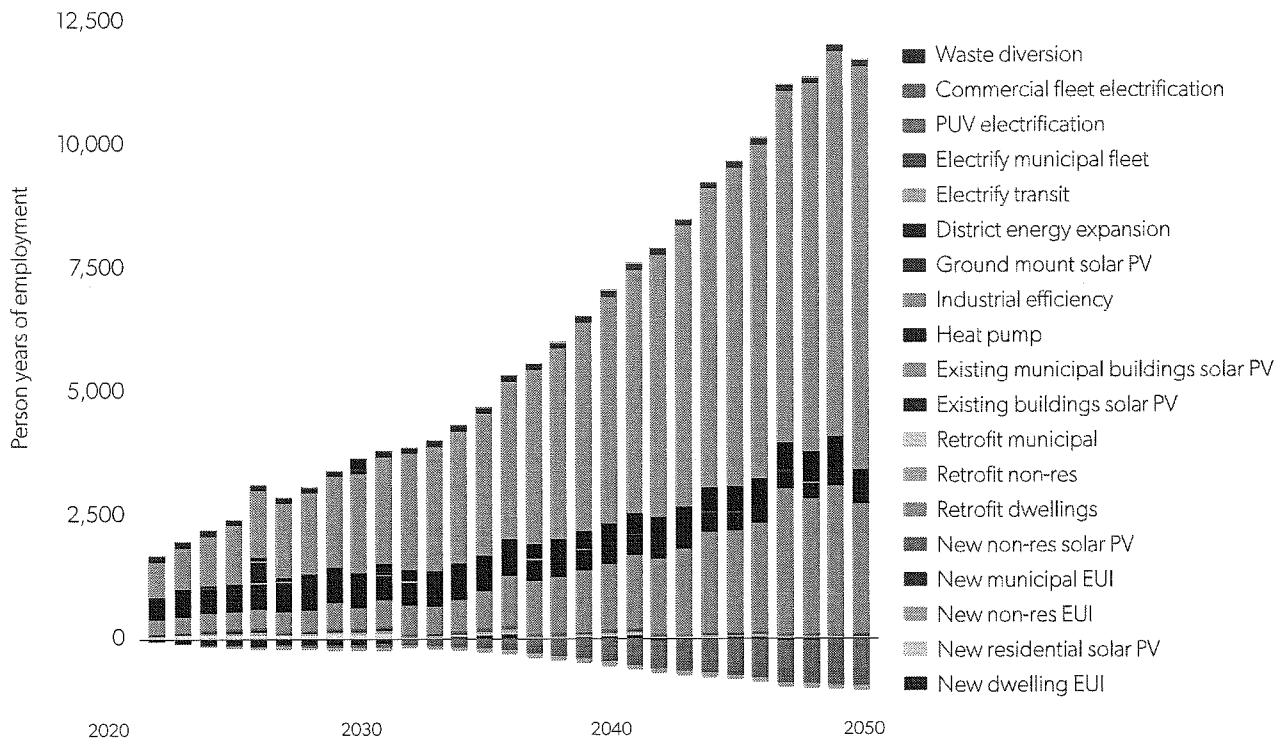


Figure 8. Additional person-years of employment associated with the net-zero scenario actions.

Conclusion

This financial analysis summarizes the overall financial and economic impacts of the CEEP in contrast to the business-as-planned scenario. Despite the fact that some actions on their own may not be cost-effective, overall the plan has a positive net present value and impact on jobs.

This analysis is based on the best available assumptions of projected costs and economic indicators out to 2050; many of these are highlighted in the table at the end of this document. It is important to note that this financial analysis is comprehensive, but incomplete. It misses many indirect benefits (e.g., on public health, resilience to extreme weather, and resilience to fuel cost fluctuations) as well as costs (e.g., the costs of inaction) that are difficult to quantify. Nonetheless, this financial and economic analysis remains an important tool to support decision-makers in their analysis of the CEEP.

Key Financial Assumptions

	CAPITAL INVESTMENT ASSUMPTION
LAND USE	
Land-use intensification Reduce avg. dwelling size Decrease share of single-detached housing	• Capital costs associated with land use intensification encompass standard investment in the community such as new housing developments; therefore they are considered to be $0. • Generally speaking with more infill development new infrastructure spending decreases.
NEW BUILDINGS	
New res. buildings w/ heat pumps New res. buildings w/ solar PV New commercial building efficiency Commercial buildings w/ solar PV	• The cost for new construction of buildings on a $/m^2 is estimated to be: • Single-detached: $1,776 / m^2 • Double: $1,426 / m^2 • Apt 1-4 storey: $2,341 / m^2 • Apt 5-14 storey: $2,556 / m^2 • Apt > 15 storey: $2,610 / m^2 • The premium associated with meeting high-efficiency building standards is assumed to average 10%. • Energy savings associated with high-efficiency buildings is calculated to be 80-90% over existing building stock. • A residential heat pump has a capital cost of approximately $6,000 (non-res is ~$10,000 and scaled to the heating requirement), with approximately $160 annually to maintain (~$400 annually for non-res)
EXISTING BUILDINGS	
Retrofit homes/energy efficiency Residential electric water heaters Heat pump as part of residential retrofits Retrofits industrial buildings Retrofits of commercial and industrial	• 100% of residential buildings built before 2017 are retrofitted; all non-residential buildings are retrofitted. • The average cost of retrofits was assumed to be (per GJ of energy saved): » Residential: $600-$2,500 (depending on the age of the building and baseline energy use intensity) » Non-Res: $500-$1,500 (depending on the age of the building and baseline energy use intensity) • A residential heat pump has a capital cost of approximately $6,000 (non-residential is ~$10,000), with approximately $160 annually to operate (~$400 annually for non-residential)

	CAPITAL INVESTMENT ASSUMPTION
RENEWABLE ENERGY	
Solar PV- net metering old and new buildings 280 MW Ground Solar Farm Renewable Energy Certificates (RECs) Organic Waste to RNG Hydrogen introduced to natural gas networks	• Solar PV has a capital cost of approximately $2,000 per kW. The capital cost is expected to decrease towards 2050. • RECs are assumed to cost $10/MW. • The lithium-ion battery for energy storage is anticipated to decrease by as much as %50 by 2050. • RNG upgrading costs via Canadian Biogas Association RNG Financial Tool. • Hydrogen is assumed to start at $75/GJ, decreasing to $52.50/GJ by 2050.
INDUSTRY	
Industrial upgrades	$/GJ 2025 / 2038 Lighting upgrades (avg.) $115 / $59 Space heating upgrades (avg.) $27 / $34 Water heating upgrades (avg.) $33 / $49 Motive upgrades (avg.) $107 / $176 Process heat upgrades (avg.) $28 / $43
PROGRAM 5: TRANSPORT	
Expand bus service Electrify transit system Increase/improve cycling & walking infrastructure E-Bikes Electrify municipal fleets Electrify personal vehicles Low carbon commercial transport activity	• The cost of an electric vehicle is approximately $55,000 in 2016 and below $34,000 by 2050. 100% of personal car sales are electric by 2040. • Fuel cost of gasoline per litre goes up to 26% with the carbon tax and market factors added by 2040. • Transit electric bus capital costs assumed to decrease to traditional engine costs by 2050.
WASTE & WASTEWATER	
25% less water use (technology & behaviour change) Wastewater process efficiency	• Behaviour change programs are a cost of staff and communications from the city • Wastewater process efficiency included under industrial efficiency
MUNICIPAL BUILDINGS	
Retrofit municipal buildings Solar PV on municipal buildings	• See retrofit and solar PV figures in Programs 1 & 3
NATURAL ENVIRONMENT & SEQUESTRATION	
Tree planting	• Cost of tree planting is valued over $2.5 million ($2.5/tree)

APPENDIX C: Implementation Strategy

November 2021

Purpose of this document

Once Council approves the CEEP ('ReCharge Hamilton'), the City will need to turn to implementation immediately. To support the CEEP's implementation, this Strategy proposes a short-term, high-level implementation plan (0-5 years) to help the City pivot efficiently from planning to doing.

This plan also includes guidance for setting up a long-term monitoring framework to ensure progress, continuous improvement, accountability, and transparency.

Contents

Acronyms

AD	anaerobic digester
CEEP	Community Energy and Emissions Plan
CIPEC	Canadian Industry Program for Energy Conservation
CHP	combined heat and power
DE	district energy
EV	electric vehicle
FCM	Federation of Canadian Municipalities
FTE	full-time equivalent
GHG	greenhouse gas
IESO	Independent Electricity System Operator
HIEA	Hamilton Industrial Environmental Association
HRAI	Heating, Refrigeration, and Air Conditioning Institute of Canada
MOU	memorandum of understanding
NGO	non-governmental organization
NRCan	Natural Resources Canada
PACE	property assessed clean energy
PV	photovoltaic
RE	renewable energy
RNG	renewable natural gas
TBD	to be determined
VKT	vehicle kilometres travelled

UNITS

CO_2e	carbon dioxide equivalent
GJ	gigajoule
Km	kilometre
Kt	kilotonne
MW	megawatt
t	tonne

Context

The following near-term (0-5 year) Implementation Strategy aims to guide progress on the pathway laid out in the CEEP. The direction of the pathway is driven by the target of net-zero carbon emissions by 2050, however the shape of the pathway is influenced by:

- input from the CEEP Stakeholder Advisory Committee;
- survey responses from the general public;
- input from City Staff;
- research on best practices; and,
- consultant experience from other projects.

As a result of this input, this Strategy is designed to enable the GHG reduction measures identified in the CEEP and to maximize co-benefits including economic development, improved equity and public health outcomes.

This Strategy includes some key City-led initiatives, but the majority of CEEP implementation will require resources and leadership from various actors in the community, including utilities, industry, businesses, and institutions (e.g., colleges and universities). Partnerships are critical to achieving the target of net-zero emissions by 2050.

Partnerships mobilize diverse skills, expertise, and capacity to support the implementation of the CEEP, and they have an opportunity to improve inclusion and social equity.

Funding, resources, and enabling policies from higher levels of government will also be critical to achieving the CEEP targets. Coordinated and early outreach and liaison will need to be prioritized.

Key to the Co-benefits Indicators

This Implementation Strategy focuses on the first steps in enabling and implementing key actions that are projected to have significant societal benefits. In addition to varying levels of greenhouse gas (GHG) reductions, actions included in this strategy result in various associated co-benefits. These include: equity improvements, employment increases, and return on investment. For simplicity we have created a code for each potential co-benefit—enabler, low, medium, and high— based on their relative impact in the net-zero scenario model undertaken for the City (see Appendix E: Net-Zero Pathway, Technical Analysis and Appendix B: Detailed Economic and Financial Analysis). These categories, and their definitions are described in the table below.