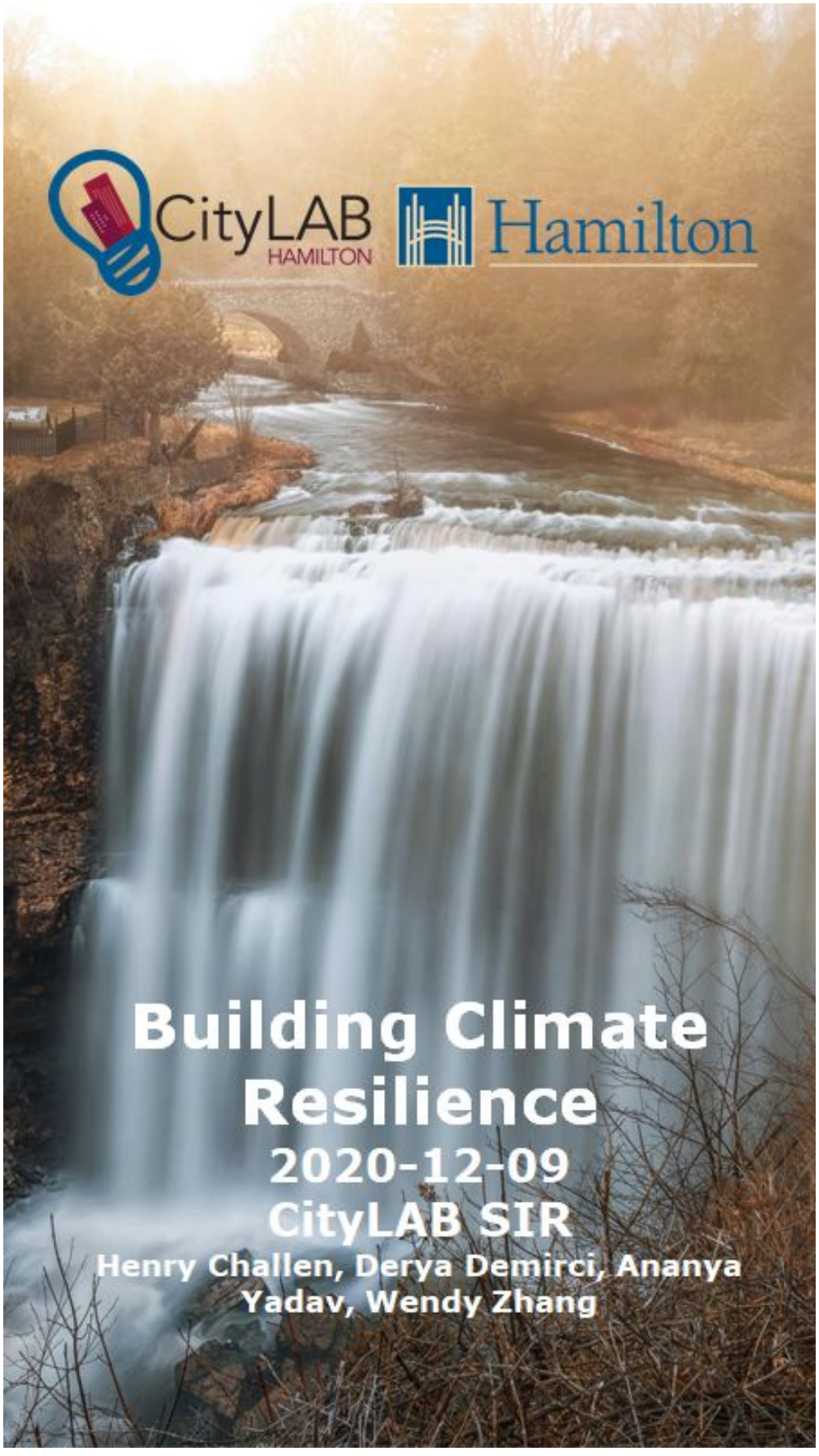
CityLAB
HAMILTON
Hamilton
Building Climate Resilience
2020-12-09
CityLAB SIR
Henry Challen, Derya Demirci, Ananya Yadav, Wendy Zhang

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.[1]

Lake Ontario and its surrounding environment, home to Indigenous people for thousands of years

[1] "Urban Indigenous Strategy," Hamilton.ca, City of Hamilton, https://www.hamilton.ca/urban-indigenous-strategy

ACKNOWLEDGEMENTS

Thank you to all CityLAB Semester in Residence (SIR) instructors (Brian, Darina, Dave, and Randy) and CityLAB staff (Juliana and Patrick) for your continued support and feedback. The skills we learned in the SIR course components of design, dialogue, city building, and project management were immensely valuable while carrying out this project.

We would also like to thank our City of Hamilton staff partner, Arlen Leeming, without whom this project would be incomplete. Thank you for checking in with us weekly, and providing us with support and constructive feedback. Your passion for your work was a guiding light for us throughout this project.

Lastly, a special thank you to all those who we interviewed in Hamilton and beyond for the CityCAST podcast. Thank you to Chris McLaughlin (Bay Area Restoration Council); Beatrice Ekoko, Deepak Palanichami (Environment Hamilton); Jon Davey (North End Neighbourhood Association); Doug Smith (City of Vancouver); Danielle Koleyak (City of Edmonton); Tanya Laing, Jillian Curley, Heather Galbraith (City of Calgary). It was a privilege to hear about how you are leading change in your cities. We hope that the invaluable information and recommendations that you shared with us will inspire positive change in Hamilton.

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EXECUTIVE SUMMARY

Introduction

The CityLAB Semester in Residence (SIR) brings together an interdisciplinary team of students from McMaster University, Redeemer University, and Mohawk College. It partners them with City of Hamilton staff, community partners, and members of the broader community to work collaboratively on innovative and sustainable projects in the city. From September to December 2020, a team of four CityLAB SIR students (Ananya Yadav, Derya Demirci, Henry Challen, Wendy Zhang) were partnered with staff from Hamilton Public Works, to help set the groundwork for Public Works' Climate Resiliency Strategy. A climate emergency was declared in Hamilton in March of 2019[2]. Thus, this project is among one of the many in the city, that are imperative to building a more climate resilient Hamilton.

Project Focus

The aim of this project was to develop a list of sustainability and community engagement recommendations that can be applied to Public Works' Climate Resiliency Strategy. Climate change is a dynamic force, requiring creative thinking, disruptive innovations, and dramatic changes to the status quo. The goal of our project was to conduct a horizon scan of sustainability work happening nationally and internationally to inform recommendations that can be applied to Hamilton.

Based on the Arcadis Sustainable Cities Index 2018, **Vancouver**, **Montreal** and **Calgary** were chosen as key sustainable Canadian cities. Although the Arcadis index highlights Toronto as one of the top sustainable cities in Canada, it was excluded from this report. Thus, the focus was on reviewing and reaching out to cities that did not have established networks with Hamilton. As such, **Edmonton** was chosen, as Edmonton has just launched its climate plan and could speak to the successes and challenges that they are currently experiencing.

Using the same Arcadis Sustainable Cities Index, **Stockholm**, **Copenhagen**, and **Barcelona** were chosen as world exemplars of sustainable cities outside of Canada.

[2] Samantha Craggs, "Hamilton Declares a Climate Emergency," CBC, March 18th, 2019, https://www.cbc.ca/news/canada/hamilton/climate-change-1.5061326.

Additionally, **Portland** was also chosen because we were informed by our city staff member, Arlen Leeming, that Portland is doing great work in sustainability regarding climate change.

In addition to the report, the project group also organized interviews with municipal staff working in Vancouver, Edmonton, and Calgary's sustainability departments. Interviews with environmental organizations in Hamilton were also conducted. The interviews were compiled and edited to be posted onto the CityCAST podcast—as a ***Resilient Cities*** segment. Out of six recorded podcasts, three have been submitted for evaluation along with this report (See Appendix A).

Along with the report and podcasts, the SIR student group also developed a website prototype for an online engagement tool.

Design & Dialogue

Two key learning elements of the CityLAB SIR were the design and dialogue components.

Design

Various lessons from the SIR design component were applied by the project group in the creation of this project. A basic systems approach was used to examine the problem of climate change through a wide lens, accounting for all the systems that are at play within a city and beyond. The recommendations outlined in this report hope to capture this systems-wide thinking and the dynamic nature of climate change.

Additionally, general design principles were used to make powerpoints, invitations, infographics, and this report more appealing. For example, by using large text and visual aides, we designed the website with specific consideration to the accessibility needs of the wide variety of stakeholders in Hamilton, a virtue that we discussed in a variety of design classes.

Furthermore, the Wednesday field design acted as valuable learning experience for the project. Specifically, we become comfortable making recommendations for Hamilton-based issues, using other cites as examples and doing independent research into the “best practices” of a variety of fields. Appropriating other cities’ initiatives to potentially work in a Hamilton context requires a solid understanding of the constraints of such a design within Hamilton.

Dialogue

Regarding dialogue, the principles of respect, deep listening, and emotional awareness were applied when carrying out podcast interviews for this project. Guests were respected, welcomed, and listened to in order to ensure that they felt comfortable sharing. The medium of a podcast was chosen to allow the voices of environmental leaders and city staff from across the country, to reach and inspire the broader Hamilton community.

Facilitation of interviews required practising reflexivity. Being an effective host required being able to empathize with the guest: sensing when they don’t want to breach a topic, when they were passionate about something, and when they were feeling uncomfortable. Reflexivity in these situations involved picking up on these cues on the fly and adjusting our responses accordingly.

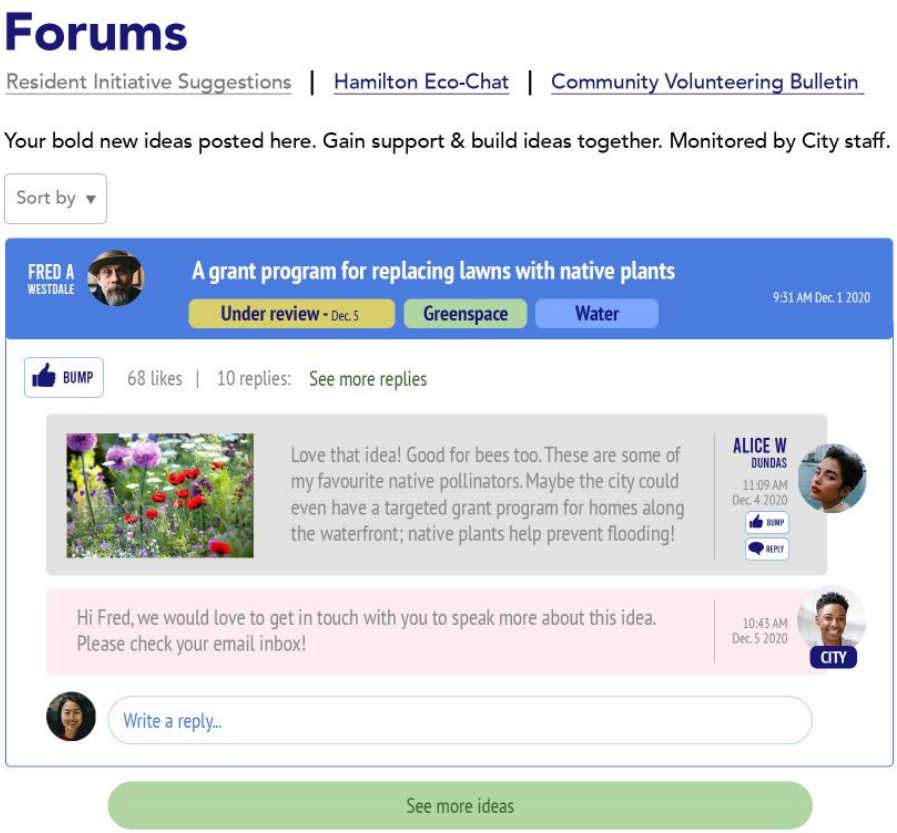
Relevance to City Strategic Priorities

The City of Hamilton's 2016-2025 Strategic Plan, which was approved by City Council in June 2016 outlines seven strategic priorities.[3] Listed below are the strategic priorities that align with this project:

1. Community Engagement and Participation

a. The *Resilient Cities* podcast segment provides a platform for guests to broadcast their ideas about sustainability to the public. It provides members of the Hamilton community with the opportunity to learn about sustainability, equipping them with the necessary knowledge to engage in dialogue about climate change and push for change in their communities.

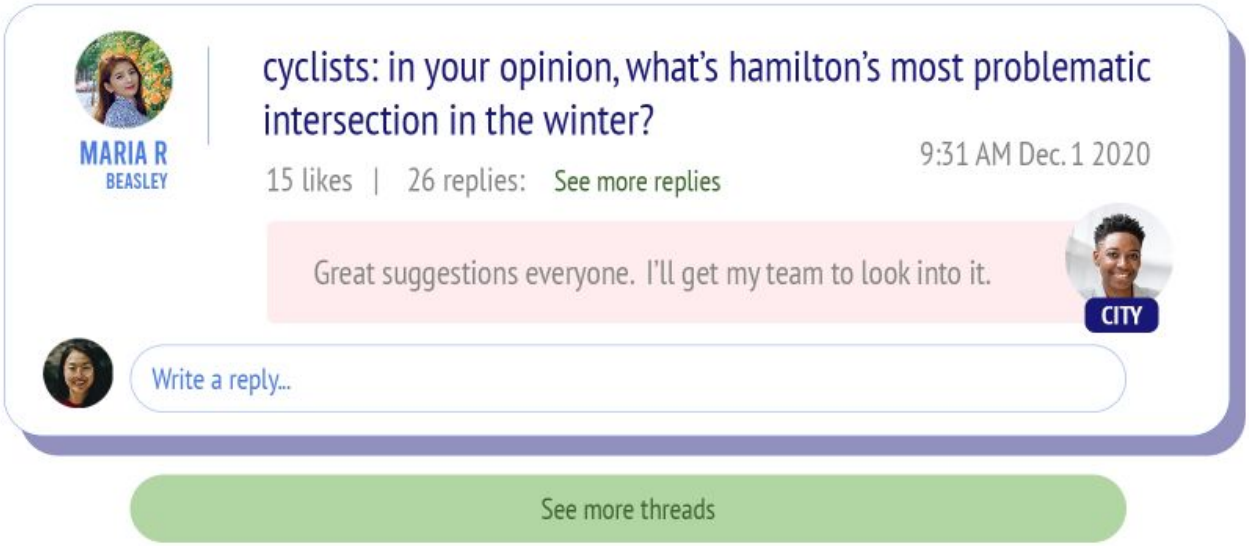
b. The prototype of an online engagement tool (see below) provides Hamiltonians with the opportunity to share their sustainability ideas with an online community and Hamilton City staff. It also allows the City to ensure a continuous and reciprocal engagement relationship with the community.



[3] "Our Commitment to Our Community," Hamilton.ca, City of Hamilton, November 11th, 2020, https://www.hamilton.ca/government-information/trust-and-confidence-report/our-commitment-our-community.

Hamilton Eco-Chat

What are your favourite hidden natural gems in Hamilton? How do you bike up the mountain? What sustainability hacks did you discover this month? What eco-projects are you working on? How are you making your school/workplace/places of worship more sustainable? What isn't working for you in Hamilton? Share about it!



See more threads

Community Volunteering Bulletin

Find passionate and like-minded individuals to help you realize your most ambitious project ideas. Get out and involved in your community!*

*In-person volunteering where social distancing is not possible is temporarily discontinued

Community Garden - near Mohawk & Upper James
Help wanted: 2 regular volunteer gardeners
Posted 12/07/20

Web seminar, Jan 1, 2021 - Green Venture
Help wanted: 1 tech savvy volunteer
Posted 12/03/20

See more postings

Make a posting

2. **Healthy & Safe Communities**

   Climate change can negatively impact the health and safety of citizens. Key recommendations in this report outline how to keep communities in the city safe and healthy.

3. **Clean & Green**

   Respect for the natural environment; a healthy balance between natural and urban spaces; waste management; and sustainable, efficient and renewable energy are key focus areas of the recommendations presented in this report.

4. **Built Environment and Infrastructure**

   Transportation; land development; water, wastewater and stormwater; old and new buildings are key focus areas of recommendations presented in this report.

5. **Culture and Diversity**

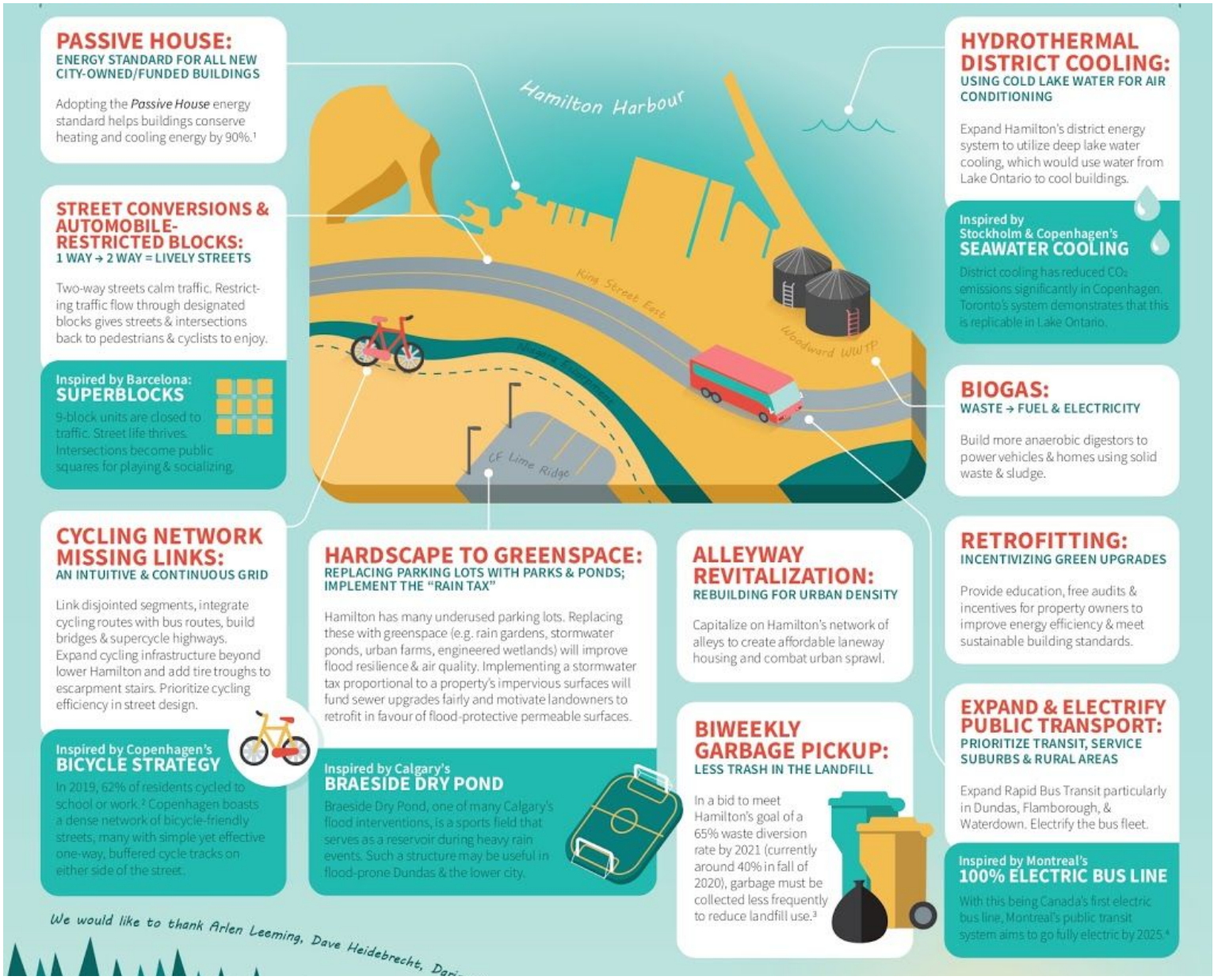
   Climate change has the most adverse impacts on the most vulnerable in our society. Thus, there is a focus on equity, diversity and inclusion as key focus areas for change in the city.

6. **Our People and Performance**

   For lasting change to be made, City staff, and partners must be empowered to make change, and to learn new skills and stay accountable to the residents of Hamilton.

Key Recommendations

Our recommendations were divided between 5 categories: GHG's, Infrastructure and Land Use; Sustainable and Alternative Transportation; Natural Environment; Waste and Water; and Education and Engagement. The following infographic outlines some of the key recommendations. For a more detailed list of recommendations please refer to Section 4.0 (pg. 53).



Key Conclusions

Hamilton has a long way to go, but the solutions are out there and experts are willing to share and help. Climate change is a global issue and the only way to ensure that everyone survives and prospers is to work together. For true changes to be made, the attitude of city council and stakeholders will need to change to make climate initiatives a top priority. We hope that this plan is the first step on the long journey towards climate mitigation and sustainability in Hamilton.

LIST OF ACRONYMS

ACT: Albert Community Transit Fund

BARC: Bay Area Restoration Council

BEBs: Battery operated buses

BEEP: Business Energy and Emissions Profile

BEVs: Battery operated vehicles

Bill 229: *Protect, Support, and Recover from COVID-19 Act*

BRT: Bus rapid transit

CO2E: Carbon Dioxide equivalent

CSO: Combined sewer overflow

CUSP: Climate and Urban Systems Partnership

CUTRIC: Canadian Urban Transit Research & Innovation Consortium

EH: Environment Hamilton

ETS: Edmonton Transit Services

FCEBs: Fuel cell electric buses

FCM: Federation of Canadian Municipalities

GHG: Greenhouse gas

GTHA: Greater Toronto and Hamilton Area

LRT: Light rail transit

Mt CO2e: Megatonnes of carbon dioxide equivalent

NENA: North End Neighbourhood Association

NO_X: Nitric oxide

NO_2: Nitrogen dioxide

NPO: Non-profit organization

PM_{10}: Particulate matter (10 micrometers in diameter or smaller)

POC: People/person of colour

PTIF: Public Transit Infrastructure Fund

RHI: Riparian Health Inventory

SNAP: Sustainable Neighbourhood Action Plan

TTC: Toronto Transit Commission

UNFCCC: United Nations Framework Convention on Climate Change

ZEVs: Zero-emission vehicles

CLIMATE CONTEXT IN HAMILTON

In response to the climate emergency, Hamilton must move forward with a plan to coordinate city-wide climate mitigation and adaptation strategies. Before looking to other jurisdictions for best practices, policy makers must have a solid understanding of the climate context on the ground in Hamilton. An effective climate plan must consider all of the following:

1. **Hamilton's climate strengths and existing assets.**
   Hamilton's assets include our rich natural capital, highly active environmental organizations, citizen engagement with climate issues, and existing successful policies that address climate change and its impacts. These assets must be protected and enhanced.

2. **Hamilton's areas of need and improvement.**
   Areas of improvement can be gleaned through reporting of existing indicators, projections, and listening to Hamilton's residents and climate leaders. Areas of improvement can also be made obvious in the wake of adverse events (e.g. the flooding events in 2005/2006 and the need for better stormwater management).[4]

3. **Hamilton's unique opportunities.**
   Hamilton is a unique place. With over 150 waterfalls, a Class 1 Marshland (Cootes Paradise), and the Niagara Escarpment right in our backyards—as well as acres of undeveloped brownfields, alleys, and vacant parking lots—Hamilton has significant potential to become a vibrant, one-of-a-kind green city.[5] The city can be an exemplar to others through proudly embracing its industrial heritage while pushing the needle on climate action.

Photo credit: **Hamilton Naturalists' Club**[6]

[4] Hamilton Independent Community Panel Review, Hamilton: Hardy Stevenson and Associates Limited, April 2019. https://www.hamilton.ca/sites/default/files/media/browser/2017-04-26/flooding-servicing-study-icp-peer-review-2009.pdf
[5] Cassie Shortsleeve, "Why Hamilton, Canada Is the Waterfall Capital of the World," Conde Nast Traveler, July 24th, 2017, https://www.cntraveler.com/story/why-hamilton-canada-is-the-waterfall-capital-of-the-world.
[6] Hamilton Naturalists' Club, December 17, 2019, https://www.instagram.com/p/B6Lf_JdHg2S/

STRENGTHS & EXISTING ASSETS:

Community Initiatives & Conservation Authorities

In addition to its extensive natural greenspace, Hamilton has a variety of environmental groups (both independent and in partnership with the City) who are and have historically been instrumental to spearheading climate action within the city.

In looking outside of Hamilton for potential initiatives to adopt in Public Works' Climate Resiliency strategy, it is critical not to overlook the work citizens are already doing. Not only is it inefficient for the City to replicate an existing initiative, but it signifies a lack of acknowledgement for citizens' visions, and it damages public trust. Thus, when implementing a new program, we believe it is crucial to investigate whether a similar initiative is already in the works in Hamilton communities. Instead of starting afresh, it may be worth looking into the feasibility of a formal partnership or collaboration to further expand and financially support the project. Thus, it is important that the City devises a strategy to become aware of community initiatives in order to more effectively plan initiatives, but also to better understand Hamilton's climate context from all perspectives (see section 4.6 for recommendation - website).

In accordance with this philosophy of actively learning from local experts, we invited the following guests to a podcast discussion:

- **Chris McLaughlin** (Executive Director of the **Bay Area Restoration Council** [BARC]);
- **Jon Davey** (Environment & Climate Change Committee Chair for the **North End Neighbourhood Association** [NENA]); and
- **Beatrice Ekoko** (Senior Project Manager for **Environment Hamilton**), joined by Deepak Palanichami (Intern with Environment Hamilton)

With each of these guests we discussed each organization's mission, initiatives, successes, and challenges to better understand the context of climate action in Hamilton. We also asked them what they felt were key priorities the City of Hamilton should address. Summaries of these podcast discussions can be found in Appendix B.

BAY AREA RESTORATION COUNCIL

Environment Hamilton

AREAS OF IMPROVEMENT:

What should Hamilton focus on?

Through our readings and discussions with our interview guests, we have identified five major areas of improvement in Hamilton:

1. Greenhouse Gas Emissions (GHGs) from the Industrial Sector

With the declaration of climate emergency in 2019, Hamilton set an ambitious target to achieve city-wide **carbon neutrality by 2050**. Although GHG emissions have decreased 33% between 2006 and 2017 due to the province-mandated phasing out of coal-generated electricity, the 2017 estimate still sits around 10.4 megatonnes of carbon dioxide equivalent (Mt CO2e).[7][8] Emissions have stayed relatively constant between 2015 and 2017.[9]

A significant contributor to Hamilton's emissions is its industry sector. Emissions from the industrial sector comprised 73% of Hamilton's GHG emissions in 2017, compared to an average of 19% in other municipalities within the Greater Toronto and Hamilton Area (GTHA) in 2015.[10] Additionally, industrial emissions have caused Hamilton to consistently have the highest GHG emissions per capita at about 10.4 tonnes per capita compared to the GTHA average of 6.9 tonnes per capita in 2017. This is despite lower per capita emissions in other sectors such as buildings and transportation.[11]

Thus, the biggest impacts in emissions reduction will come from innovation and reformation of how energy is used among Hamilton's industries. In creating Hamilton's Community Energy Plan, the City needs to prioritize working with Hamilton's industrial sector to innovate new solutions. However,projects that engage the general public to reduce emissions in other sectors are also necessary. This mobilizes

[7] "Community Energy Plan," Hamilton.ca, City of Hamilton, August 4th, 2020, https://www.hamilton.ca/city-initiatives/priority-projects/community-energy-plan
[8] Carbon Emissions Inventory for the GTHA, Toronto: The Atmospheric Fund, 2017. https://taf.ca/wp-content/uploads/2019/12/GTHA-carbon-emissions-inventory-2019.pdf
[9] *Ibid*
[10] Greenhouse Gas Emissions Inventory for the Greater Toronto and Hamilton Area, Toronto: The Atmospheric Fund, 2019. http://taf.ca/wp-content/uploads/2017/12/TAF_2015_GTHA_Emissions_Inventory_2017-12-06.pdf
[11] Carbon Emissions Inventory for the GTHA, Toronto: The Atmospheric Fund, 2017. https://taf.ca/wp-content/uploads/2019/12/GTHA-carbon-emissions-inventory-2019.pdf

residents to champion emissions reductions themselves, and to push for further action from the industrial sector.

2. Car-Dominated City & Unsafe Streets

Another key area of concern we have flagged is Hamilton's reliance on cars. According to data in Hamilton's Transportation Master Plan, Hamilton has not met its 2011 targets for modal split, with the percentage of trips made in single occupant vehicles remaining relatively constant at 67% in 2011 compared to the 2001 baseline (68%) and the target (58%).[12] If Hamilton wishes to achieve its 2031 target for single occupant vehicle trips (52%), the City must do more to promote alternative modes of transportation such as walking, cycling, and rideshare.

The relationship between Hamilton's car dependency, and the design of Hamilton's streets are a self-fulfilling prophecy. Hamilton's streets are outdated; they were designed in an industrial era to maximize the efficiency of driving into the downtown industrial core. Wide and one-way with coordinated street lights, this structural prioritization of automobile traffic on Hamilton's streets makes it easy and fast to drive from one end of the city to the other. Thus, driving has become a transportation mode of choice for many. The speeding cars negatively impact the safety of pedestrians and cyclists, neighbourhoods, schools, businesses, as well as the environment. Our current car culture demands more ramps, more lanes, and more roadways to optimize traffic flow, only to generate more traffic. It's time to divest.

"One of the most jarring things I saw when I came here as an outsider is the five-lane highways cutting through our downtown"

- Keanin Loomis, CEO of Hamilton Chamber of Commerce [12]

Main & Dundurn:
1 way, 4 lanes

[12] City of Hamilton Transportation Master Plan Review and Update, Hamilton: City of Hamilton, 2018, https://www.hamilton.ca/sites/default/files/media/browser/2018-10-24/tmp-review-update-final-report-oct2018.pdf.

Additionally, truck routes, the lack of a continuous cycling network, and poor transit service in the suburbs are barriers to walking and cycling in the city.

Trucks

Instead of taking the highway around the city after loading, trucks leaving the Port frequently take a shorter route through downtown neighbourhoods, making them unsafe to walk and bike through.

Disconnected Cycling Infrastructure

In accordance with its Cycling Master Plan, Hamilton has been making good progress with its cycling network, having added more than 85 km of bicycle lanes and more than 325 bicycle racks since 2010.[13] However, there remains a need for additional connections to be made between existing bicycle routes, as the usability of the network is limited by its disjointedness. Many bicycle lanes exist in isolation with no intuitive connections or wayfinding signage between them. This is discouraging to less experienced cyclists.

Poor Transit Coverage

While Hamilton's downtown core is well-serviced with a dense network of busses that arrive frequently, suburbs and rural areas, such as in Dundas, Ancaster, Stoney Creek, Glanbrook, and Flamborough are not well-serviced.[14] Car use is most prevalent in these areas that are underserved by the HSR. The BLAST network is Hamilton's proposed frequent rapid transit system that will improve connectivity within Hamilton, but more routes must be implemented to ensure as many residents as possible are living within walkable distance to a transit stop.[15] Area rating remains a limitation to improving transit coverage due to reduced funding.[16]

Photo source: **City of Hamilton**

[13] Cycling review and master plan, Hamilton: City of Hamilton, June 6th, 2018, https://www.hamilton.ca/sites/default/files/media/browser/2018-06-06/draft-tmp-backgroundreport-cyclingmp-11-1.pdf.
[14] Ryan McGreal, "Area Rating Keeping us Divided" Raise the Hammer, February 13, 2105, https://raisethehammer.org/article/2498/area_rating_keeps_us_divided.
[15] TRANSPORTATION MODAL SHARE TARGETS AND TRANSIT STRATEGIES POLICY PAPER 1 / 59, City of Hamilton: Hamilton, January 2005, http://www2.hamilton.ca/NR/rdonlyres/4929A56F-4222-4A62-B399-5E3860F7A764/0/AppendixB.pdf.; Ten Year Local Transit Strategy," Hamilton.ca, City of Hamilton, July 26th, 2018, https://www.hamilton.ca/city-initiatives/priority-projects/ten-year-local-transit-strategy
[16] Teviah Moro, "No changes to hamilton Transit area rating for 2020," Hamilton Spectator, March 3rd, 2020, https://www.thespec.com/news/hamilton-region/2020/02/26/no-changes-to-hamilton-transit-area-rating-for-2020.html.

3. Wastewater Management & Flood Resilience

The City of Hamilton has a reputation for its poor sewage management, largely thanks to a 4 year, 24 billion litre sewage spill into Chedoke Creek and Cootes Paradise between 2014 and 2018.[17] Public confidence in water quality is low due to this history, and the water's look and smell.[18] Hamilton Harbour, into which one Burlington, and two Hamilton wastewater treatment plants discharge, is listed as an Area of Concern by Environment and Climate Change Canada.[19] Hamilton's challenge with sewage management largely derives from an old combined sewer system that serves much of the lower city. Unlike separated sewer systems, combined sewer systems reach capacity during high precipitation events and require bypasses, resulting in combined sewer overflows (CSOs). This untreated water enters our waterways and can result in environmental degradation as contaminated sediments, debris, and excess nutrients are introduced into aquatic ecosystems. Between 1989 and 2010, the City constructed nine underground CSO tanks, able to prevent 314,000 m^3 of untreated sewage from entering into Hamilton's waterways.[20] However, more action is necessary. As of the writing of this report on December 5th, 2020, a total of ten CSO events with measured volumes have occurred this year, with a total combined sewage overflow volume well of 1.3 billion litres. In reality, this figure is much higher, as many outfalls do not have flow metering. According to data in Hamilton's Combined Sewer Overflow Log, six to upwards of ten CSOs occur per month.[21] These measurements indicate a need for better stormwater management methods where it falls, *before* stormwater ends up in the sewer system and must rely on limited city infrastructure.[22]

Moreover, not only are effective wastewater management methods important to the health of our watershed, they also protect the city from flooding. As climate change brings heavier and more erratic precipitation events, Hamilton will become more vulnerable to flooding.[23] This is particularly the case in older parts of Dundas, Ancaster, and Binbrook which are constructed without storm sewers, as well as the lower city by the Woodward Wastewater Treatment Plant.[24] A number of floods in recent years have

[17] Don Mitchell, "Hamilton, Ont. to hire monitor in response to sewage spill into Cootes Paradise," Global News, April 29th, 2020, https://globalnews.ca/news/6883539/hamilton-sewage-response-cootes-paradise/.
[18] Chris McLaughlin, Hosts, "Conversation with Barc," Resilient Cities, Tuesday November 4th, 2020.
[19] "Great Lakes: Area of Concern," Government of Canada, July 7th, 2018, https://www.canada.ca/en/environment-climate-change/services/great-lakes-protection/areas-concern/hamilton-harbour.html
[20] "Combined Sewer Overflow Storage Strategy," Hamilton.ca, City of Hamilton, March 3rd, 2020, https://www.hamilton.ca/city-initiatives/our-harbour/combined-sewer-overflow-storage-strategy.
[21] "Monitoring Wastewater Overflows and Bypasses," Hamilton.ca, City of Hamilton, December 2nd, 2020, https://www.hamilton.ca/home-property-and-development/water-sewer/monitoring-wastewater-overflows-and-bypasses.
[22] Chris McLaughlin, Hosts, "Conversation with Barc," Resilient Cities, Tuesday November 4th, 2020.
[23] Samantha Craggs, "Expect climate change to cause more flooding of the Red Hill Valley Parkway: report", CBC, September 18th, 2020, https://www.cbc.ca/news/canada/hamilton/red-hill-flooding-1.4827270.
[24] "Flooding Ares Hamilton," Conterra Foundation and Repair, 2020, https://conterrafoundation.ca/blog/flooding-hotspots-hamilton-ontario.html.

demonstrated that flood resilience—achieved through effective stormwater management, smart infrastructure, and land use regulations—should be a priority.[25]

4. Urban Sprawl & The Need for High Density

Hamilton's population is projected to grow from around over 537,000 in 2016 to 820,000 by 2051, increasing by 236,000 over the next 30 years.[26] To accommodate a growing population without encroaching on Hamilton's surrounding rural agricultural land, urban Hamilton will need to build up its density. The province has set a baseline goal for the city to have 50% of its future residential development occur within Hamilton's current urban boundary. However, environmental organizations such as Environment Hamilton are pushing for a more ambitious goal: a commitment to Hamilton's current urban boundary. Without this commitment, urban sprawl will infringe on Hamilton's unprotected whitebelt lands, which would increase Hamilton's size and subsequently its ecological footprint.[27] To prevent urban sprawl from occurring, the city needs to invest in high density solutions to residential development and smart mixed land use.

Examples of high density residential properties | Photo source: **City of Hamilton**

[25] Nick Westoll, "Hamilton area dealing with flash flooding after heavy rainfall," Global News, April 20th, 2020, https://globalnews.ca/news/3394058/dundas-hamilton-flooding/.
[26] "2016 Population Census," City of Hamilton, 2016, https://www.hamilton.ca/sites/default/files/media/browser/2017-02-09/2016-census-population-occupied-private-dwellings-community-2001-2016-2.pdf.; Teviah Moro, "Boundary busting? Hamilton plans for 820,000 people by 2051," The Hamilton Spectator, Dec 8th, 2020, https://www.thespec.com/news/hamilton-region/2020/12/08/boundary-busting-hamilton-plans-for-820000-people-by-2051.html?fbclid=IwAR30CDc_U8iRfNvfJpKMdfDU2GPXAZdP5O4ytjh_r0IgLBjPDbfulk8ZGoU.
[27] *Ibid*

5. Climate Inequity

Hamilton's wealth disparity is significant, with Hamilton's poverty rate of 16.7% being significantly higher than the provincial and national averages[28]. One of the ways this social issue manifests is in the unequal distribution of green assets across Hamilton. For instance, communities of lower socio-economic status have the fewest bike lanes, safe sidewalks, and traffic calming measures, resulting in a higher incidence of accidents for pedestrians and cyclists.[29] Similarly, urban trees, which provide environmental as well as health benefits, are not equally distributed throughout the city.[30] It can be observed that communities with a lower socio-economic status have fewer trees. For example, this inequality in tree canopy coverage became clear in the North End Neighbourhood through the Sustainable Neighbourhood Action Plan (SNAP). SNAP addressed this inequality through a tree-planting initiative in the neighbourhood prior to the planting of trees.

More generally, there is a need for an equity lens to be applied to climate issues. As climate change disproportionately affects the city's most vulnerable, the impacts of climate change will worsen Hamilton's socioeconomic divide.

[28] "The Life-Sized City - Hamilton," TVO, October 23rd, 2020, https://www.tvo.org/video/documentaries/the-life-sized-city-hamilton.
[29] Julian Agyeman, "Poor and black 'invisible cyclists' need to be part of post-pandemic transport planning too," The Conversation, May 27th, 2020, https://theconversation.com/poor-and-black-invisible-cyclists-need-to-be-part-of-post-pandemic-transport-planning-too-139145?fbclid=IwAR0O_Q21JnHC2T27ssfNm65uQ33RHE9HpKcSd-E-OhvMJ6JPRW_kGqg1rBU
[30] "Chapter 3: The Urban Forest," Tree Canada, https://treecanada.ca/resources/canadian-urban-forest-compendium/3-benefits-of-urban-forests/

PRINCIPLES & INTANGIBLES:

Lessons from *Resilient Cities*

Interviewing for our podcast series, *Resilient Cities,* has been a refreshing learning experience. In speaking with both Hamilton-based and global climate leaders, we were able to further develop our understanding of the key principles behind successful climate action. Here are some of the recurring themes from our conversations:

Key Demands of Hamilton NPOs:

1. Financial & Political Support

When asked how best the city can support Hamilton organizations' initiatives, the Bay Area Restoration Council indicated a need for increased funding.[31] Environmental organizations are frequently limited by the number of staff they can hire and resources available to run initiatives. In light of significant provincial funding cuts to the Conservation Authorities program, the BARC's ability to continue conservation efforts in Hamilton's watersheds and protect Hamiltonians from flood risk will be severely impacted.[32] Political support from the City such as city councillors is needed to push back against this budget cut that will ultimately negatively affect Hamiltonians.

2. Equity in Climate Action

Social justice and climate change issues are inextricably linked. Marginalized communities will be most vulnerable to climate change impacts, yet are often the least consulted about climate projects. Ultimately, climate action that is not properly informed by engagement with vulnerable populations will not serve everyone equally. Thus, poorer POC neighbourhoods are often the least climate resilient, and cities are only as resilient as their least resilient communities. However, the City must also be prepared for potential pushback from these communities to proposed climate projects, which may be perceived as gentrification. This points towards a need for more thorough dialogue with these citizens to improve both citizens' understanding of the new initiative's potential benefits, as well as the City's understanding of the community's best interests. To ensure that sustainability assets are distributed fairly, it is critical that the City prioritizes Hamilton's vulnerable communities in the planning, public engagement, and implementation stages of climate action.[33]

[31] Chris McLaughlin, Hosts, "Conversation with Barc," Resilient Cities, Tuesday November 4th, 2020.
[32] "Why cuts to conservation authorities will make it harder to prevent floods," CBC, April 26, 2019, https://www.cbc.ca/news/canada/hamilton/why-cuts-to-conservation-authorities-will-make-it-harder-to-prevent-floods-1.5112133
[33] Beatrice Ekoko and Deepak Palanichami , Hosts, "Conversation with Environment Hamilton," Resilient Cities, Thursday December 3rd, 2020.

3. Prioritizing Transportation

In the wake of the LRT cancellation, the City of Hamilton has $1 billion in funding to spend on transit upgrades.[34] A common theme in many of our conversations with interview guests is that prioritizing investment in public transportation is a good first step in Hamilton's climate strategy.[35] Going forward with public transportation improvements, such as implementation of BLAST (Hamilton's proposed bus rapid transit system), station upgrades, and the adoption of a renewably-powered fleet will:

- Improve connections between suburbs and the downtown core, increasing the convenience of getting around by bus, and reducing car traffic
- Reduce emissions through fewer single occupant vehicles on the road and a higher efficiency bus fleet
- Increase density, as developers build new infrastructure around transit routes
- Improve public enjoyment of transit facilities via beautification and functional upgrades, increasing ridership
- Improve social equality by increasing the accessibility of transit

The promising return on investment from transit improvements make it a worthwhile priority project.

4. Education

Public awareness and education on climate issues are critical to creating the culture shift towards sustainable practices that Hamilton needs. For most Hamiltonians, the value of complete streets, rain barrels, and a district heating/cooling system are not top of mind.[36] The normalcy of a street with priority given to cars may be so deeply ingrained that the possibility of any other reality is never considered. Engaging the younger generation through educational programs, such as BARC's Stream of Dreams, encourages young people to connect with climate issues and push for positive change.

[34] Shawn Jeffords, "After abrupt cancellation of Hamilton, Ont. LRT, new panel again recommends light rail or bus rapid transit," On-Site, April13th, 2020https://www.on-sitemag.com/infrastructure/after-abrupt-cancellation-of-hamilton-ont-lrt-new-panel-again-recommends-light-rail-or-bus-rapid-transit/1003967842/.
[35] Jon Davey, Hosts, "Conversation with NENA," Resilient Cities, Wednesday December 2nd, 2020.
[36] Chris McLaughlin, Hosts, "Conversation with Barc," Resilient Cities, Tuesday November 4th, 2020.

Copenhagen, Denmark

NECESSARY ELEMENTS OF CLIMATE RESILIENT CITIES:

Important Lessons Learned from Across the World

This section highlights some of the key recommendations that were emphasized in our conversations with city staff members from across Canada. The need for climate champions, a political collaboration between the province and city, the importance of building relationships and accountability, and the need for community engagement and community-building projects are key lessons that the City of Hamilton must consider and apply when carrying out initiatives to fight climate change.

1. Climate Change Champions

Throughout this project, a key theme that recurred in the conducted research and interviews is to have a climate change champion. A climate change champion is described as someone willing to advocate for

climate change initiatives and ensure resources and funding are available for changes to be made. Climate change champions hold the power and networking abilities to communicate with local municipalities and are able to give climate actions the priority that they deserve. This would also allow the community to be more informed about the ways in which climate change impacts them. An informed citizenry is an essential element in creating climate-resilient cities. Without a climate change champion, implementations of climate change initiatives would go unnoticed by the community. Therefore, it is essential to have a climate change champion that is willing to use their voice and power to bring attention to implement climate change actions.

2. Political Collaboration (Provincial/Municipal)

Political collaboration within provinces and cities is a key element needed in any climate-resilient city. Laws need to be put in place that would ensure that any implementations and developments made are sustainable and will not cause further damage to the environment. For example, Schedule 6 in Ontario's *Protect, Support, and Recover from COVID-19 Act* (Bill 229) includes changes to the law that would cause more damage to the natural environment,and be a setback to climate change initiatives. Developing permits have been removed under Section 6, which means that harmful and unsustainable developments could potentially be implemented. The bill also allows developers to fast-track approvals and appeal, which can lead to the allowance of potentially harmful developments in the natural environment.[37] This is a prime example that demonstrates the importance of political collaboration within cities and provinces, as the provincial government's actions are working against the City's best interests regarding watershed protection. If the two levels of government are not on the same page, there could be detrimental damage done to the environment that would only further the irreversible consequences of climate change.

3. Building Relationships & Accountability

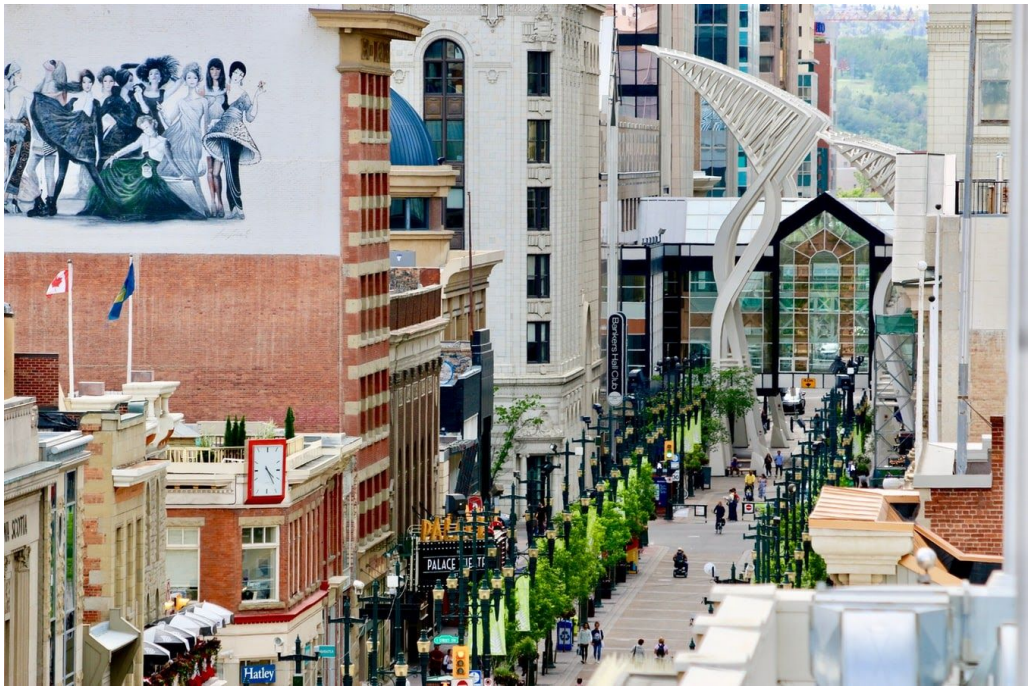
A key element to building resilient cities is sharing knowledge and best practices learned through experiences. Climate change is a global issue that impacts every city, therefore solutions and best practices must be shared with everyone. We learned that cities around the world have been inspired by each other and have implemented similar climate change projects. In our podcast sessions, municipal staff from across Canada emphasized the importance of collaboration in fighting climate change. It is also essential that relationships are built with residents and organizations in the city where there is a need for action. A climate change project that is successful in one city may fail in another due to a lack of engagement and support from citizens. Another important key aspect to building a climate-resilient city is ensuring that accountability is being practiced. Once relationships are made between a city and its stakeholders, they need to maintain this relationship and hold one another accountable for their actions. An example of this was seen in Vancouver when the sustainability committee failed to interact

[37] "Bill 229, Protect, Support and Recover from COVID-19 Act (Budget Measures)," Legislative Assembly of Ontario, 2020, https://www.ola.org/en/legislative-business/bills/parliament-42/session-1/bill-229.

with local businesses which not only caused further delays in their plans but also damaged the relationship [See Appendix A for the Vancouver Podcast]. Therefore, relationship maintenance, respect, and accountability must be continuously practiced to successfully build a climate resilient city.

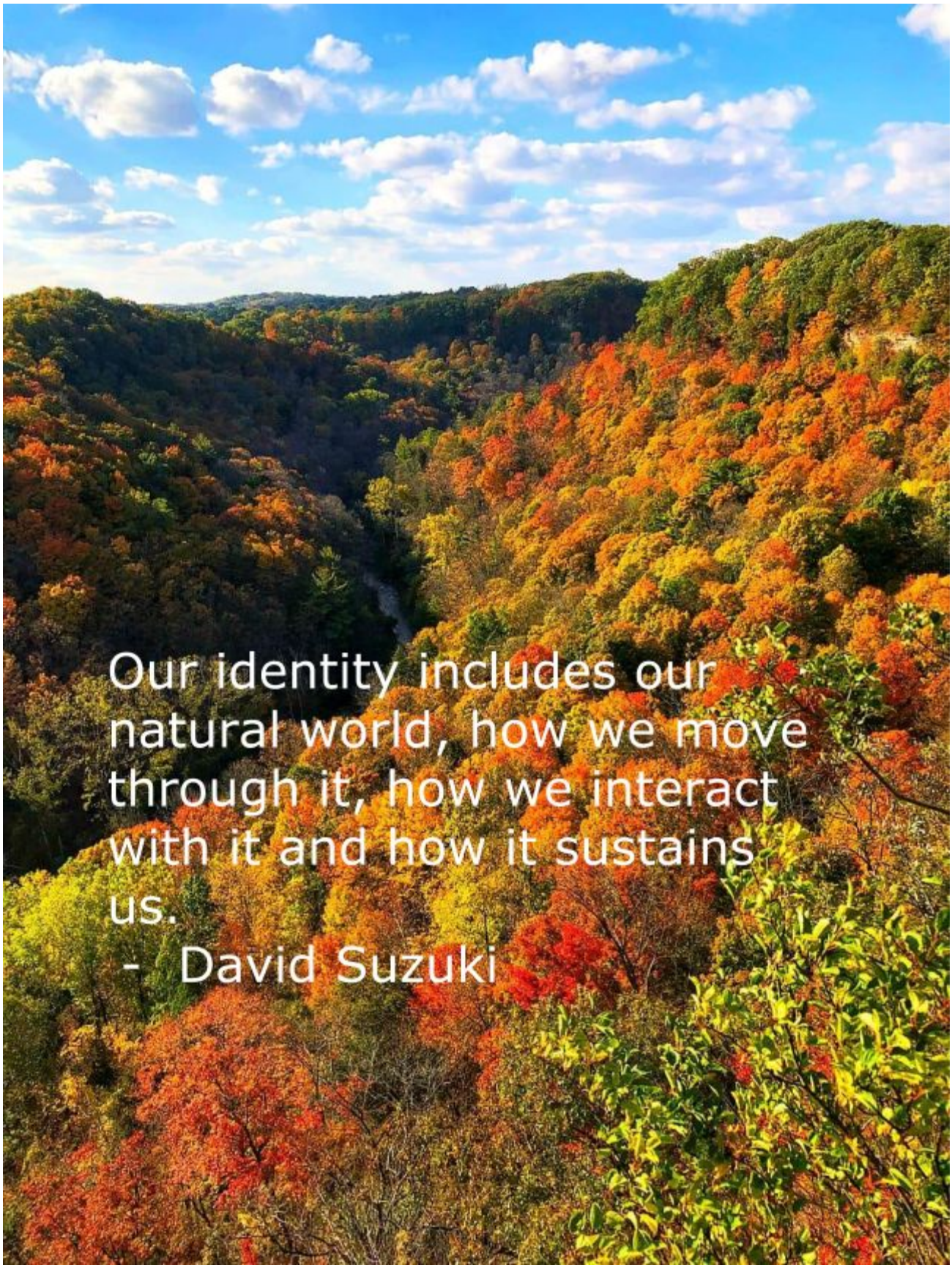
4. Community Engagement & Community Building Projects

Another important element in climate resilient cities is effective community engagement strategies. In order for climate change actions to be successful, residents and stakeholders must be involved in community decisions. Community building projects build the wide support that is needed to mobilize the general public to push for greater change. Many of the best projects and initiatives taking place around the world are successful because proper engagement and community building skills were incorporated into their action plans. As stated by Member of Parliament Matthew Green, "the real leadership is on the ground".[38] All relevant stakeholders within a city, such as residents, organizations and businesses need to come together to reduce their carbon footprint, or little to no change will be seen. Creating community building projects that would help fight against climate change is an important element that every city should implement. Portland, which is a world exemplar in climate resiliency, carries out various community-building projects such as tree planting programs. This gets the community involved, and they get to take ownership of their neighbourhoods. Such personal connections to the city are needed in order for cultural shifts to occur and to get residents to take climate change seriously.



Downtown Calgary

[38] MP Matthew Green, CityLAB SIR Guest Speaker, November 27, 2020.


Our identity includes our natural world, how we move through it, how we interact with it and how it sustains us.
- David Suzuki


6.0 Best Practices
(National &
International)

BEST PRACTICES (National & International)

The following section outlines the best practices that we found through our research. It lists sustainable, and innovative ideas that have been put into action around the world. The sustainable actions are divided into five categories. The categories are: GHGs, Infrastructure and Land Use; Sustainable and Alternative Transportation; Natural Environment; Waste and Water; Education and Engagement.

GHGs, Infrastructure & Land Use

The effects of GHGs on the environment are vast, complex and undeniably one of the main causes of climate change and today's climate catastrophe. The Paris Agreement, created by the United Nations Framework Convention on Climate Change (UNFCCC), lamented the need for a drastic global reduction in greenhouse gas emissions. To achieve the target maximum global heating of 1.5°C, there needs to be a global GHG reduction of 7.6% per year for the next 10 years.[39] This is truly a monumental task, and will not be achieved unless drastic changes are made locally, nationally and globally. The following section highlights successful initiatives that have been carried out around the world to reduce GHG emissions. Only the cities that have been chosen for the purposes of this report have been examined. This section will highlight best practices related to heating and cooling systems, and energy efficiency in the cities.

To manage the complex technical, political and financial issues associated with climate change mitigation and resilience, cities require effective physical infrastructure. The United Nations predicts that by 2050, 68 percent of the global population will live in an urban environment. This means that cities across the world are in the process of the biggest population boom in human history, borders have expanded at unforseen rates, and suburbs and natural areas alike are gobbled up by hungry municipalities. Concurrently, the federal funding municipalities receive also decreases, which has led cities to be more reliant on land development - which is often associated with environmental degradation. For example, the percentage of federal funding for Canadian municipalities dropped from 9% to 8% from 2010 to 2016. Hamilton needs drastic changes in the way it develops land and its willingness to sacrifice natural resources for economic growth. This section will also outline examples of effective land use and redevelopment.

[39] "Cut Global Emissions by 7.6 Percent Every Year for Next Decade to Meet 1.5°C Paris Target - UN Report," United Nations Climate Change, 26th November, 2019, https://bit.ly/36VP00n

Montreal:

- Montreal Households are the *"greenest in Canada"* as of 2016, producing 5.4 tonnes of CO_2 per household. Compared to 9.6 tonnes of CO_2 in Toronto for example.[40] The City wants a 30% reduction of 1990 levels by 2020.
    - As a first step in this direction, in 2007 the City adopted a plan to reduce its own GHG emissions by 20% by 2012.[41]
    - The Port of Montreal offers ships a natural gas fuel solution to cut the emissions from the port (major contributor to pollution).[42]

- **Lande** is a non-profit organization that works to redevelop land.[43]
    - It works with municipalities to buy vacant lots from landowners. It then presents the City with information on the lot and develops a purchasing/development strategy while also working on ways to gain the necessary funding for redevelopment.
    - The NPO has built partnerships with the municipal and provincial governments to acquire land to repurpose it.

Vancouver:

- The city actively promotes the **Passive House** system, and makes it easier for builders to meet passive house certification.
    - This is a rigorous building code that cuts a building's energy consumption by upto 90%.[44]
    - Unlike other standards, Passive House takes all energy use into account. This includes domestic hot water systems (DHW), heating, cooling, auxiliary and household electricity. Auxiliary and household electricity are often not accounted for by other standards.[45]

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[40] Cory Allen, "Montreal households the greenest in Canada: UBC study," UBC, July 27th, 2016 https://news.ubc.ca/2016/07/27/montreal-households-the-greenest-in-canada-ubc-study/

[41] "Sustainable Development," Montreal, http://ville.montreal.qc.ca/portal/page?_pageid=7137,79225585&_dad=portal&_schema=PORTAL

[42] "Investing for a sustainable world," Port Montreal, 2019, https://www.port-montreal.com/m/rapport-annuel/2019/sites/default/files/rapport-sommaire-2019-en.pdf.

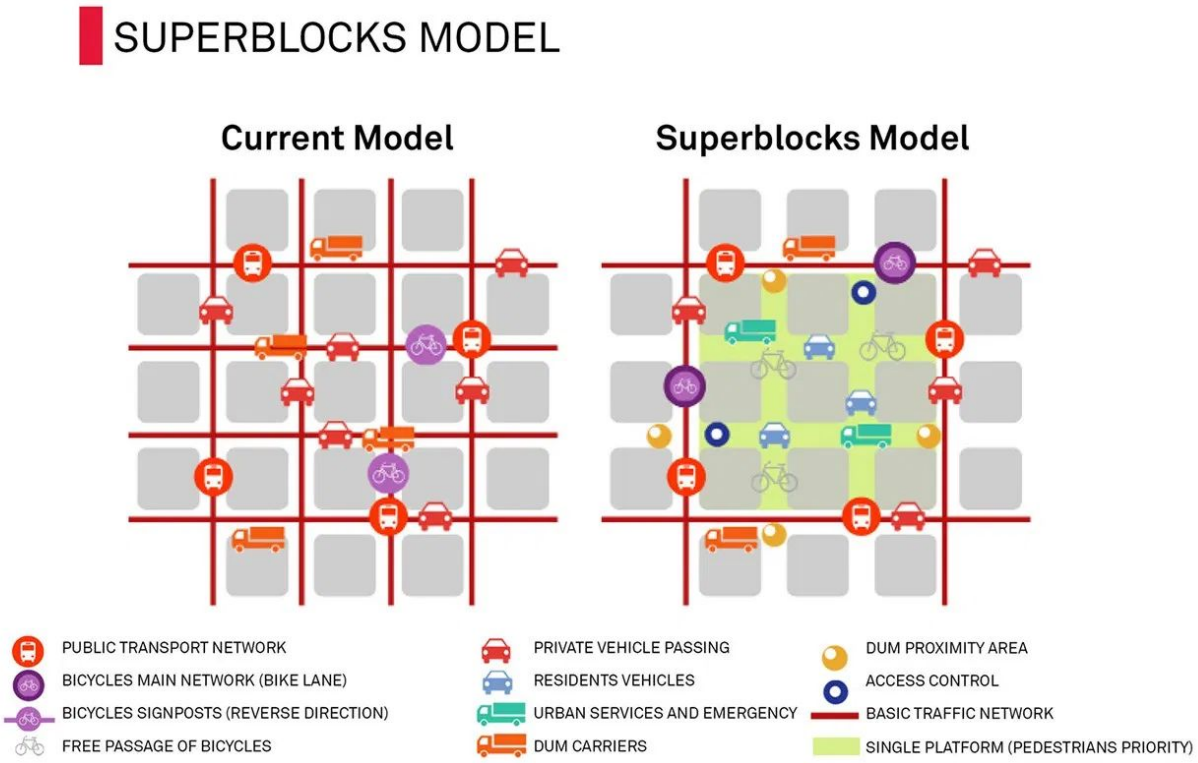
[43] "Lande," Lande, https://landemtl.com/a-propos-lande/.

[44] "Buildings:2050," metro Vancouver, http://www.metrovancouver.org/services/air-quality/climate-action/climate2050/regional-priorities/buildings/Pages/default.aspx.

[45] "The Passive House Difference," International passive House, https://passivehouse-international.org/index.php?page_id=238#:~:text=Passive%20House%20stipulates%20Primary%20Energy,cooling%2C%20auxiliary%20and%20household%20electricity.

Barcelona:

- Barcelona's targets for emissions reduction are to achieve:
  - A 45% GHG reduction by 2030 compared to 2003 levels,[46]
  - A 30% reduction in air pollutants (e.g. NO_2, PM),[47]
  - Net zero emissions by 2050[48]



Source: Ajuntament de Barcelona

- **Superblocks**[49]
  - Superblocks are mixed-use neighbourhoods of nine blocks with four inner streets closed to non-essential traffic.
  - Speed limit within the superblock is limited to 10 km/h.

[46] "Barcelona and climate change, a constant struggle," HCC Hotels, October 21st, 2020, https://www.hcchotels.com/en/blog/barcelona-and-climate-change-a-constant-struggle/
[47] "Frequently Asked Questions," Barcelona, https://ajuntament.barcelona.cat/qualitataire/ca/actualitat-i-recursos/preguntes-frequents.
[48] "Barcelona and climate change, a constant struggle," HCC Hotels, October 21st, 2020, https://www.hcchotels.com/en/blog/barcelona-and-climate-change-a-constant-struggle/
[49] "Superblocks," Barcelona Architecture, https://barcelonarchitecturewalks.com/superblocks/.

- Traffic is diverted to roads around the Superblock perimeter
  - Increase of traffic around perimeter found to be minimal: 2-5%[50]
- Intersections and streets become a place for pedestrians to mingle and play.
- As of November 2020, 7 superblocks are in operation. 500 potential superblocks are planned to cover the whole city.[51]
- Projected Cumulative Benefits of 500 superblocks:[52]
  - Car trips will decrease by 230,000 a week in favour of walking, cycling, transit
  - NO_2 decreased by 25%
  - 667 premature deaths from air pollution, noise, heat
  - Increased quality of life and longevity (+200 days)
- Although initially met with skepticism, the project now boasts high levels of engagement and satisfaction.

- **Barcelona Rondes Low Emissions Zone** (opened Jan 1, 2020)
  - A large 95 km^2 low-emissions zone where only energy-certified vehicles can enter on weekdays.[53]
  - Restricted vehicles include:
    - Petrol cars registered before 2000[54]
    - Diesel cars bought before 2006[55]
    - Foreign vehicles, unless registered for certification (limits tourist traffic)
  - Owners of restricted vehicles encouraged to give up their old cars for free 3-year transit pass
  - **Goal:** reduce emissions, improve air quality, and improve public health of residents[56]
  - **Target:** reduce NO_2 emissions by 15% by end of 2020[57]
  - **Projected benefits:** will reduce NO_X to 31% and PM_{10} to 39%[58]

[50]David Roberts, "Barcelona's radical plan to take back streets from cars," Vox, may 26th, 2019, https://www.vox.com/energy-and-environment/2019/4/9/18300797/barcelona-spain-superblocks-urban-plan#:~:text=Cars%20completely%20swamped%20cities%20in,spaces%2C%20or%20"superblocks.
[51] Barcelona plans major increase in 'green' zones, BBC, november 12, https://www.bbc.com/news/world-europe-54920342.
[52] Natalie Mueller, "Changing the urban design of cities for health: The superblock model," Science Direct, January 2020, https://www.sciencedirect.com/science/article/pii/S0160412019315223?via%3Dihub#bb0035.
[53] "Frequently Asked Questions," Barcelona, https://ajuntament.barcelona.cat/qualitataire/ca/actualitat-i-recursos/preguntes-frequents
[54] Ana Garcia Valdivia, "Barcelona Opens One Of Europe's Largest Low Emissions Zones", Forbes, January 13th, 2020, https://www.forbes.com/sites/anagarciavaldivia/2020/01/13/barcelonas-ambitious-low-emissions-zone-to-ban-most-polluting-vehicles/?sh=1882d2b5631f.
[55] *Ibid*
[56] "Frequently Asked Questions," Barcelona, https://ajuntament.barcelona.cat/qualitataire/ca/actualitat-i-recursos/preguntes-frequents
[57] na Garcia Valdivia, "Barcelona Opens One Of Europe's Largest Low Emissions Zones", Forbes, January 13th, 2020, https://www.forbes.com/sites/anagarciavaldivia/2020/01/13/barcelonas-ambitious-low-emissions-zone-to-ban-most-polluting-vehicles/?sh=1882d2b5631f.
[58] "Frequently Asked Questions," Barcelona, https://ajuntament.barcelona.cat/qualitataire/ca/actualitat-i-recursos/preguntes-frequents

- **Solar Hot Water Ordinance**[59]
    - All new developments and retrofits must have 60% of their running hot water supplied by solar energy.

Copenhagen:

- **District Heating System**
    - 98% of all households in the city are connected by an efficient district heating system.[60]
    - About 30% of the annual district heating demand is covered with **surplus heat from waste incineration**, and the remaining production of district heating is **based on geothermal energy and fuels** such as wood pellets, straw, straw pellets, natural gas, oil and coal.[61]
    - The system **captures heat from electricity production** - normally released into the sea - and channels it back through pipes into people's homes. The system cuts household bills by 1,400 EUR annually, and has saved Copenhagen district the equivalent of 203,000 tons of oil every year (that's 665,000 tons CO2).[62]

- **District Cooling System**[63]
    - The traditional air conditioning system is replaced by sending cold water through a network of pipes that supply cooling for commercial and private buildings. Cold harbour water is used to power the system.
        - Free **cooling from seawater abstraction**, running surplus heat from district heating network through absorption cooling and traditional compression chillers.
        - This would save 14,000 tonnes of CO2 per year.[64]
    - This cooling system supplies the centre of Copenhagen with cold water, and the pipe system is being expanded for more supply in the future.
    - This saves 70% of the energy compared to traditional air-conditioning.[65]

[59] "Barcelona's Solar Hot Water Ordinance," C40 Cities, November 3rd, 2011,https://www.c40.org/case_studies/barcelonas-solar-hot-water-ordinance
[60] "98% of Copenhagen City Heating Supplied by Waste Heat," C40 Cities, November 3rd, 2011, https://www.c40.org/case_studies/98-of-copenhagen-city-heating-supplied-by-waste-heat
[61] *Ibid*
[62] *Ibid*
[63] "Barcelona's Solar Hot Water Ordinance," C40 Cities, November 3rd, 2011,https://www.c40.org/case_studies/barcelonas-solar-hot-water-ordinance
[64] "Keeping cool under pressure," State of Green, https://stateofgreen.com/en/partners/city-of-copenhagen/solutions/keeping-cool-under-the-co2-pressure/
[65] *Ibid*

- Buildings - Energy Use and Emissions
    - Copenhagen is the first city in the world to have a completely **centralized building monitoring system**.[66]
        - Remote data from heat, water, electricity meters is provided on an hourly basis. This is important for identifying areas with the highest energy usage and potential problem areas.
    - New buildings in Copenhagen must be constructed to Denmark's **Low Energy Class ratings** - the 2020 standard calls for near net-zero energy buildings.

Portland:

- Portland has been well on track to reaching its target of a 50% reduction goal in greenhouse gas emissions from 1990 levels.
    - In 2007, $C0_2$ emissions were 13,998 metric tonnes and since 2019, there has been a 40% decrease from the 2007 baseline.[67]
    - Large emissions reductions have been a result of the **Renewable Portfolio Standard** set in 2007 that requires 50% of electricity used must come from renewable sources by 2040[68]

- The city has also implemented its first natural gas fueling station, called **"Poop to Power"** in 2019.
    - Through "Poop to Power" the city aims to replace over one million gallons of diesel fuel with renewable natural gas which aims to eliminate 21,000 tonnes of greenhouse gas emissions.[69]

- Portland passed a bill in 2016 that **bans the expansion of new fossil infrastructure**[70]

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[66] *Ibid*
[67] Carbon Footprint Report, Portland Water Bureau: Portland, 2007, https://www.portlandoregon.gov/water/article/467452.
[68]https://www.oregon.gov/energy/energy-oregon/pages/renewable-portfolio-standard.aspx#:~:text=%E2%80%8B%E2%80%8BOregon's%20Renewable%20Portfolio,from%20renewable%20resources%20by%202040.&text=In%20March%202016%2C%20the%20passage,50%20percent%20renewables%20by%202040.
[69] "Renewable Portfolio Standard," Oregon Department of Energy, https://www.portlandoregon.gov/fish/article/676006.
[70] "How Portland Passed a Groundbreaking Fossil Fuel Ban in Their City." Stand.earth, October 16, 2019. https://www.stand.earth/page/fossil-fuel-free/local-to-global/how-portland-passed-groundbreaking-fossil-fuel-ban-their-city.

Stockholm:

- The City Council has set the following targets:
    - Emissions of no more than 2.3 tonnes of CO2e per resident by 2020,[71]
    - Zero GHG emissions by 2040,[72]
    - Zero use of fossil fuels in 2040[73]

- **Hammarby Sjöstad**[74]
    - During the 1990's this was a heavily polluted industrial site near downtown Stockholm by Lake Hammarby.
    - In 2004, the City started a development plan to build 11 000 homes for 25 000 residents, while also creating 10 000 new jobs.
    - The project is focused on sustainable energy practices, for example it uses 34% district heating and is entirely powered by renewable energy sources (mainly nuclear and hydro).

Hammarby Sjöstad, Stockholm | Photo Source: Urban Green Blue Grid

[71] Strategy for a fossil-fuel freeStockholm by 2040, Stockholm STAD: Stockholm, 2017, https://international.stockholm.se/globalassets/rapporter/strategy-for-a-fossil-fuel-free-stockholm-by-2040.pdf.
[72] "Stockholm Sweden," Carbon Neutral City Alliance, https://carbonneutralcities.org/cities/stockholm/
[73] *Ibid*
[74] "Hammarby Sjöstad, Stockholm, Sweden," Urban Green-Blue Grids, https://www.urbangreenbluegrids.com/projects/hammarby-sjostad-stockholm-sweden/.

- Green energy[75]
    - 81% of electricity is produced by **hydro and nuclear** in Stockholm.
    - An estimated 1.3 million kWh energy produced by solar which is an up and coming energy provider in the city.

- The **Hammarbyverket district heating** plant is the largest in the world, and can power 95,000 two room apartments.[76]
    - Hammarbyverket takes **heat from wastewater plants** and uses it to heat buildings.
    - It has seven heat pumps with 225mv of power.
    - It is the largest district heating plant in the world.
    - Nearly 90% of the buildings in Stockholm are connected to district heating.[77]
    - There is nearly 3000km of heating line.

- **District Cooling System**
    - Cooling mainly comes from ocean water. However, in the summer it is cooled by Lake Ropsten.
    - This system is similar to the cooling system in Copenhagen.

Photo Source: Gurvir Chana

[75] The City of Stockholm's Environmental Work, Stockholm STAD: Stockholm, http://miljobarometern.stockholm.se/content/docs/tema/Environmental-Work-Stockholm-2017.pdf.
[76] *Ibid*
[77] "Stockholm's Innovation in District Heating and Cooling," Smart City Sweden, https://smartcitysweden.com/best-practice/401/stockholms-innovations-in-district-heating-cooling/#:~:text=Central%20Stockholm%20is%20the%20location,in%20the%20region%20of%20Stockholm.

SUSTAINABLE & ALTERNATIVE TRANSPORTATION

In 2010, transportation contributed to 14% of the world GHG emissions, with 95% of these emissions sourced from petroleum based fuels.[78] As electric, hydrogen and biofuels trains, busses and cars become increasingly affordable and accessible, fossil fuels will soon no longer be compatible with modern transit. Here in Hamilton, we are lagging behind in terms of sustainable transit. The LRT, promised to be a beacon of hope and was a much needed disruptor for the city that was designed for cars, rather than people. In 2019, there were 9,500 car collisions, with 1,729 of those causing injuries and deaths. While the LRT was cut due to funding issues. The province has assured Hamilton that Hamilton will still receive the over $1B that was promised for the LRT. These recommendations are ways in which Hamilton can spend this money to become a greener, safer and more accessible city.

Edmonton:

- In 2018, Edmonton Transit Service (ETS) **purchased a total of 50 Proterra BEBs**, the first Canadian transit agency to purchase such a large number of BEBs in one procurement round.
    - They secured funding through the Public Transit Infrastructure Fund (PTIF) and the Alberta Community Transit (ACT) fund.
    - Before the Toronto Transit Commission (TTC) secured 60 BEBs in 2019, Edmonton made history for the largest electric bus purchase in Canada.
    - The city got two BEBs in 2019 along with its charging infrastructure and charging verification system, while another 20 BEBs are scheduled to be delivered and deployed by 2020.

- **Vision Zero:** changes to infrastructure and traffic-safety concerns through consulting with citizens to further establish a strategy called the **"Safe Mobility Strategy (2021-2025)"** to improve the safety of streets.
    - **Intersection safety devices**
    - Upgrading crosswalks

Montreal:

- Currently still a car-centric city.[79]
    - 70% of rush hour trips are car traffic.
    - City has set a goal of reducing this to 35% by 2031.

[78] "Global Greenhouse gas Emissions Data," EPA, https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data#:~:text=Transportation%20(14%25%20of%202010%20global,fuels%2C%20largely%20gasoline%20and%20diesel

[79] "Public transit use up in Montreal area, particularly among young people, report says," CBC, Jan 21th, 2020, https://www.cbc.ca/news/canada/montreal/montreal-transit-ridership-1.5434284.

- Most cycling lanes of all Canadian cities 72km (2015)[80]
    - Montrealers bike the most compared to all other canadian Cities

Vancouver:

- Vancouver is part of the CUTRIC's ***Pan-Canadian Electric Bus Demonstration & Integration Trial: Phase I*** along with the jurisdictions of Brampton, and York Region, with 18 BEBs and seven overhead chargers across three cities and five routes.[81]
    - This project has supported the publication of North America's SAE J3105 standard for high-powered BEB charging.
    - In early 2019, TransLink and Metro Vancouver received the first four BEBs.

- On November 17, 2020 Vancouver became the first Canadian city to approve the development of a **transport pricing strategy** for the city's Metro Core by 2025.[82]
    - This will help create more road space for transit, walking, and cycling.
    - GHG emissions and other pollution from vehicles will be reduced.
    - Revenue collected from the transport pricing will be re-invested in transit and active transportation options.

Barcelona:

- Reduced speed limits on most streets (30 km/h) to disincentivize driving and increase street safety[83]
- **Green Axes**[84]
    - Designated areas of pedestrian and cyclist priority
    - A **network of linked pedestrian squares**
    - 21 new squares, 33 hectares of pedestrian/cyclist space
    - Construction planned for 2022

[80] Cycle Cities Full Report, Pembina Institute: Calgary, 2015, https://www.pembina.org/reports/cycle-cities-full-report-rev.pdf.
[81] Best Practices and key considerations for transit electrification and charging infrastructure deployment to deliver predictable, reliable, and cost-effective fleet systems. Petrunic et al., 2020. Cutric. Accessed December 9, 2020 https://cutric-crituc.org/wp-content/uploads/2020/06/Best-Practices-and-Key-Considerations-for-Transit-Electrification-and-Charging-Infrastructure-Deployment-to-Deliver-Predictable_-Reliable_-and-Cost-Effective-Fleet-Systems.pdf
[82] Vancouver, City of. "Transport Pricing." City of Vancouver. Accessed December 9, 2020. https://vancouver.ca/streets-transportation/transport-pricing.aspx.
[83] This is not a Drill, Ajuntament de Barcelona: Barcelona, January 15th, 2020, https://www.barcelona.cat/emergenciaclimatica/sites/default/files/2020-01/Climate_Emergency_Declaration.pdf.
[84] Barcelona plans major increase in 'green' zones, BBC, november 12, https://www.bbc.com/news/world-europe-54920342.

Copenhagen:

- The City will **systematically reduce inner-city parking spaces**.
    - Planned to reduce the number of people allowed to park in the city by around 1,500 a year, with a target of eliminating up to 11,200 parking spaces by 2025.[85]
    - Rather than revoke permits, the city will refuse to replace any permits that are given up when drivers give up their cars, move out of the city or die. The expansion of the system of car-free spaces in the city has had some great advantages:
        - Residents have had time to develop a completely new urban culture and discover and develop new opportunities for transportation.
        - Car owners have had time to get used to the idea of not driving and parking in the city center, and instead using public transport and bicycle.
        - As a result, people have had time to change their habits and patterns of mobilization.

- All new buses produce zero emissions
    - In March 2020, the first **hydrogen fuel cell electric buses** (FCEBs) were delivered and started operating in the city.
    - Out of 47 newly ordered buses, 32 will be purely electric. This contract is expected to be carried out in June 2021.[86]
    - Denmark's 2018 climate plan outlined that **all new buses must be zero-emissions** in cities starting in 2025. However, Copenhagen is already fulfilling this target, with it's new zero-emission buses in operation 6 years ahead of schedule.[87]

- **Cycle superhighways** (***Super Cykelstier***) connect work, study, residential areas, and neighbouring regions. They are also planned to be constructed near train stations to easily connect a commute with public transport.
    - July 2019: 62% of the city's residents are now commuting to work or school by bike.[88]
    - There are 60 superhighways planned in total (over 850 km of cycle superhighways), of which 9 are currently operational.

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[85]Ruben Koops,"Ruim 10.000 parkeerplaatsen verdwijnen voor 2025," Het Patrool, March 28th, 2019, https://www.parool.nl/nieuws/ruim-10-000-parkeerplaatsen-verdwijnen-voor-2025~b8496335/?utm_source=twitter&utm_medium=social&utm_campaign=shared%20content&utm_content=free&referrer=https://www.parkeagle.com/ .
[86]Hampel, Author: Carrie, and Name *. "Keolis Awarded Electric Bus Operation in Copenhagen." electrive.com, April 16, 2020. https://www.electrive.com/2020/04/15/keolis-awarded-electric-bus-operation-in-copenhagen/.
[87]Copenhagen Way Ahead Of Official Plans - Electric Buses To Enter Operation 6 Years Early." CleanTechnica, March 28, 2019. https://cleantechnica.com/2019/03/28/copenhagen-way-ahead-of-official-plans-electric-buses-to-enter-operation-6-years-early/
[88]"Copenhagen Has Taken Bicycle Commuting to a Whole New Level." Los Angeles Times. Los Angeles Times, August 8, 2019. https://www.latimes.com/world-nation/story/2019-08-07/copenhagen-has-taken-bicycle-commuting-to-a-new-level.

- After construction of the bicycle superhighways, on average there was an increase in the number of cyclists with an over 23% increase on weekdays. Of these 23%, 14% were car users who made the shift to using bicycles.[89]
- Initiatives in place on cycle superhighways
  - **Green waves**: In Copenhagen at a constant speed of approximately 20 km/h cyclists can enjoy a green wave. A green wave occurs when a series of traffic lights (in this case traffic lights for bikes) are coordinated to allow continuous traffic flow over several intersections in one main direction.
  - **Traffic lights for bikes**
  - **Air pumps**
  - **Clear biking signage**

Stockholm:

- **Biofuel Busses**[90]
  - First city in the world to have a zero emission bus network.
  - Planned for 2025, was achieved in 2018.
  - 64% of fuel comes from biofuel waste, produced in the city's waste management plants.

- The Swedish phrase ***"I stan utan min bil"*** translates to, **"in town without my car"**[91]
  - Stockholm attempted a **car free day** in their downtown area in 2015.
  - Lead to greater public opinion towards reducing car access to downtown areas after people were able to experience the benefits of safer, pedestrian friendly roadways.

Calgary:

- **Rapid Transit Network**
  - 4 BRT Lines
    - **Dedicated bus lanes, signal priority, heated shelters, real-time info displays**[92]
  - 1 LRT Line under construction
    - Projected to save over 30,000 tonnes GHG/year (6,100 vehicles worth)[93]
  - Target: 67% of people living within 400 m of Primary Transit Network; 15-20% ridership[94]

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[89] About Cycle Superhighways." Supercykelstier, October 22, 2020. https://supercykelstier.dk/about/.
[90] Liene Norberg, "Stockholm is the world's first capital with 100% fossil free bus services," Biofuel Express, https://www.biofuel-express.com/en/stockholm-is-the-worlds-first-capital-with-100-fossil-free-bus-services/#:~:text=As%20the%20first%20capital%20in,fossil%20free%20fuel%20in%202025.
[91] "Swedish capital goes car free for the first time," September 18th, 2015, The Local Se, https://www.thelocal.se/20150918/swedish-capital-goes-car-free-for-first-time.
[92] "Max Yellow arrived Dec.23," Calgary Transit, https://www.calgarytransit.com/max-y.
[93] *Ibid*
[94] "Calgary Transportation Plan," Calgary, https://www.calgary.ca/transportation/tp/planning/calgary-transportation-plan/calgary-transportation-plan-ctp.html

- **Primary Cycling Network** [95]
    - connects “major destinations such as Activity Centres, corridors and major institutions.
- **The Rotary/Mattamy Greenway** under construction[96]
    - 138 km of pathways encircling the city connecting greenspaces

- **Bicycle Rack Sponsorship Program**[97]
    - Call 311 to install a new bike rack in location of your choice
    - Installed 600 new bike racks between 2002 and 2010

- **Bicycle Stations**[98]
    - secure bicycle parking with facilities (e.g. lockers, showers, repair facilities, bicycle resources, coffee shop, bike rentals, tourism information)

One of Stockholm’s many waterfront’s

[95] “Path and BikewayPlan,” Calgary, January 13th, 2020, https://www.calgary.ca/transportation/tp/cycling/cycling-route-improvements/pathway-and-bikeway-plan.html
[96] “The Rotary/ Mattamy Greenway,” Calgary, https://www.calgary.ca/csps/parks/pathways/calgary-greenway.html
[97] “Cycling Strategy,”, Calgary, https://www.calgary.ca/transportation/tp/cycling/cycling-strategy/cycling-strategy.html.
[98] *Ibid*

NATURAL ENVIRONMENT

Cities around the world have unique relationships with the natural world based on geographic, cultural and political factors. Through our research, we noticed that the world's leading climate cities were able to tap into their unique surroundings to leverage the natural benefits their neighbourhoods are immersed in to create proactive sustainability initiatives. Whether it was Stockholm using the freezing water of the North Atlantic to cool its buildings, or Montreal being almost completely powered by hydro electricity from the great dams of Northern Quebec, the keys to creating a more sustainable world often exist in finding ways to work with the landscape, rather than against it. Hamilton, an industrial city, needs to figure out how it creates a healthy sustainable environment and fix many of the issues it has created for itself. For example, we suggest that Hamilton implement carbon sinks, increase tree coverage, prioritize people over cars and increase public greenspaces and access to natural beauty.

Copenhagen:

- **Cloudburst Management Plan**[99]
    - Policy in place for directing rainwater to the nearest body of water through the use of gravity wherever possible.
    - **Tåsinge Plads** - Water retention parks
        - 1,000 m^2 of unused asphalt has been turned into 'wild' urban nature.[100]
        - Park transformed what was once mostly pavement into a multi-levelled public space that captures and holds rainwater from 4,300 square metres of the surrounding neighbourhood. Sculptural elements like upturned umbrellas capture rain and provide water for plants. The park is part of a wider climate adaptation plan that aims to create a more climate resilient Copenhagen through the type of green infrastructure and park investments seen in Tåsinge Plads.

Stockholm:

- In 2001, 20 000 trees were dying in the city due to malnutrition and pollutants. The City worked quickly to reverse this trend.[101]
    - Discovered that the current compact method of construction was not allowing adequate rain to reach tree roots, new construction standards were developed for more porous materials that allowed more water to seep into the ground.
    - The city decided to re-think their method of planting, becoming more selective regarding the

[99] "Copenhagen." International Water Association. Accessed December 9, 2020. https://iwa-network.org/city/copenhagen/.
[100] "Tåsinge Plads." Tåsinge Plads - Klimakvarter Østerbro. Accessed December 9, 2020. http://klimakvarter.dk/en/projekt/tasinge-plads/.
[101] Len Phillps, The Stockholm Solution for Planting Trees, February 27th, 2017, https://www.linkedin.com/pulse/stockholm-solution-planting-trees-len-phillips.

species and location of trees planted.
    - Noticed a drastic uptake in the health and longevity of the newly planted trees.

Portland:

- **Backyard Habitat certification program**[102]
    - Program where residents can create backyard habitats that would create healthier outdoor environments for people and wildlife.
    - Technicians come to the home and assist with the plantations of native plants and stormwater management elements.

- **Ecoroofs**
    - Vegetative roofing systems replacing conventional roof buildings.
    - Assist with decreasing stormwater runoff, reduce pollutants and erosion and preserve fish habitat.[103]
    - Increase habitat for birds and insects and provide much needed greenspace for urban dwellers.

Setting sun in Portland

[102] Backyard Habitat Certification Program. Portland Audubon, July 23, 2019. https://audubonportland.org/get-involved/backyard-habitat-certification-program/.
[103] "Portland Ecoroofs". Portland Ecoroofs RSS. Accessed December 9, 2020. https://www.portlandoregon.gov/bes/44422.

WASTE & WATER

In cities, safe drinking water and waste management are intertwined. Cities that efficiently manage their sewage systems, rain overflow facilities, waste management and water transportation systems are able to keep residents safe and healthy. Drastic changes need to occur globally in the way municipalities deal with waste, recycling and water conversation if a greener standard is to be achieved. For example, Hamilton has recently come under fire for its disastrous waste and flood water management system. In February of 2020, with the assistance of a private consulting group, the city decided against any form of clean up operation for the 24 billion-litre sewage leak into the Chedoke Creek, which flows through a number of residential areas. Furthermore, Hamilton's current rain water and flood prevention systems are already insufficient for current rainfall levels, and will become obsolete as annual rainfall levels rise with global warming. This lack of accountability is indicative of the lack of commitment by the City of Hamilton to ensure the safety of Hamiltonians through the preservation of our waterways. We decided changes needed to be made, so we looked around the world at cities who have had greater success in water preservation, and in some cases have brought their aquatic ecosystems back from the brink of destruction. The Haudenosaunnee people of the Great Lakes know the value of water. One of their addresses to nature states "We give thanks to all the Waters of the world for quenching our thirst and providing us with strength. Water is life."[104] Maybe the keys to a better relation with water have been in North America for thousands of years?

[104] Joyce King "The Value of Water and the Meaning of Water Law for the Native Americans Known as the Haudenosaunee", Cornell Journal of Law and Public Policy, 2017 https://scholarship.law.cornell.edu/cgi/viewcontent.cgi?article=1114&context=cjlpp.

Montreal:

Water:

- **Green Infrastructure Stream of the Investing in Canada Plan (2020)**
    - The Government of Canada and Quebec are both investing 19.3$ million each to upgrade municipal drinking water, storm water management and wastewater collection systems across the province and Montreal. This is both a form of economic stimulus, environmental protection and a much needed infrastructure upgrade for a city like Montreal which has been plagued with leaky pipes and lead contamination.[105]

Waste:

Waste GHG emissions down 78% between 1990 and 2014. The goal is to recycle 70 percent of recyclable materials.[106]

Green Labs Initiative:

- Working with McGill's labs to increase their sustainability. Started by students who were concerned about the university's recycling policies. Greenlabs uses initiatives like glove recycling, lab equipment sharing programs and intensive data collection to help McGill make more environmentally sustainable choices

Barcelona:

- **Municipal waste fee** for homeowners
    - Fee is dependent on the amount of waste produced.
    - Incenvitizes production of less waste.

- **Automated Waste Collection**: Public pneumatic waste system[107]
    - An automated vacuum sucks waste thrown into public garbage/recycling bins around the city to a central collection point via underground pipes.
    - Available for use any time of day.
    - Pick-up from a centralized point reduces emissions.
    - Reduces odour and pests, encourages walking/cycling.

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[105] GovernmentOrganization, and Government of Canada. "Canada and Quebec Invest in Water Infrastructure to Ensure Adequate Services and Stimulate the Economy in t..." Canada.ca. Government of Canada, September 15, 2020. https://www.canada.ca/en/office-infrastructure/news/2020/09/canada-and-quebec-invest-in-water-infrastructure-to-ensure-adequate-services-and-stimulate-the-economy-in-the-centre-du-quebec-region.html.

[106] Progress Report on Montréal's 2013-2020 Citywide Greenhouse Gas Emissions Reduction Plan, Montreal: montreal, 2018, http://ville.montreal.qc.ca/pls/portal/docs/PAGE/ENVIRO_FR/MEDIA/DOCUMENTS/PROGRESSREPORTCITYWIDEPLAN2013-2020.PDF.

[107] "Pneumatic collection,", Agencia de Residus de Catalunya, September 9th, 2009, residus.gencat.cat/en/ambits_dactuacio/recollida_selectiva/models_de_recollida/segons_sistema_de_recollida/recollida_pneumatica/.

- **Bon Pastor Mobile Waste Collection**
    - Rotations of temporary waste bins throughout the week, set up and taken down at night.
    - Installed in tighter spaces where installation of pneumatic waste systems is not possible.
    - Can be set up in strategic locations to maximize accessibility.
    - Highly successful at increasing waste sorting.
    - Fleet that picks waste up is electric.[108]

Copenhagen:

- Has a sewage system that is centrally managed through an IT system that is able to control and monitor the sewage system.
- The city sends less than 2% of its waste to landfill.
- Approximately 45% of the waste is recycled and maximum use is made of the residual waste to generate heat for the city's district heating network.
- The City of Copenhagen's new resource and waste plan **"Circular Copenhagen 2019-2024"**, aims to recycle 70 per cent of the city's waste.
- At a household level, paper, glass, batteries, plastic, metal, electronics, gardening waste, bulky waste and residual waste are collected separately, making source separation an easy choice for the public. The recyclable materials are treated at dedicated facilities turning the materials into recyclable resources.

- **Sludge incineration plant** at Lynneten:
    - With this project the process of disposal of sludge has been turned from an energy consuming to an energy producing process. There is much **more surplus heat available to the district heating system** and there is a lot of **biogas** available.

[108] "Selective waste collection improves in Bon Pastor," InfoBarcelona, august https://www.barcelona.cat/infobarcelona/en/tema/environment-and-sustainability/selective-waste-collection-improves-in-bon-pastor_848623.html.

- **CopenHill**[109]
    - Furnaces, steam and turbines convert over 440,000 tons of annual waste into enough clean energy to deliver electricity and heating for 150 000 homes.

Copenhill, Copenhagen (Photo Credit: **BIG-BJARKE INGELS GROUP**[110]**)**

Stockholm:

- **Henriksdal wastewater treatment plant** is one of the largest in Europe. Serves 800,000 people.[111]
    - Processes 3.5 cubic meters of waste water per second.[112]
    - Currently being upgraded 2017-2022 with a polymeric membrane.
    - Will allow pharmaceuticals and other harmful solvents to be filtered out of the water supply.
    - The membranes have a pore size of 40 nanometers, this filters out all harmful substances, including microplastics.
    - Biogases from the plant are then used to fuel Stockholm's busses.

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[109] "Waste-to-Energy CHP - Amager Bakke Copenhagen." State of Green, August 12, 2019. https://stateofgreen.com/en/partners/ramboll/solutions/waste-to-energy-chp-amager-bakke-copenhagen/.
[110] Big-Bjarke Ingels Group, https://big.dk/
[111] The City of Stockholm's Environmental Work, Stockholm STAD: Stockholm, http://miljobarometern.stockholm.se/content/docs/tema/Environmental-Work-Stockholm-2017.pdf.
[112] "Henriksdal wastewater treatment plant, The Mbr Site, January 15th, 2019, https://www.thembrsite.com/directories/case-studies/henriksdal-wastewater-treatment-plant/

- Aiming for 70% food waste recycle rate.[113]
- 500 kg of waste thrown away per capita.[114]
- 230 000 tonnes of waste a year - this has stayed constant for the last 10 years.[115]
- Overall objective: Less than 250 kg food and residual waste per person and year by the end of 2020.

- **Riddarfjärden clean up**[116]
  - City worked tirelessly to clean up Riddarfjärden, a central bay in Stockholm.
  - Was known as the dirt ditch in the 1940's and 1950's.
  - Due to the cleanup efforts, residents can now bathe and swim in any of Stockholm's waterways, with the city having 31 official bathing spots.

Edmonton:

- **Biweekly garbage collection** to promote less non-divertible garbage in landfill and achieve 90% waste diversion[117]
  - Program in its pilot, but very successful in Waterloo, where green bin use has increased by 150% since starting biweekly garbage collection in 2017.

Calgary:

- Flood resilience projects in wake of 2005 and 2013 floods:
  - Ongoing restoration of riparian areas through **riverbed renaturalization** and **bio-engineered reinforcements/floodwalls**[118]
  - Upstream mitigation: 2 planned reservoirs on the Bow and Elbow rivers (provincial projects) to reduce flood risk by 80% on Elbow River[119]
  - Constructed higher Glenmore Dam gates to manage a 2005-size flood
  - Community-level flood protection on the Bow River: e.g. planned **Downtown Flood Barrier** (flood wall and berms will be incorporated into placemaking elements) to prevent a 1:200 year flood event
  - Other community-level flood protection:
    - Stormwater improvements (e.g. outfalls, increasing wastewater treatment capacity)

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[113] "Stockholm." CNCA. Accessed December 9, 2020. https://carbonneutralcities.org/cities/stockholm/.
[114] https://www.stockholmvattenochavfall.se/globalassets/pdf1/riktlinjer/avfall/avfallsplan/sva072-avfallsplan_en.pdf
[115] Waste Management Plan for Stockholm 2017-2020 Stockholm Vatten och Avfaill: Stockholm, 2017, https://www.stockholmvattenochavfall.se/globalassets/pdf1/riktlinjer/avfall/avfallsplan/sva072-avfallsplan_en.pdf.
[116] The City of Stockholm's Environmental Work, Stockholm STAD: Stockholm, http://miljobarometern.stockholm.se/content/docs/tema/Environmental-Work-Stockholm-2017.pdf.
[117] Hamdi Issawi, "Edmonton picks 13 neighbourhoods to try out new garbage collection system," Toronto Star, March 5th, 2019, https://www.thestar.com/edmonton/2019/03/05/edmonton-picks-13-neighbourhoods-to-try-out-new-garbage-collection-system.html
[118] "Riparian areas in Calgary", Calgary.ca, 2018, https://www.calgary.ca/uep/water/watersheds-and-rivers/riparian-areas.html.
[119] "Calgary's Flood Resilience Plan," Calgary.ca, https://www.calgary.ca/uep/water/flood-info/mitigation-and-resilience/flood-projects.html.

        - Storm Lift stations
        - Gravel bar removals
        - Bridge improvements
    - Property-level/policy:
        - Changes to Land Use Bylaw to regulate development on floodplains
            - Considering restrictions to land use/occupancy on the floodplain (e.g. schools, hospital

EDUCATION & ENGAGEMENT

When making decisions that affect stakeholders, strategic and thorough public engagement between all levels of government and stakeholders is required to ensure that democratic principles are upheld and citizens' needs are met. As climate change affects everyone, with most marginalized populations made most vulnerable, everybody has a right to education and to have their voice heard. Being able to effectively educate citizens on what it means to be sustainable is a key step in having a more eco friendly city. Furthermore, having "champions" in city councils is also a key tool for enacting positive legislative and municipal changes. Without having support in the governing body of a city, it can be quite difficult to create effective change within a city.

Vancouver:

- **Talk Green to Us Campaign**[120]
    - This campaign was launched during the development phase of the City's Greenest City Action Plan in June 2010.
    - Through an online forum, more than 3000 users submitted and ranked over 700 ideas on how Vancouver could meet its 2020 greenest city targets.
    - Working groups that consisted of city staff, and external advisors then developed these idea submissions into draft strategies and actions.
- **ZEBx**[121]
    - In 2016, the City released its Zero Emissions Building Plan, that requires most new buildings to be near zero emissions by 2025, and all new buildings to be zero emissions by 2025.
    - In 2017, the province of British Columbia released the BC Energy Step Code, which creates the path for all new buildings in the province to be net zero ready by 2032.
    - ZEBx is an organization that was created to help industry through this transition. It works with a variety of partners, which include industry associations, governments, researchers, trades programs, suppliers, and global experts. It's aim is to accelerate knowledge, capacity, and passion for zero emissions buildings in Vancouver and British Columbia.

[120]"Vancouver: Greenest City 2020," British Columbia Sustainable Energy Association, https://www.bcsea.org/blog/olive-dempsey/2010/11/18/vancouver-greenest-city-2020.
[121] "The Zero Emissions Building Exchange," ZEBx, https://zebx.org/.

A QUICK GLANCE AT KEY RECOMMENDATIONS FOR THE CITY OF HAMILTON

This infographic provides a short summary of some of the key recommendations made in this report. More in-depth recommendations are outlined in the next section.

8.0 Recommendations for the City of Hamilton Based on Best Practices

RECOMMENDATIONS FOR THE CITY OF HAMILTON

Based on Best Practices

The following is a list of recommendations informed by the best practices we found in our research and through our podcast interviews.

GHGs, Infrastructure, & Land Use - *20 Total Recommendations*

GHGs

a) *Recommendation 1:* Foster relationships with industries, private companies, and research institutions to develop and implement new energy efficiency technologies, particularly for the industrial sector.
b) *Recommendation 2:* Investigate opportunities for switching to a district heating and cooling system (e.g. Copenhagen, Stockholm).
c) *Recommendation 3:* Adopt a consumption-based emissions inventory.
    i) Emissions created in the production and shipment of goods manufactured outside of Hamilton, should be included in the City's monitoring of scope 3 emissions, if the goods are used by Hamiltonians (e.g. in Portland and Calgary).
d) *Recommendation 4:* Participate in and promote the Government of Ontario's Carbon Offset Program to Hamilton businesses.
e) *Recommendation 5:* Offer ships a discount on sustainable methods of fuel when they enter the bay. This reduces the pollution they emit while in Hamilton, and other cities on the lake (e.g. Montreal).
f) *Recommendation 6:* Set a date for the city to be fossil fuel free and create a fossil fuel ban (e.g. Stockholm, Portland).

LOW EMISSIONS & ENERGY EFFICIENT BUILDINGS

a) *Recommendation 7:* Adopting strict standards for energy efficiency (e.g. Passive House).
b) *Recommendation 8:* Set a target for net-zero emissions for all new buildings.
c) *Recommendation 9:* Retrofitting all old buildings for net-zero emissions.
d) Recommendation 10: Use of Distributed Energy Systems in all buildings
    i) Through using sensors, actuators, and meters, the system can monitor and manage the building's performance. Not only can the system control the building's heating, cooling,

lighting, but it can also provide suggestions for improvements to save costs and improve reliability. [122]

e) *Recommendation 11:* Limit buildings' embodied emissions through focusing on the sustainable use and transport of building materials (e.g. Vancouver)
f) *Recommendation 12:* for residential buildings promote the home energy retrofit grant program from the Federation of Canadian Municipalities.[123]
g) *Recommendation 13*: Implement a centralized building monitoring system'
h) Recommendation 14: Continue building residential/ commercial sites with sustainable purpose such as Pier 8 (e.g. Stockholm)
i) *Recommendation 15:* Legally require all new developments and retrofits to have solar water heaters
    i) Inspired by Barcelona Environment Ordinance's (mandatory solar water heating in all new developments and renovations)
j) *Recommendation 16:* Centralized district heating and cooling systems for greater energy efficiency
    i) District cooling system: use water from Lake Ontario for cooling
    ii) Can connect this into water purification system to also get warm water

[122]Matthews, Kayla. "The 7 Most Popular Green Building Practices in 2020." Green Building Insider, April 29, 2019. https://greenbuildinginsider.com/387/7-most-popular-green-building-practices.

[123] "Community Efficiency Financing," Federation of Canadian Municipalities, https://fcm.ca/en/programs/green-municipal-fund/community-efficiency-financing.

LAND USE

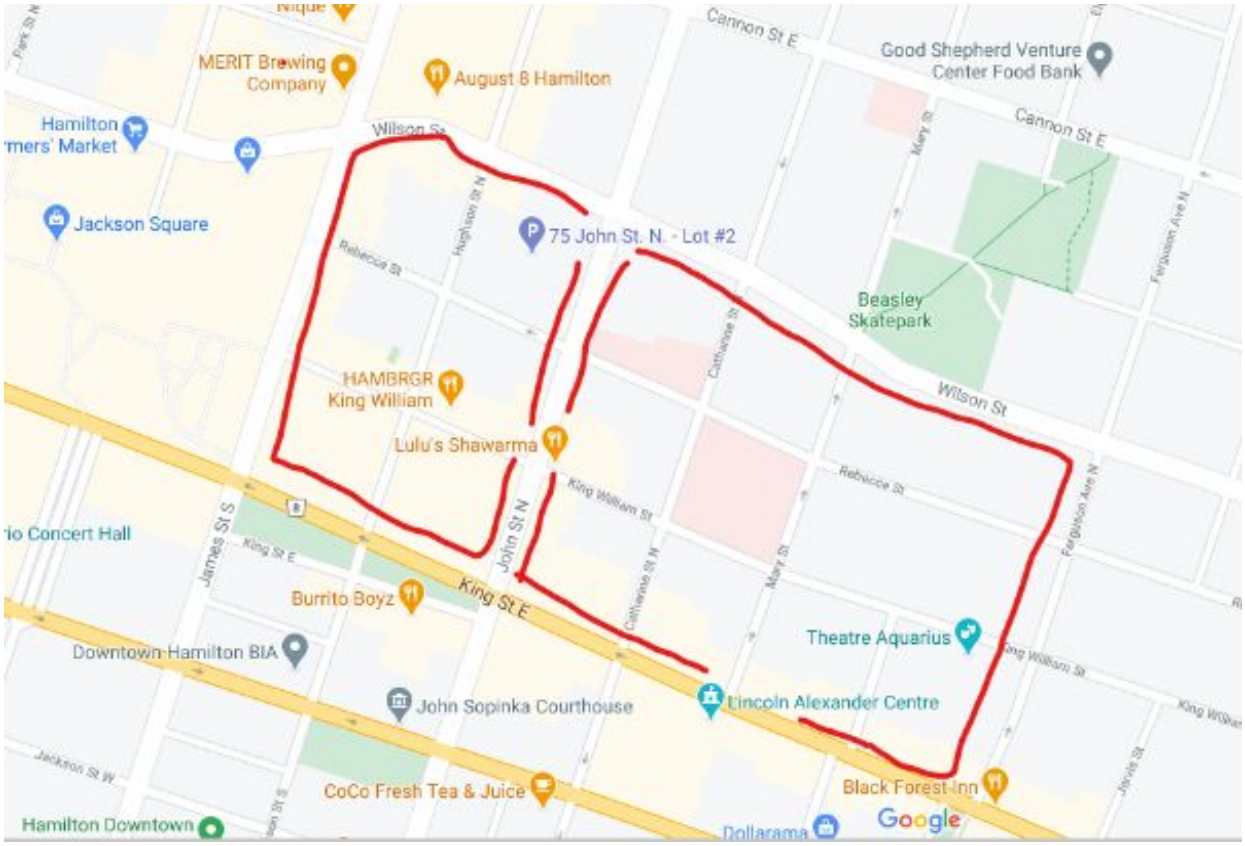
a) *Recommendation 17:* Commit to a hard urban boundary to prevent urban sprawl into valuable agricultural land.[124]

b) *Recommendation 18:* Work with landowners and the city to broker deals to buy vacant lots. Lots can be used for community gardens and public parks. (inspired by Montreal's *Lande*)

c) *Recommendation 19:* Establish a Low Emissions Zone in the downtown core to prevent high emissions vehicles (e.g. trucks) from entering during the certain hours of the day. Energy certification is required for entry. (inspired by Barcelona's Rondes Low Emissions Zone)

d) *Recommendation 20:* Create a Hamilton Superblock (inspired by Barcelona). Restrict non-essential traffic flow on inner streets and reduce speed limits within restricted blocks to 10 km/h.

i) A great pilot project could be undertaken next to Jackson Square.



[124] Beatrice Ekoko, Hosts, "Conversation with Environment Hamilton," Resilient Cities, Wednesday December 3rd, 2020

SUSTAINABLE AND ALTERNATIVE TRANSPORTATION - *21 Total Recommendations*

SUSTAINABLE TRANSPORTATION

a) *Recommendation 1:* Transitioning all city buses to generate zero emissions through the use of battery electric buses (BEB) and fuel cell electric buses (FCEB).
   i) Apply for the Government of Canada's **Zero Emission Vehicle Infrastructure Program** to secure funding.

b) *Recommendation 2:* Transition to zero-emission buses (ZEB) must employ a system-oriented approach. There must be investment into all ZEB assets including buses, fuelling system(s), energy storage devices, chargers, smart-charging software and controls systems, real-time data collection tools, and redesigned garage facilities.
   i) A systems-wide approach will encourage other corporations, and general public to switch over to zero-emission vehicles (ZEV) because ZEV infrastructure (charging stations, energy storage devices etc. will already be in place)
   ii) Real-time data collection tools, and information sharing mechanisms across municipalities are key to evidence-based decision making both locally, and nationally

c) *Recommendation 3:* As charging is a significant barrier to personal electric vehicle use, building a network of EV charging stations in the city will encourage a transition to EVS.

d) *Recommendation 4*: Promote and incentivize switching to ZEV's for all City vehicles, and other corporate vehicles.

e) *Recommendation 5:* Promote and incentivize switch to battery electric vehicles (BEVs), and hydrogen fuel cell electric vehicles (HFCEVs) for cars, and light-duty trucks

f) *Recommendation 6:* Build a robust utility relationship to ensure sustainable electrification initiatives. (Example: Vancouver, BC Hydro)

g) *Recommendation 7:* Issue parking permits in the City (especially in the downtown area) to limit the number of cars entering.

h) *Recommendation 8:* Test viability of biofuel busses, using waste from water treatment plants - (e.g. Stockholm)

ALTERNATIVE TRANSPORTATION (e.g. walking, biking)

a) *Recommendation 9:* Encourage a shift away from car culture through promoting biking and walking as active and alternative modes of transportation
    i) Examples: Smart Commute (already in place in Hamilton)
b) *Recommendation 10:* Create a continuous cycling network within and around Hamilton, with a focus on connecting disjointed segments. Connect and expand on existing bike lanes and routes both within the city and create connections between neighbourhoods, as well as between Hamilton and neighbouring regions (e.g. Burlington)
    i) Inspired by Calgary's Cycle Track Network, which contributed to an 3.7% increase in cycling/walking in 3 years.
c) *Recommendation 11:* Work with newly arriving immigrants, especially women, to increase comfort with biking and accessibility to increase their independence and community involvement (e.g. Montreal)
d) *Recommendation 12:* Where connections do not currently exist between biking infrastructure, install temporary wayfinding signage directing cyclists to another cycling connection or destination.[125] Examples include route markers and pavement markings.
e) *Recommendation 13:* When designing new biking infrastructure, prioritize accessibility
    i) Inspired by Calgary's 5A Network Guiding Principles
f) *Recommendation 14:* All new bike lanes should be buffered wherever possible, with one bike lane (one going in each direction) on either side of the road. This is the safest and most intuitive way to construct biking infrastructure.
    i) Inspired by Copenhagen
g) *Recommendation 15:* Existing bike lanes that are not currently buffered should be buffered.
h) *Recommendation 16:* Attempt a "I stan utan min bil" or "in town without my car" day where no cars are permitted in the downtown commercial areas such as James street and Lock Street. (e.g.Stockholm)[126]
i) *Recommendation 17:* To create a more connected transit system that does not rely on driving to transit stops, invest in additional biking facilities (i.e. bike parking, air pumps, bike share etc.) at bus stops and stations.[127]
    i) Inspired by Calgary's Cycling Strategy
j) *Recommendation 18:* Implement green waves into new and existing bike lanes and routes.

[125] "Municipal Development Plan and Calgary Transportation Plan 2018 Monitoring Progress Report," Calgary, https://www.calgary.ca/pda/pd/municipal-development-plan/municipal-development-plan-and-calgary-transportation-plan-2018-monitoring-progress-report.html.
[126] "Swedish capital goes car free for the first time". Accessed December 9, 2020. htt ps://www.thelocal.se/20150918/swedish-capital-goes-car-free-for-first-time.l-goes-car-free-for-first-time.
[127] "Calgary Cycling Strategy," Calgary," https://www.calgary.ca/transportation/tp/cycling/cycling-strategy/cycling-strategy.html.

    i) A green wave occurs when a series of traffic lights are coordinated to allow continuous traffic flow over several intersections in one main direction.
    ii) Green waves prevent bike rush hours, and allow for a more pleasant and safe biking experience

k) *Recommendation 19:* Partner with Lime or Bird to pilot an electric scooter program. Electric scooters are convenient to rent; they can be parked and picked up anywhere with the help of a tracking ad similar to Uber, without the need for designated scooter parking areas. A city-wide electric scooter program can help reduce the number of short trips taken in vehicles and improve emissions.
    i) Inspired by Calgary's Electric Scooter Share Pilot

l) *Recommendation 20:* Implement a grant program to promote walking and playing on streets via community-led revitalization of underused walkways, traffic calming initiatives, and reclaiming of street space. This grant would be similar to Hamilton's existing Clean and Green Neighbourhood Grant.
    i) Inspired by Calgary's Activate YYC microgrant program (an action proposed in Calgary's Pedestrian Strategy)

m) *Recommendation 21:* Designate officially recognized Pedestrian Priority Areas next to schools, hospitals, libraries, and community centres. Investigate redesigning streets in these areas to prioritize pedestrians and cyclists. Pilot this program at Dr. J.E. Davey Elementary School, in Beasley; this is a priority area due to unsafe road conditions.[128]
    i) Inspired by Barcelona's pedestrian/cyclist priority Green Axes

[128] Justin Chandler, "Walking the walk: Making the trip to school safe for kids", TVO, September 24th, 2020, https://www.tvo.org/article/walking-the-walk-making-the-trip-to-school-safe-for-kids,

NATURAL ENVIRONMENT - *7 Total Recommendations*

a) *Recommendation 1:* Put pressure on the provincial government to appeal schedule 6 in the amendment to Bill 229. Schedule 6 poses a serious threat to the power of conservation authorities to protect natural spaces from development, particularly the very watersheds that Hamiltonians have worked so hard to protect. The City should be highly concerned about this bill. If the City is at all interested in maintaining the health of Cootes Paradise, Hamilton's watersheds, and the City's partnerships with conservation authorities, it is imperative to stand in solidarity and fight for schedule 6 to be appealed.[129]

LOW IMPACT DEVELOPMENT: GREEN INFRASTRUCTURE FOR FLOOD MITIGATION

a) *Recommendation 2:* Convert unused parking lots into modern green spaces to prioritize people over cars. Incorporate low-impact development green infrastructure that is beneficial for stormwater management such as, permeable pavements, storm ponds, rain gardens, bioswales etc.

URBAN FARMS

a) *Recommendation 3:* Convert vacant industrial land into a large urban farm in the heart of the city accessible to everyone. This can be achieved through soil restoration, volunteer-driven farming, and educational programming to teach residents about the importance of eating healthy and local.
    i) Inspired by Hamilton's own McQuesten Urban Farm & Calgary's Highfield Farm

b) *Recommendation 4:* Create a guidebook for members of the public looking to start their own urban farm on City-owned grassy boulevards adjacent to residential housing.
    i) Inspired by Calgary's Residential Boulevard Garden Guidelines.

c) *Recommendation 5:* Create and make visible a reporting system for urban farmers seeking city approval to set up pop-up food markets on City-owned property.
    i) Inspired by Calgary

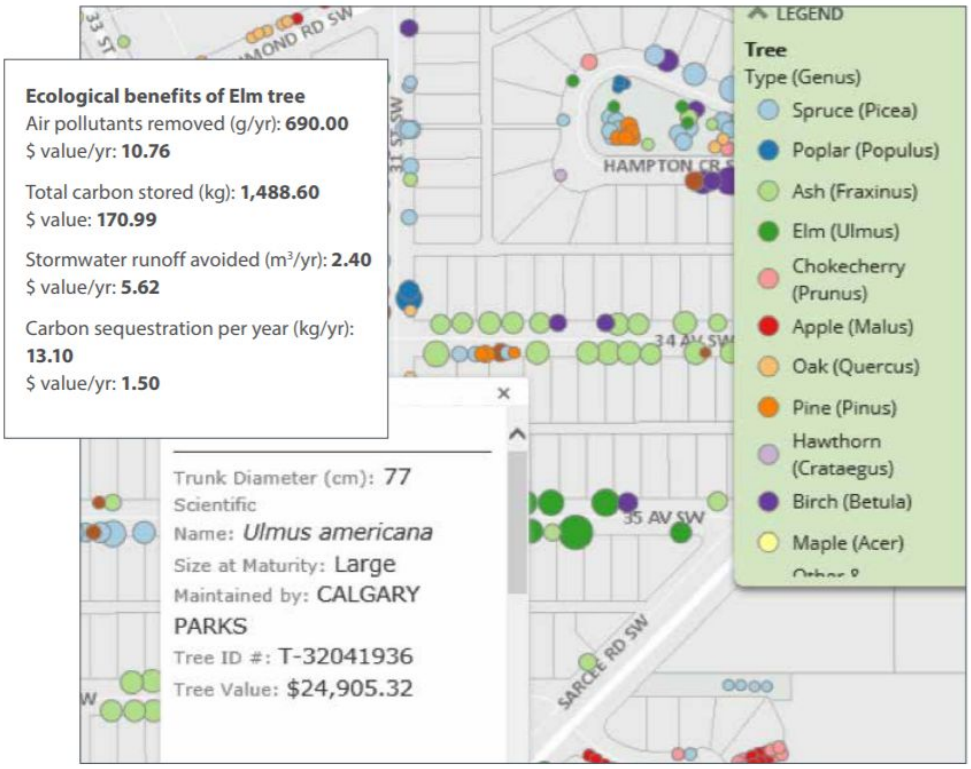
d) *Recommendation 6:* Create a vacant land reappropriation group to work with landowners and communities to create urban farms from vacant lots
    i) Inspired by Lande https://landemtl.com/

[129] "Province refuses to kill controversial legislation in wake of Greenbelt Council resignations," CBC, December 7th, 2020, https://www.cbc.ca/news/canada/toronto/ontario-greenbelt-latest-1.5830891.

URBAN FOREST

a) *Recommendation 7:* Create an interactive online map to monitor the health of urban trees, show pruning/planting information, and display their ecological value. This tool will help coordinate and communicate management services both internally and with property owners. It may also serve as an educational resource for the public.

   i) Inspired by Calgary's Urban Forest Management Map



WASTE AND WATER - *17 Total Recommendations*

WASTE MANAGEMENT

a) *Recommendation 1:* Invest more in waste management plants that turn waste into energy
b) Recommendation 2: Work with Hamilton Health Sciences and McMaster University to set up a Green Labs initiative to increase recycling and reduce lab waste. (e.g. Montreal)
c) *Recommendation 3:* Pay-as-you-throw program (e.g. Barcelona, to be considered in Calgary in 2021)
    i) Tracks garbage bin usage, rewards those that make less garbage
d) *Recommendation 4:* Implement a surcharge fee for incorrectly disposed materials in commercial loads that offload at City landfills. Each load should be inspected and an additional fee will be incurred for incorrectly disposed materials (recyclable, compostable, hazardous items)
    i) Inspired by: Vancouver's Disposal Ban Program, Calgary's Disposal Surcharge Materials Rate
e) *Recommendation 5:* Electrify the garbage fleet (e.g. Vancouver, Barcelona, Montreal, Calgary)

WASTEWATER MANAGEMENT

a) *Recommendation 6:* Use a central IT system to monitor and control the entire wastewater system in the city.
b) *Recommendation 7:* In new developments in regions served by Hamilton's combined sewer system, create infrastructure to treat wastewater separately from the existing combined sewage overflow system to avoid overflows. For example, create a localized water treatment facility for the new West Harbour district that does not connect to the existing municipal combined sewer system.
    i) Inspired by Hammarby Sjöstad
c) *Recommendation 8:* Implement a stormwater treatment fee proportional to a property's impermeable surfaces. This will help to fairly fund sewer upgrades and encourage property owners to install more permeable surfaces.
d) *Recommendation 9:* Investigate the feasibility of eventually separating the combined sewer system.
e) *Recommendation 10:* Create a polymeric membrane filtration system for a water treatment plant that is able to detect microplastics and other deadly contaminants from water. (Stockholm)
f) *Recommendation 11:* Store the bi-waste from the waste management process to make biofuel for public transit. (Stockholm)
g) *Recommendation 12:* Improve ease of acquiring a rain barrel. Partner with Green Venture's rain barrel programs to allow for year-round ordering from 31 (e.g. Calgary)

WATERSHED PROTECTION & FLOOD MITIGATION

a) *Recommendation 13:* Recreate a living shoreline. Install bioengineered structures along the waterfront (such as timber crib walls interspersed with living plants) to replace riprap and naturalize the shoreline. This will improve aquatic ecosystems and support biodiversity through habitat restoration, which may even bring aquatic life back into urban areas. Restoring or augmenting a developed/armoured shoreline (e.g. along the Harbourfront) with natural elements will also protect nearby infrastructure from flooding by allowing vegetation and soil to absorb excess water.
    i) Inspired by Calgary's Riparian Action Plan

b) *Recommendation 14:* To supplement bioengineered structures along the waterfront, create a seawall that blends seamlessly into placemaking structures/landscaping along the Waterfront trail, such as ledges for sitting or vegetated earthen berms. This seawall will prevent flooding further upland.
    i) Inspired by Calgary's proposed Downtown Flood Barrier & Eau Claire Promenade.

c) *Recommendation 15:* implement a *"Ba*ckyard Lakefront Garden" program to encourage lakeshore residents to re-naturalize segments of the waterfront on private property by planting native species. This program could involve the provision of grants and be used to educate Hamilton's most flood-vulnerable residents about flood protection.
    i) Inspired by Portland's Backyard Habitat Certification Program and Calgary's Riparian Action Plan

d) *Recommendation 16:* Renaturalize segments of Hamilton beach by planting trees and other native species to prevent flooding along Beach Boulevard.

e) *Recommendation 17:* Acquire parking lots throughout the city (e.g. Limeridge Mall, downtown core, Dundas) and convert lots into dry ponds as flood mitigation strategy (e.g. Calgary's storm ponds)

EDUCATION AND ENGAGEMENT - *6 Total Recommendations*

a) *Recommendation 1:* **Creation of an online green innovation hub**
   i) A place where anyone in the city, whether it be residents or business owners can submit their ideas for a more green, and sustainable Hamilton. All users of the site will be able to vote on initiatives, to showcase which ideas are the biggest priorities for Hamiltonians. City staff will monitor this idea hub, and mark ideas as "under review", "project started", or "project implemented". This will allow for accountability, and also allow residents to see whether their idea is being worked on by the City.
   ii) This online hub will not only be a place to share ideas, but to inform its users of sustainability projects in Hamilton. These projects will be showcased on a map.
   iii) To add, users of the site can learn and seek inspiration from sustainability work happening around the world.

b) *Recommendation 2:* **Annual Public Works' Sustainability Conference**
   i) This conference will act as a place of knowledge exchange where residents, and professionals can learn about sustainability initiatives happening around Canada, and the world.
      (1) Leading experts in various fields (energy efficiency standards, biking infrastructure, etc.) will be invited to hold workshops to share with City staff and industry leaders in Hamilton on how to implement new ideas to the city.

c) *Recommendation 3:* Continue to build **partnerships** with the private sector, non-profit organizations and other large public institutions (e.g. educational institutions, health institutions etc.).
   i) This will allow the city to build local capacity to carry out sustainability initiatives. In some cases, rather than starting from scratch, it is better to reinvent the wheel, and build from, and empower work that is already being done.

d) *Recommendation 4:* Develop a **heat island map** to be used by the City when building shading infrastructure, shelters, and social supports.
   i) Inspired by Edmonton's online interactive Heat Map

e) *Recommendation 5*: Develop an educational gardening program for homeowners looking to make their yard more eco-friendly. Eco-friendly yards with permeable surfaces, natural vegetation, and rain barrels will improve residents' understanding and appreciation of water conservation.
   i) Inspired by Calgary's YardSmart Program

f) *Recommendation 6:* Upgrade/develop a website for all sustainability and environmental projects done by the city and NPO so that eager citizens can get further involved (e.g. Stockholm).


9.0 Conclusion

CONCLUSION

This semester in CityLAB SIR (2020), the Climate Resiliency Team very much enjoyed working and learning together. With the support of Arlen Leeming, Dave Heidebrecht, and all our other CityLAB SIR friends, we have been able to conduct comprehensive research on sustainable cities around the world and infuse our own voices into a written set of recommendations for Public Works' Climate Resiliency Plan. Through working on this project, we had the opportunity to learn about the ingredients of a truly resilient city.

Climate change is a global challenge borne by all, so we must listen and learn from each other. Educational podcast sessions were conducted to learn more about successful climate change initiatives and engagement strategies in high sustainability cities to bring this information to the City of Hamilton.

A limitation of this project was the difficulty in securing interviews with experts from international cities. Instead of interviewing representatives from all eight cities, we were only able to conduct interviews with experts from our chosen Canadian cities; information from international cities was collected through literature review. Other limitations of this project include COVID-19 restrictions on in-person community engagement with Hamilton stakeholders and the time constraints on dialogue length with our busy interview guests. Through this, new connections were made between public works and experts from national cities, and a sense of collaboration was created to pave the way for a better, more sustainable world.

As our time with this project comes to an end, next steps for those taking it on after us involve further developing and maintaining the connections made with the national and international experts we have reached out to. We would like to invite them to future annual conferences held by Public Works, where they may be able to share their expertise with the Hamilton community and the City. Further information on next steps are provided in our transition report.

We look forward to seeing some of the measures proposed in this report implemented within the city to create a greener, more climate-resilient Hamilton.

"The future will be green, or not at all."

– Jonathon Porritt

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Appendices

Appendix A - Deliverables

Podcasts

These are the podcasts selected for evaluation purposes only. The remaining podcasts will be uploaded on the CityCAST podcast.

City of Edmonton - **Danielle Koleyak** (Environmental Project Manager)
- ➢ https://drive.google.com/file/d/17wOk9yzYJCynmhYdjmxhJjvPuZ654Zfa/view?usp=sharing

City of Vancouver - Doug Smith (Sustainability Director)
- ➢ https://drive.google.com/file/d/1-mLH8VSLIn8NEWL91BGetLHq6To3MvgV/view?usp=sharing

Environment Hamilton - Beatrice Ekoko (Project Manager, Friendly Streets, Lighthouse Project, Benchmarking Project, Pollinators Paradise Project)**, Deepak Palanichami** (Intern)
- ➢ https://drive.google.com/file/d/1iNBt5vW8XSTFFaqxnidhRJSL9V_jtcxr/view?usp=sharing

Online Sustainability Hub and Engagement Tool

The website prototype linked below presents research conducted throughout the project and act as an online sustainability hub where individuals can share their ideas and provide feedback on climate change initiatives.
- ➢ https://hchallen17.wixsite.com/citylabclimateres

Project Showcase: Infographic & Video

Multimedia summary pieces describing the project.

Video
- ➢ https://drive.google.com/file/d/1ezmmJQZNdwxs440G1BqPTvRYLfh1dPiI/view?usp=sharing

Infographic
- ➢ https://drive.google.com/file/d/1vVWe_mE7fVahlLskEw0Wy0QfHIKRfuVh/view?usp=sharing

Appendix B: Hamilton Podcast Summaries

Summary 1

Resilient Cities

Podcast Discussion: Hamilton CityLAB SIR Students & Bay Area Restoration Council (BARC)

When we spoke with Chris Mclaughlin from the BARC, he explained that his group is involved in a number of projects in Hamilton. Chris spoke about the challenges associated with being a NPO in Hamilton. He stressed that amount of time spent on trying to secure funding and the bureaucracy he faces. His group is currently working on the Hamilton Harbour Remedial Action Plan.

Furthermore, Chris works on (HHWSP) Hamilton Harbour Watershed Stewardship Project in collaboration with Hamilton Conservation Authority which was started in1994. This is the group's flagship project which helps with planting trees, plants, hedgerows and nativeflowers to protect against erosion and preserve the natural habitat. The project also promotes Wildlife Habitat Enhancements such as turtle nesting sites, improved fish habitat and management of invasive species. Furthermore, throughout this project, BARC works on Water Quality Improvements which includes fencing livestock out of streams, improving manure storage systems, controlling erosion, decommissioning abandoned water wells. Finally, the (HHWSP) is also involved in local education programs, working with students on increasingly environmental accountability through Stream of Dreams, while also working with landowners and farmers to improve their sustainability practices.

Through these projects, BARC has Contacted thousands of urban and rural landowners in HCA's watershed; providing them with information on their individual role to maintain the health of the watershed.Made verbal Stewardship Agreements with over 170 landowners to consider the effects of their land management practices on the health of the watershed. These Stewardship Agreements cover over 2,600 hectares of land. This includes over 80 kilometres of watercourses and over 1,500 hectares of natural area.

In spite of this success, BARC has also been facing a number of challenges and Chris stated there are still a number of issues in Hamilton his group is trying to address. For example, the Contaminated Sediment at Randle Reef from the nearby heavy industry remains a serious issue. A "blob" of coal tar was dumped in water before the 1960s and prior to pollution law, and it remains the most contaminated site in the Harbour, the worst Canadian site of its kind. This has led to BARC developing the **Randle Reef Remediation Plan. Chris faced** challenges in putting the plan together: funding, stakeholders/partners, construction company. Thankfully it resulted in a capped engineered containment facility (ECF) built at Hamilton Port Authority.

Looking forward, Chris is anticipating the following challenges: Pharmaceutical's, Invasive Species Land Redevelopment.

To conclude our conversation, we asked Chris what changes he would like to see made in the city to ensure that BARC can continue to be successful. He stated that he would like the city to support NPO more, and to give them more freedom/ money to make the changes that they have the experience in. Furthermore, he stated, somewhat tongue in cheek, that his group needs to have more funding and have better channels to secure funding from the city to continue to do the great work they do.

Summary 2

Resilient Cities

Podcast Discussion: Hamilton CityLAB SIR Students & North End Neighbourhood Association (NENA)

Our talk with Jon Davey followed a different, but none-the-less productive format to our previous conversation with Dave. NENA works to inform citizens of changes happening in the north end neighborhoods of Hamilton. Through several specific communities, such as Jon's environmental committee, NENA attempts to solve many of the issues that the north end is disproportionately affected by, such as climate change, industrial pollutants, and gentrification.

Jon and his environmental committee are focused on four main priorities: Emission reductions, greener buildings, transportation, and preserving green space. Firstly, the priority of NENA is to work with the major industries in downtown Hamilton - most notably the steel industry. The industry is very much "too big to fail" for the city's economy, but is also the cause of great human and environmental suffering for the area. Secondly, adding green elements to North End's buildings is also a priority for Jon's committee. Many buildings in the area are vestiges of the steel industry boom era which was fueled by the battlefields of The Second World War and led to investment from across the globe. These buildings, while beautiful, have not been kept up to date in terms of their sustainability infrastructure and practices. For Hamilton to become a more sustainable city, funding and programming will need to be allocated for a comprehensive retrofit to bring this up to standard. Furthermore, NENA works on persevering and increasing green spaces in the North End, which are key to fitness, safety, and mental health. Finally, Jon was adamant that the current transportation model and system in Hamilton was insufficient. According to Jon, the municipality needs to start investing in public transit, cycling networks. This needs to be done alongside neighborhood regions, rather than in opposition to them.

One of the projects the city is working on that NENA is keenly overtaking and collaborating with is the Pier 8 development on the Hamilton waterfront. The land in this area has been predominantly industrial for many years. The project is adding 1600 residential units, with a mix of market and subsidized prices. NENA has worked with the project developers to ensure that the development is done sustainability. According to Jon,

consultation is key throughout the process, and that whenever there is a development in the North End, it is key that the community benefits from it. In this case, groups like NENA help to ensure that the development would provide family units and affordable housing. Jon did have some complaints regarding the project, stating that it seems to be a car-centric design so far with no sidewalks, more space for cars. Furthermore, the building is planned to have 45-stories which limits sunlight and accessibility for the surrounding area. According to Jon, it will be quite difficult to manage traffic with the proposed signs.
Pier 8 is a key development for Hamilton as it is a model for many of the climate changes and challenges that Hamilton is facing. According to Jon, these issues include:

- Increasing water levels on the harbor
- Increased precipitation
- Algae blooms
- Increased water temperature
- Increased fertilizer run-off from farmlands
- Decreasing lake ice levels
- Flooding affecting sail clubs

Flooding was one of the major discussion points that NENA attempts to address. The city and neighborhoods will have to work together to manage stormwater and create/ increase an effective infrastructure to deal with the rising levels. Some examples that Jon mentioned include permeable surfaces, bioswales that are standard features that would be built into renovations of sweets/rebuild streets.

We asked Jon about his group's connections in the city. He responded that Environment Hamilton is a natural partner due to their constant and dedicated work in preserving Hamilton's natural resources and beauty. Furthermore, Jon felt that NENA has had a good working relationship with the city.

Hamilton’s North End is a very diverse and multilayered neighborhood, Jon, therefore, faces several challenging stakeholders when NENA attempts to engage with citizens on climate change based issues. Some of these challenging stakeholders include the steel industry which is still a major player in Hamilton's politics and decision-making. We spoke about how Sweden could prove to be an excellent example moving forward, as they have transitioned their steel industry to be more sustainable. Jon mentioned that changes can be made if the city prioritizes environmental sustainability. For example, ensuring that new buildings have fewer parking spaces and more bike racks will encourage residents and employees to take the sustainable option to work.

We also spoke about the role of equity in the North end and how that plays a role in environmental decisions in the North End. According to Jon, as fossil fuels become increasingly expensive, questions will be raised regarding who is allowed to use them. How do we make sure people have access to energy to live safely and happily. COVID-19 has also played a role in group projects. As projects like garbage cleanup have been impacted, leading to an adverse outcome for the environment.

Summary 3

Resilient Cities

Podcast Discussion: Hamilton CityLAB SIR Students & Environment Hamilton

On December 3rd we spoke with Beatrice Ekoko, Senior Project Manager at Environment Hamilton, and Deepak Planichami, a former CityLAB student who is currently doing an internship with the group. To begin our discussion, we asked our guests what the most pressing issues in Hamilton were at the present moment, what progress had been made? Beatrice stressed the importance of the fact that the pandemic is happening alongside the pandemic even though some groups have used it as an excuse for their slow response to climate issues. She went on to state that any climate action needs to be brought about alongside social justice, in other words, climate justice. This goes hand in hand with the inequality of climate change, which disproportionately affects indigenous and other marginalized peoples. She went as far as to say that " Ontario's role is the same as Alberta's tar sands" through Hamilton's constant expansion and consequential environmental destruction. Deepak added that his hometown of Brampton is home to many marginalized groups who lack access to proper food security, which is being addressed by a backyard gardening program.

We also spoke about the lack of effective climate infrastructure in the city. Most notably the stormwater management system. Elements such as parking lots need to be rethought and must begin pulling their weight when it comes to stormwater storage and management. This form of green construction needs to be implemented alongside green conservation areas to allow for increased environmental protections. Unfortunately, the opposite is currently underway as the Ford government is currently trying to undermine the protection powers of conservation authorities. Environment Hamilton is addressing this kind of issue by training people to use the environment bill of rights to push for change and be more civically engaged. This is key as there is currently a huge contradiction in Hamilton where we want to have an image as a proactive and forward-thinking city but in reality, the city is founded and funded on harmful policies such as harmful truck routes, allowing the business to continue polluting through unmonitored smokestacks. Beatrice hopes that the city can be focused on friendly streets with improved walkability and friendly streets to improve the quality of life.

We then asked how Environment Hamilton involves people and who they specifically target for their engagement strategies? They especially mentioned that Climate Ready Hamilton was a group that they had effectively engaged and collaborated with, which is a group that provides shelter to vulnerable citizens during extreme weather events.

We also discussed the role of belonging in developing effective climate change solutions. For citizens to feel like they have a say in climate outcomes, they need to feel like they belong and are accepted. Beatrice used the example of the Beasley Neighbourhood, in which they spoke with kids from the local elementary school to gauge how they felt about the community and the changes they felt they needed to feel safe.
Environment Hamilton is also very concerned about the rapid loss of biodiversity in Hamiton. We are living in global mass extinction and Hamilton is not safe from its effects. Biodiversity loss has to be looked at as both a product and a cause of climate change. EH (Environment Hamilton) is currently working on a pollinator project

to increase habitat, encourage residents, faith communities, and businesses to create pollinator-friendly spaces and habitats while also avoiding using harmful pesticides.

For EH, it is important to remember that they are a nonprofit organization rather than a charity because of their advocacy work through public funding and fundraising. They have therefore fought the city on several harmful environmental projects. They also work with advocates to draft letters and emails to show the city that their actions are unacceptable. This is not to say they are not respected by the city, they have valuable relations with all levels of city governments and are consulted on several projects. For example, they often speak with Janette Smith, city manager, about where the action plan needs to go. When asked what citizens can do, Beatrice responded that they have to demand more from their councillors, more money for more sustainable projects in the city and their communities. Stakeholders can also: Be prepared to delegate, talk to their councilors, start thinking ahead to elections while constantly remaining educated and involved.

Appendix C: Directory of Climate Plans & Strategies

CANADIAN CITIES

Calgary:

- ❏ Climate Resiliency Strategy
- ❏ Calgary Community GHG Reduction Plan
- ❏ Municipal Development Plan
- ❏ CalgaryTransportation Plan
- ❏ Electric Vehicle Strategy
- ❏ Cycling Strategy
- ❏ Pedestrian Strategy
- ❏ 30 by 30 Water Efficiency Plan
- ❏ Riparian Action Program
- ❏ Flood Resiliency Plan

Edmonton:

- ❏ Climate Resilient Edmonton: Adaptation Strategy and Action
- ❏ Edmonton's Community Energy Transition Strategy Plan

Montreal:

- ❏ Climate Change Adaptation Plan 2015-2020 Report

Vancouver:

- ❏ Climate Emergency Action Plan
- ❏ Greenest City Action Plan
- ❏ Zero Waste 2040
- ❏ Climate Change Adaptation Strategy
- ❏ Neighbourhood Energy Strategy
- ❏ Zero emissions buildings
- ❏ Transportation 2040 Plan

INTERNATIONAL CITIES

Portland:

- ❏ 2015 Climate Action Plan
- ❏ Climate Change Preparation Strategy
- ❏ Climate Action Through Equity

Stockholm:

- ❏ Stockholm Climate Action Plan for Climate and Energy 2010-2020

Copenhagen:

- ❏ CPH 2025 Climate Plan
- ❏ CPH 2025 Climate Plan - Roadmap 2021-2025
- ❏ Resource and Waste Management Plan 2024

Barcelona:

- ❏ Climate Plan 2018-2030
- ❏ Bicycle Strategy
- ❏ Zero Waste Strategy
- ❏ Barcelona Environment Ordinance
- ❏ The Energy, climate change and air quality plan of Barcelona
- ❏ Mobility Plan: Pacte per la Mobilitat Laboral

Appendix D: Technical Directory of External Organizations

These are organizations we came across in our research that may be helpful in informing the Public Works' Climate Resiliency Strategy. These organizations can be helpful contacts to reach out to in the future to lead workshops, and talks.

BEEP (Business Energy and Emissions Profile) is an online tool that provides data to businesses seeking to reduce their carbon footprint[130]

BEEx (Building Energy Exchange) aims to reduce climate change effects by improving the infrastructure of buildings and creating efficient solutions for sustainable buildings in New York City.[131]

Cycling Embassy of Denmark, established in 2009, is a network of individuals and organizations aimed to promote cycling and communicate cycling solutions.[132]

Canadian Urban Transit Association (CUTA), a member based association that supports public transit as the core of integrated mobility.

EnergyLAB Nordhavn, utilized Copenhagen's Nordhavn as a full-scale smart city energy lab and demonstrated how electricity and heating, energy-efficient buildings and electric transport can be integrated into an intelligent, flexible and optimized energy system .[133]

The International Association of Public Transport (UITP) - North American Branch, aims to promote and defend public transit and sustainable mobility solutions in the region, along with exchanging best practices and networking between UITP members.

ZEBx (Zero Emissions Building) is a platform created by the City of Vancouver that would assist with the transition of achieving a zero emissions building goal by 2032.[134]

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[130]"Data-Driven Insights for Community Carbon Reduction." Business Energy and Emission Profiles (BEEPs) : Climate Smart : Cut Costs, Cut Carbon. Accessed December 9, 2020. https://climatesmartbusiness.com/services/business-energy-and-emission-profile.
[131] Building Energy Exchange, December 8, 2020. https://be-exchange.org/.
[132]"Cycling All over the World." Cycling Embassy of Denmark. Accessed December 9, 2020. http://www.cycling-embassy.dk/.
[133] "Future Smart Solutions in the Metropolitan Area, Nordhavn." State of Green, July 22, 2019. https://stateofgreen.com/en/partners/energylab-nordhavn/solutions/energylab-develops-future-smart-energy-solutions-in-nordhavn/.
[134] ZEBx. Accessed December 9, 2020. https://zebx.org/about/.

Appendix E: Network Directory

The organizations and networks listed below may be helpful in facilitating networking opportunities, as well as securing grants, and other funding.

CUSP (Climate and Urban Systems Partnership) explores innovative ways to educate citizens about climate change concepts[135]

CUTRIC (Canadian Urban Transit Research & Innovation Consortium) is a nonprofit organization aimed to create solutions that would reduce emissions and improve the quality of transportation across Canada[136]

FCM (Federation of Canadian Municipalities) provides grants and funding for municipal environmental projects while also providing resources to solve challenges in communities[137]

[135] Climate & Urban Systems Partnership: About. Accessed December 9, 2020. http://www.cuspproject.org/about.
[136]"Federal Party Platforms in Focus. CUTRIC. Accessed December 9, 2020. https://cutric-crituc.org/about/.
[137] "Home: Federation of Canadian Municipalities." Home | Federation of Canadian Municipalities. Accessed December 9, 2020. https://fcm.ca/en.

Appendix F: Contact Information of Podcast Invitees (Hamilton)

Bay Area Restoration Council

- Chris McLaughlin (Executive Director)
    - cmclaughlin@hamiltonharbour.ca

Environment Hamilton

- Beatrice Ekoko (Senior Project Manager)
    - bekoko@environmenthamilton.org
- Deepak Palanichami (Intern and former CityLAB student)
    - dpalanichami@environmenthamilton.org

North End Neighborhood Association (NENA)

- Jon Davey (Environment and Climate change committee chair)
    - jon@criticalflicker.com

Appendix G: Contact Information of Podcast Invitees (External)

CANADIAN CITIES

Calgary:

Jill Curley (Corporate environmental specialist, Climate Change Adaptation)

- Focusing on emissions reduction piece of Calgary's Climate Program
- Jill.Curley@calgary.ca
- Responded - podcast guest

Heather Galbraith (Program lead for Resilience & Infrastructure Calgary)

- Focusing on the corporate side of the Resilient Calgary strategy
- Heather.Galbraith@calgary.ca
- Responded-podcast guest

Tanya Laing (Strategic advisor, Watershed Planning)

- Expertise on Calgary's Flood Resilience Plan
- Tanya.Laing@calgary.ca
- Responded - podcast guest

Edmonton:

Danielle Koleyak (Environmental Project Manager)

- Focused on climate change initiatives taking place in the City of Edmonton
- danielle.koleyak@edmonton.ca
- Responded - podcast guest

Montreal:

Jean-François Boisvert, president Montreal Climate Coalition / **Lydia Zemke**, vice-president

- https://coalitionclimatmtl.org/en/contact-us/
- Responded - No interview: invited to conference

Rozzy Roberts (Manager at The Green Labs Initiative)

- https://gliatneuro.github.io/about.html

- ❏ No interview: invited to conference

Vancouver:

Doug Smith (Director of Sustainability, City of Vancouver)

- ❏ doug.smith@vancouver.ca
- ❏ 604-829-4308
- ❏ Responded - podcast guest

Sean Pander (Manager, Green Building Programs, City of Vancouver)

- ❏ sean.pander@vancouver.ca
- ❏ 604-871-6542
- ❏ No response

INTERNATIONAL CITIES

Barcelona:

Neda Kostandinovic (Urban Planning, Division of Sustainability)

- ❏ Architect & urban planner
- ❏ Liaison for information about various sustainability projects
- ❏ Responded - No interview

Irma Ventayol Ceferino (Climate Plan Coordinator, Urban Ecology Sustainability Office)

- ❏ https://www.linkedin.com/in/irma-ventayol-521b357/?originalSubdomain=es
- ❏ Responded - No interview

Copenhagen:

Jørgen Abildgaard (Executive Climate Project Director, Municipality of Copenhagen)

- ❏ Jorgen.abildgaard@kk.dk
- ❏ No response

Kasper Brenøe Isbrand (Mobility Project Coordinator, Municipality of Copenhagen)

- ❏ ZR1B@kk.dk
- ❏ No response

Portland:

Andrea Durbin (Planning and Sustainability Director)

- ❏ andrea.durbin@portlandoregon.gov
- ❏ No response

Bob Sallinger (Director of Conversation for the Backyard Habitat Certification Program)

- ❏ bsallinger@audubonportland.org
- ❏ No response

Micah Meskel (Activist Program Manager for Backyard Habitat Certification Program)

- ❏ mmeskel@audubonportland.org
- ❏ No response

Stockholm:

Björn Hugosson (Head of Climate Unit for the City of Stockholm)

- ❏ bjorn.hugosson@stockholm.se
- ❏ Knowledge about Hammarby Sjöstad
- ❏ No response

Owen Gaffney (Director of international media and strategy, Stockholm resilience centre)

- ❏ owen.gaffney@su.se
- ❏ No response

Martin Skillbäck (City of Stockholm's development office)

- ❏ Project manager of Hammarby Sjöstad
- ❏ linkedin.com/in/martin-skillback-69656012
- ❏ No response