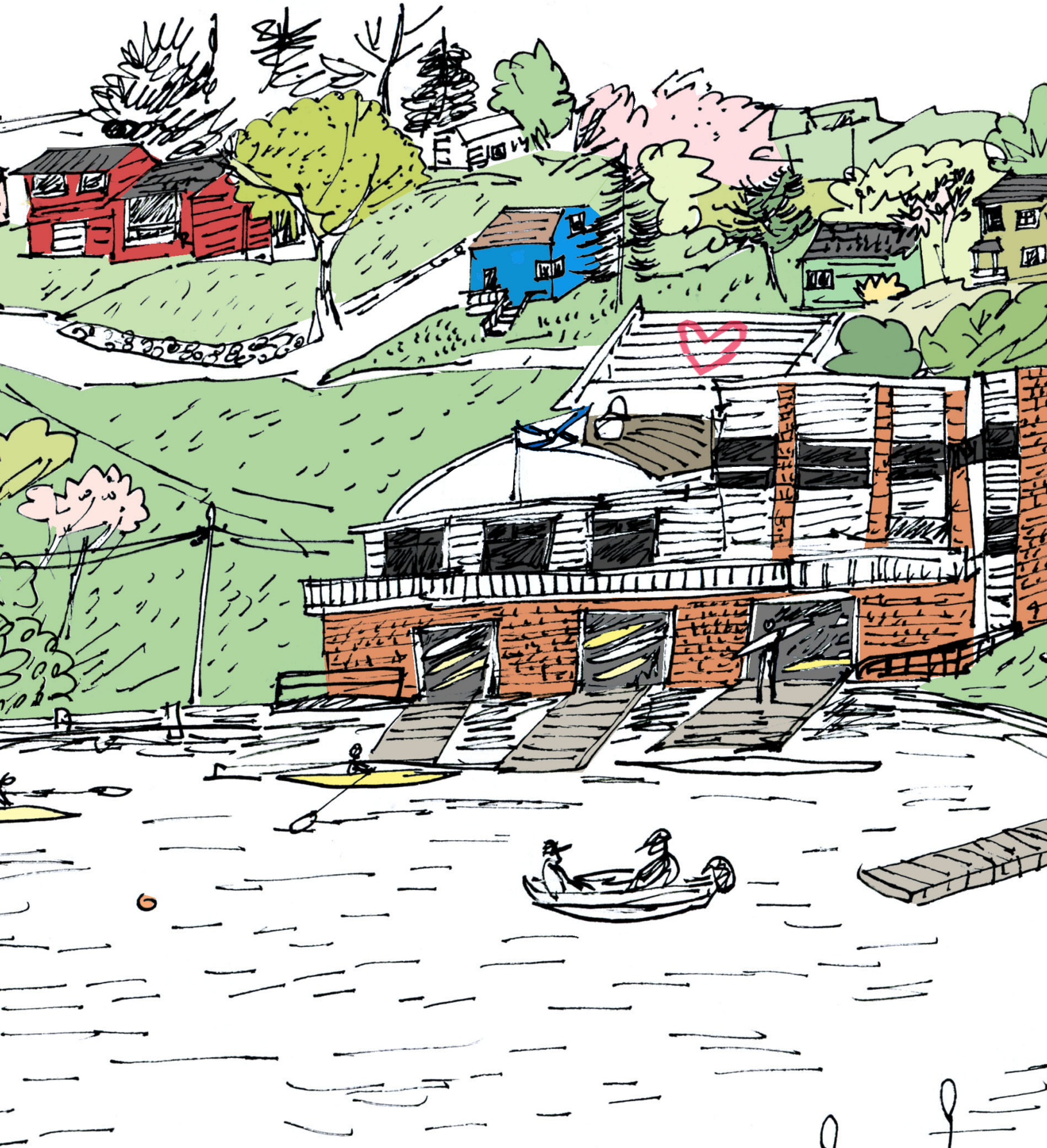
HalifACT

Acting on Climate Together



Acknowledgments

Land Acknowledgement

We would like to acknowledge that we are on the traditional and ancestral territory of the Mi'kmaq people, who are the original peoples. The Peace and Friendship treaties were signed between the British Crown and the Mi'kmaq between 1725 and 1769.

Halifax Regional Council adopted a Statement of Reconciliation[1] in 2015. Reconciliation requires ReconciliAction. We recognize the importance of meaningful consultation with our Mi'kmaq community, who has an unwavering commitment to environmental stewardship and future generations. We are all Treaty beneficiaries as Mi'kmaq and settlers alike and have shared roles and responsibilities to protect our lands and communities from the impacts of climate change.

Acknowledgements

On January 29, 2019, Halifax Regional Council declared a climate emergency, emphasizing that climate change is a serious and urgent threat to our community. The level of ambition in our community's new climate strategy, HalifACT 2050, was made possible by Council's recognition of the urgent need for action in response to the existing and predicted future threats of climate change. This plan was developed in collaboration with Sustainability Solutions Group (SSG), a consultancy specializing in climate change mitigation and adaptation modelling and planning.

More than 250 internal and external stakeholders from all levels of government, utilities, nonprofits and advocacy groups, academics and educators, industry, the Mi'kmaq, African Nova Scotian communities, Acadian groups, youth and more helped develop the plan. Stakeholder meetings were supported and facilitated by a community engagement consultancy, New Leaf Drawings throughout the plan by artist Emma Fitzgerald meld art with science and highlight the importance of place and community..

Key insights with respect to public opinion on climate change and community-level climate hazards and impacts were gained from in-person events and presentations throughout the municipality, as well as thousands of responses from online surveys and interactive mapping.

This work would not have been possible without the dedication and valued contributions of many municipal employees across the organization.

Thanks to all. May we approach the climate emergency with a hopeful, energetic and collaborative spirit, Acting on Climate Together.

[1] http://legacycontent.halifax.ca/council/agendasc/documents/151208ca1442.pdf

Mayor's Foreword

Halifax's climate is changing, posing risk to health, economic growth, safety, livelihoods and our natural world. These changes are caused by human action and will only be reversed by human action. We are feeling the impacts already, and there is no longer any doubt that urgent change is needed. This plan is a roadmap of Halifax's response to address the climate crisis, stimulate the economy, create new jobs, and build a more resilient and healthy future.

In 2019, Regional Council unanimously declared a climate emergency to convey our collective concern around climate change, as a call to action to reduce our emissions and prepare our communities. Today, we face two global challenges – the social and economic repercussions of the COVID-19 pandemic and the longer-term climate change crisis. There is no vaccine for climate change, the only solution is deliberate, meaningful action. We have an opportunity to rebuild from these challenges in strategic ways that will drive our economy more sustainably and help us be better equipped to tackle and prepare for climate change.

A deep reduction in greenhouse gas emissions requires transitions in the way we use energy, land and water, along with changes to our urban infrastructure (including transportation and buildings) and industrial systems. As you will see in this plan, there is a strong business case for taking action on climate change, and these transitions provide exciting opportunities to create new jobs, improve the built environment, stimulate innovation, and improve health outcomes. Importantly, many of the actions in this plan will result in social benefits and contribute to building stronger, more inclusive, equitable and vibrant communities.

HalifACT 2050 is our region's first comprehensive climate action plan addressing both mitigation and adaptation, and its success will depend on our collective efforts. The municipality is leading by example, implementing ambitious short and medium-term targets internally, but we cannot do it alone. We need all of you, our citizens and partners, to continue to come together on this issue. People can affect change, and they can choose alternatives that align with climate change efforts. Every small action matters, especially when we act together.

Significant effort and collaboration went into the creation of this report, and I want to thank everyone who played a role in shaping its development. I'm grateful for the outstanding work of HRM's Energy and Environment team, in particular the leadership of Shannon Miedema, as well as the vision shown by Regional Council in adopting this action plan.

We are at a pivotal moment in human history. I am proud that our municipality is leading the charge to act on climate change together and shape a better, more prosperous future for generations to come.

This is Halifax's time to lead on climate action. Let's get started.

Mike Savage

Mayor

Contents

List of Figures

List of Tables

THE
CHALLENGE

CHAPTER 1

E. Fitzgerald.

1. Responding to the Climate Emergency

Climate change is an urgent, complex and global crisis. Its long timeline, globally dispersed impacts, and the level of societal and systems change required make it challenging to rapidly transition to a low carbon future.

We are at a pivotal moment in human history. The next ten years will determine whether or not society can successfully address climate change. This report is Halifax's response to address the climate crisis, stimulate the economy, create new jobs, and build a more resilient future.

In 2018, the world's leading scientific body on climate change released a report titled Global Warming of 1.5°C. The report indicated that the risks of climate change can be substantially reduced by limiting warming to 1.5 degrees Celsius (°C) above pre-industrial levels.[2] If the world continues to emit its current level of greenhouse gases (GHGs), we will breach the limit of 1.5°C of warming in just ten years.

In 2019, Halifax declared a climate emergency, joining countries and major cities around the world, as well as nearly 500 Canadian municipalities. This plan is Halifax's response to that declaration[3].

HalifACT 2050: Acting on Climate Together is the Municipality's long-term action plan to reduce emissions and help communities adapt to a changing climate.

1.1 Halifax's Climate is Changing

Climate change risks health, economic growth, safety, livelihoods and the natural world. These impacts are being felt here at home.

Projections[4] indicate that Halifax will experience higher temperatures, more heat waves, more rain and snow and an increasing number of more severe storms, flooding events and wildfires. Extreme weather drives other climate hazards such as sea level rise, decreased snowpack and

[2] The remaining global carbon budget for having a 66% chance of limiting warming to 1.5°C is 420 $GtCO_2e$. Global annual GHG emissions are approximately 42 MtC20e. (Intergovernmental Panel on Climate Change (IPCC), 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.)

[3] The full technical report and other supporting documents for HalifACT 2050 can be accessed by visiting http://www.halifax.ca/climate or by contacting the Municipality.

[4] Climate Atlas of Canada, version 2 (July 10, 2019), using BCCAQv2 climate model data. https://climateatlas.ca/.

unpredictable runoff, and increases in invasive species and vector-borne diseases[5]. Figure 1 shows some of the projected changes Halifax can expect to experience between 2051 and 2080.

Change	1976-2005 Mean	2051-2080 Low	2051-2080 Mean	2051-2080 High
Typical hottest summer day	29.6 °C	30.7 °C	33.6 °C	36.6 °C
Typical coldest winter day	-21.3 °C	-18.8 °C	-14.6 °C	-10.7 °C
Number of +25 °C days per year	18	40	66	92
Number of +20 °C nights per year	0	1	10	27
Annual precipitation	1440 mm	1324 mm	1571 mm	1849 mm
Number of below-zero days per year	145	71	92	115
Frost-free season (days)	170	191	217	243

Figure 1. Projected climate changes for Halifax

Climate hazards pose risks for people, the built environment, natural systems and resources, economies, livelihoods, and safety. Examples of increased risks for Halifax include:

- damage to physical infrastructure such as buildings, roads, communications equipment, water and wastewater treatment plants;
- reduced water quality and quantity;
- stresses on agriculture and food systems;
- threats to biodiversity and ecosystem resilience;

[5] Vector-borne diseases are infections that are transmitted by the bite of infected insects or other arthropods, including mosquitos, ticks, and flies. Examples include Lyme disease and West Nile virus. Climate change expands the range of the vectors of disease and increases the likelihood of vectors surviving the winter.

- uncertainty for fisheries and forestry;
- physical adversity and mental health impacts;
- increased demands on emergency services;
- financial impacts on businesses and economies; and,
- diminished capacity of government to effectively provide public services.

1.2 Time is of the Essence

A deep reduction in greenhouse gas emissions requires transitions in energy, land, urban and infrastructure systems (including transport and buildings), and industrial systems. This transition provides an opportunity to create new businesses and new jobs, improve the built environment, stimulate innovation, and improve health outcomes.

In 2016, Halifax emitted approximately 5.8 $MtCO_2e$ (million tonnes of carbon dioxide equivalent).[6] Modelling results indicate that if no additional policies, actions or strategies to address energy and emissions are implemented other than those currently underway or planned, this total decreases to 3.9 $MtCO_2e$ by 2050. The decrease results from fuel efficiency standards in vehicles, planned decarbonization[7] of the provincial electricity grid, and reduced heating needs as the climate warms.

Halifax needs to reduce emissions to 1.4 $MtCO_2e$ by 2030 (75% by 2030 from 2016), and to net-zero $MtCO_2e$ by 2050 (100% by 2050 from 2016) to align with a 1.5°C pathway. Figure 2 shows the difference between Halifax's Business As Usual (BAU) scenario and the 1.5°C pathway from 2016 to 2050.

To better understand the scale of this undertaking, 1 Mt CO_2e is equivalent to the emissions from 216,000 cars driven for an entire year, or the emissions from driving around the world 99,650 times![8]

[6] There are many different greenhouse gases. In order to measure total emissions, we convert each gas that is not carbon dioxide into a calculation of carbon dioxide equivalent (in order to compare apples to apples instead of apples to oranges).

[7] The process to achieve zero fossil fuel existence. Typically refers to a reduction of the carbon emissions associated with electricity, industry and transport.

[8] United States Environmental Protection Agency, 2020. Greenhouse Gas Equivalences Calculator. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

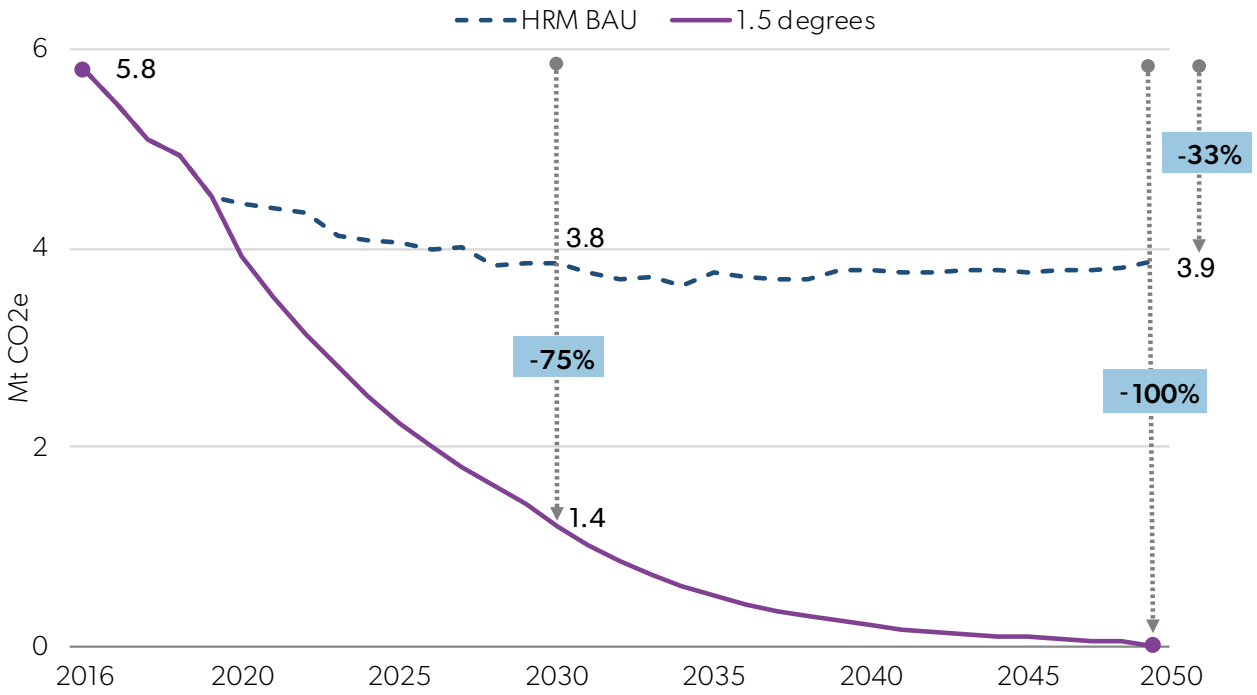


Figure 2. Halifax's 1.5°C pathway and carbon budget

1.3 The Carbon Budget - Every Tonne Counts

Every tonne of GHG emissions between now and 2050 counts. While GHG emission targets typically specify a level of annual emissions by some future target year (e.g. 30% below 2010 levels by 2030), it is the cumulative emissions over time that determine the degree of global warming that will take place. A carbon budget can be thought of like a bank account, with limited money that is spent over time. Using the carbon budget approach, it is the cumulative emissions between the present and the target year that are limited.

Carbon budgets can be calculated at various scales, from global to local. To be consistent with a 1.5°C pathway, the municipality's carbon budget is 37 $MtCO_2e$. The area under the purple curve represents the cumulative carbon emissions in the 1.5°C pathway. While the target of net-zero emissions[9] is important, Halifax must commit to a steep reduction pathway to limit total emissions over time and stay within the carbon budget. Under a BAU scenario, the municipality exceeds its carbon budget (the area under the 1.5°C curve) by 2028.

[9] Net-zero emissions refers to the end state where we reduce emissions as low as possible and then offset the remaining emissions using carbon capture techniques and purchased carbon offsets.

1.4 The Opportunity

1.4.1 HEALTHY VIBRANT COMMUNITIES

Responding to the climate emergency results in everyone benefiting from improvements in social, environmental, and economic factors critical for safe and connected, vibrant and healthy communities. Reducing GHG emissions and building resilience to climate impacts improves air quality, reduces noise pollution, provides space for recreation, physical activity and social interaction, and generally beautifies a city; the result is improved health and wellbeing of residents. Adapting to the changing climate will strengthen emergency preparedness and infrastructure resilience and enhance natural habitats and biodiversity. Many of these are no-regret measures that improve the quality of life in communities.

1.4.2 AN ECONOMIC OPPORTUNITY

HalifACT 2050 is as much an economic development plan as a climate action plan. Major investments will be required to decarbonize the building and transportation sectors and to generate clean electricity, amongst other actions. These investments will generate employment and stimulate new and existing businesses.

Based on the low carbon pathway modelled for Halifax, the first ten years of actions result in an annual average 9,000 person-years of employment. Table 1 shows the areas of this employment growth.

Table 1. Person-years of employment resulting from the low carbon pathway over ten years, 2020-2030

SECTOR	PERSON-YEARS OF EMPLOYMENT
Active transportation	597
Local renewable generation	32,763
Commercial vehicles	86
District energy	95
Non-residential buildings -- New	962
Non-residential buildings -- Retrofit	14,578
Non-residential equipment	238
Personal vehicles	2,517
Residential buildings -- New	596
Residential buildings -- Retrofit	33,111
Residential equipment	844
Transit infrastructure	3,746

1.4.3 A JUST TRANSITION

Deep emission reductions require innovation, rapid diffusion of new technologies, and the reshaping of markets and socioeconomic systems. Transitions are, by definition, disruptive.

A just transition is an approach that aims to minimize the impact on workers and communities, and to engage with the individuals and organizations who are impacted.[10]

In addition to a just transition, Halifax can preferentially deploy strategies or actions that simultaneously deliver other objectives related to health, equity, poverty alleviation, and reconciliation.

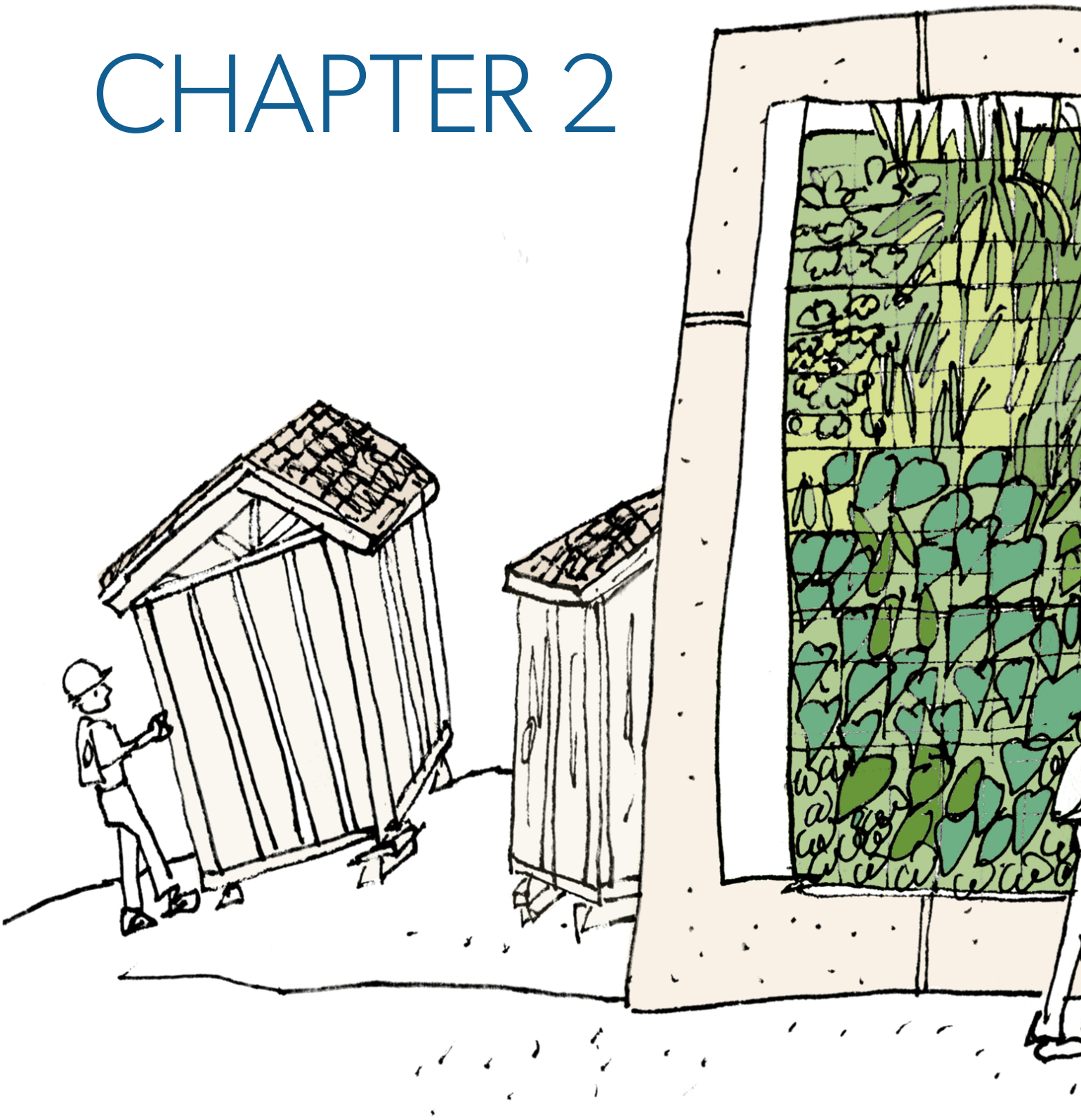
Not all people will be affected equally by climate change. Distinct groups, communities, and populations will be disproportionately affected by climate change due to one or more of the following factors: increased exposure to climate risks, increased sensitivity to climate risks, and limited adaptive capacity for coping with climate impacts. Similarly, not all will be able to equally contribute to the significant action and investment required to decarbonize.

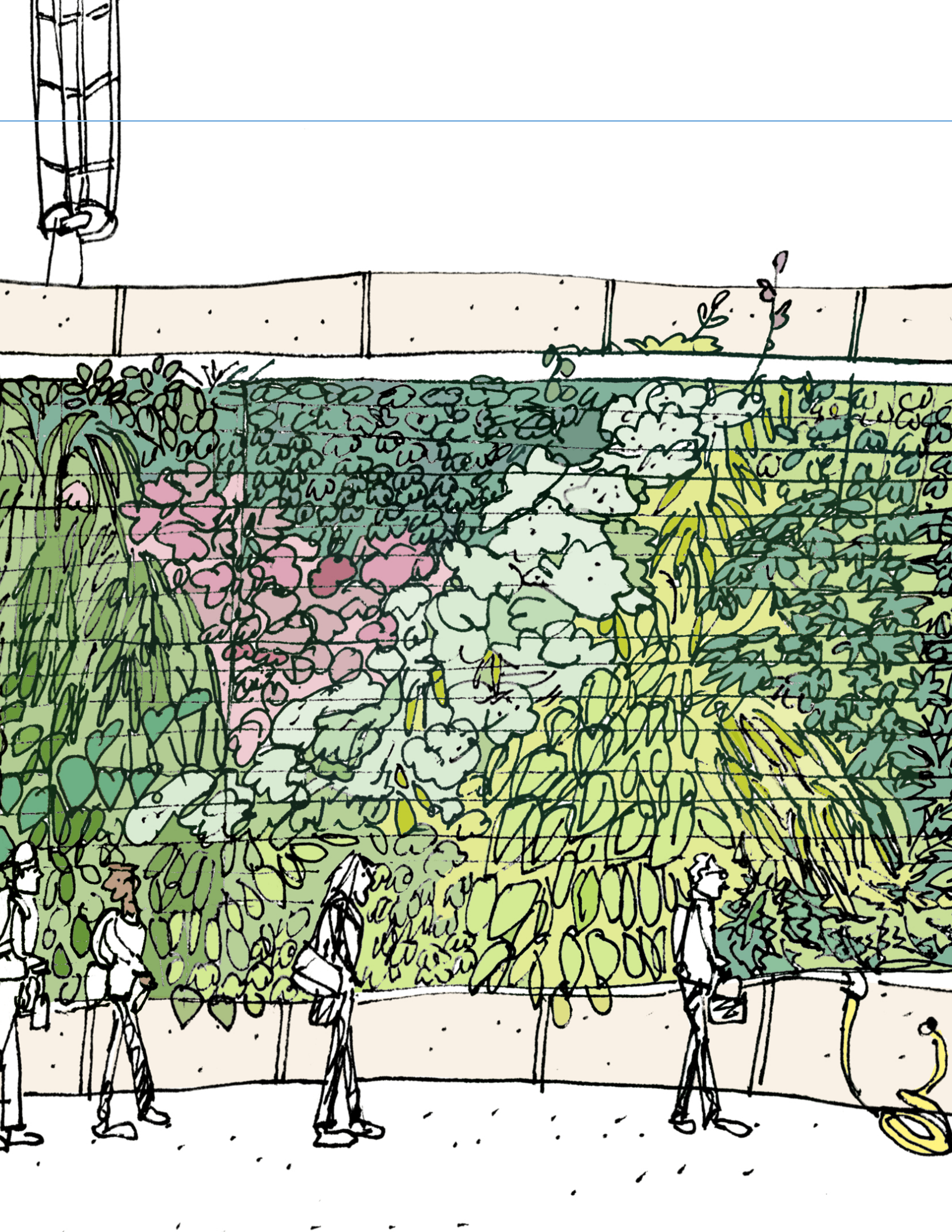
The success or failure in moving towards a decarbonized and climate resilient future will be measured both by how quickly society is able to reduce emissions and adapt to the impacts of climate change, and by how equitable and sustainable the transition is. With the constraint of limited resources, it is essential to prioritize the most vulnerable and affected members of the community, many of whom are already confronting other social and economic challenges. We must consider social equity at all levels of decision-making, program design, and implementation.

[10] Task Force on Just Transition for Canadian Coal Power Workers and Communities, Canada, & Environment and Climate Change Canada. (2019). A just and fair transition for Canadian coal power workers and communities. http://epe.lac-bac.gc.ca/100/201/301/weekly_acquisitions_list-ef/2019/19-11/publications.gc.ca/collections/collection_2019/eccc/En4-361-2019-eng.pdf

A COMMUNITY VISION

CHAPTER 2





2. A Community Vision

2.1 Broad Engagement

The development of HalifACT 2050 included advisory groups of municipal employees and community members, technical modelling and broader public engagement.

Over the past year, the HalifACT 2050 project team engaged hundreds of internal and external stakeholders and community members across the municipality. The engagement process increased awareness, facilitated discussions about strategies, tools and barriers to action, strengthened existing networks, and built new networks and partnerships to support implementation.

The project team hosted five stakeholder workshops and more than 35 pop-up sessions, presented to more than 25 groups or organizations and met with three Joint Emergency Management volunteer teams. HalifACT 2050's online presence through Shape Your City saw more than 2,800 visitors, 1,300 survey respondents, and 23,000 votes cast for priority actions. Social media channels were used to raise awareness and spark conversation.

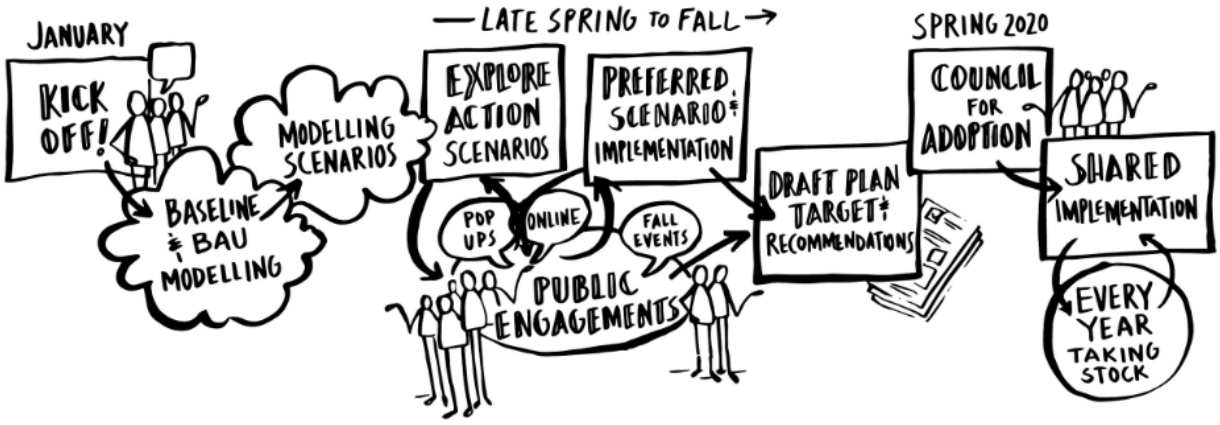


Figure 3. Process for developing HalifACT 2050

2.2 Insights

The project team received extensive information from each workshop, engagement session, and from social media platforms. The final plan and summary of actions reflects the ideas shared by stakeholders and residents. Key insights from the engagement are listed below.

- New and revised policies, regulations, standards and codes are needed to reach Halifax's targets.
- Equity needs to be considered in program development and delivery. The combination of an unequal distribution of wealth and an uneven distribution of impacts needs to inform action on climate change.
- Land-use, transportation, food and infrastructure planning policies either help or hinder efforts to address climate change.
- New funding mechanisms are needed to enable the required investments.
- Government leadership will include convening partners, developing policies, leveraging government assets and supporting research.
- Knowledge gaps within and across communities, sectors, and governments need to be addressed.
- Investment in monitoring, data collection and research will support an understanding of the current situation, risks, hazards and opportunities and will support monitoring and evaluation.

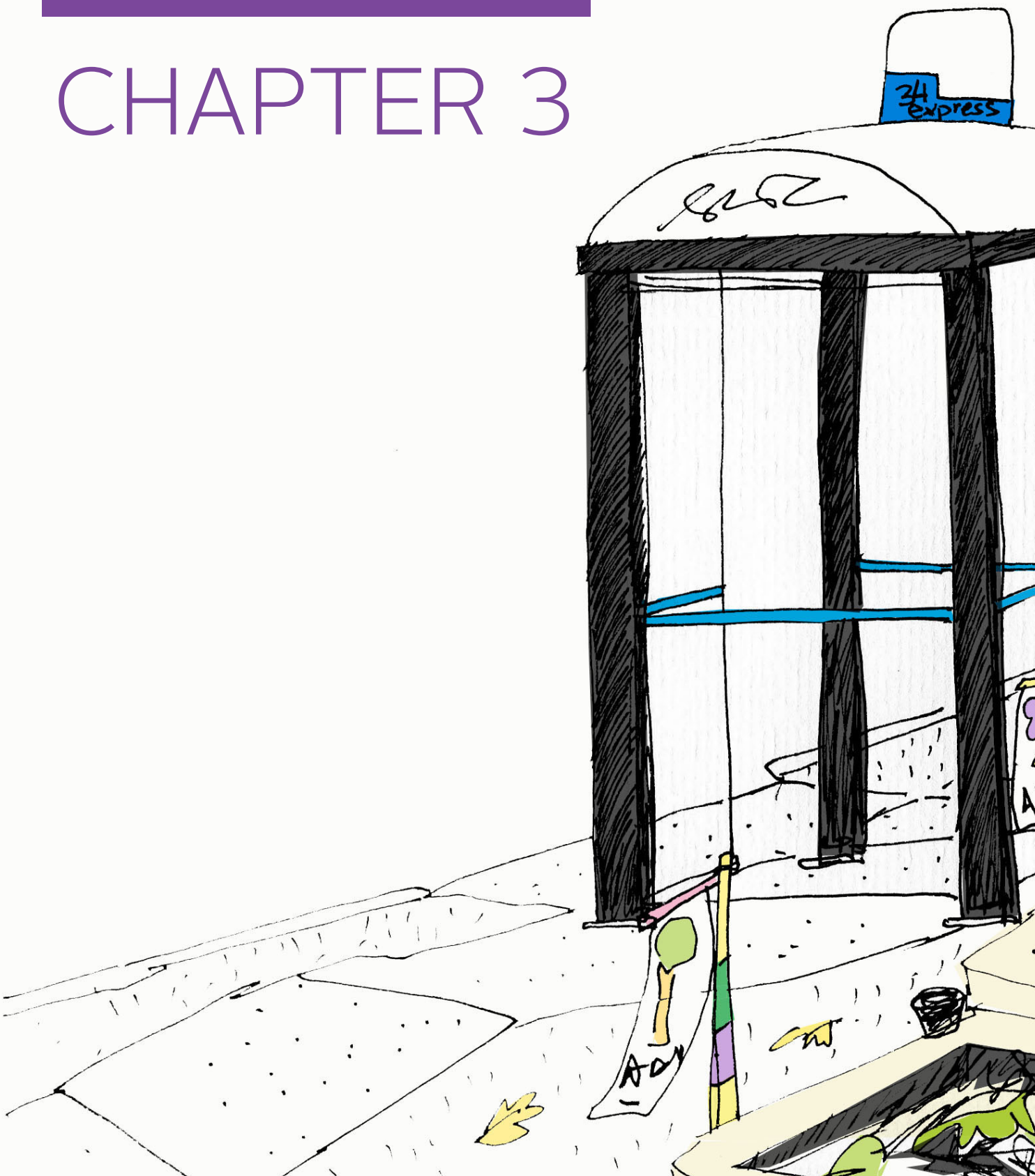
2.3 The Voice of the People

The success of HalifACT 2050 is tied to community action and stakeholder participation. HalifACT 2050 is a community-wide plan and requires collaborative solutions that overcome barriers to both mitigating and adapting to climate change. The project team engaged with more than 250 internal and external stakeholders including all levels of government, utilities, nonprofits and advocacy groups, academics and educators, industry, Mi'kmaq peoples, African Nova Scotian Communities, Acadian groups, youth and more. Participants indicated an urgency to address the climate emergency and to work together to safeguard our future.

> ***"Now is the time for action, we've been talking a long time - time to move and make decisions. Time is getting shorter and we can't wait."***
>
> ***"Congratulations for being brave and bringing a diverse group of people together for next steps."***
>
> ***"This is really important, we can't fail, we have to do it."***
>
> ***"Halifax can be a test bed, we can share that knowledge with areas that have less resources."***

GUIDING PRINCIPLES

CHAPTER 3



3. Guiding Principles

The creation and implementation of HalifACT 2050 is guided by the following common principles of climate action planning.[11]

Leadership: Innovation in community energy and emissions planning in Canadian municipalities has been defined by leadership as opposed to regulation. Climate action planning requires changes to established frameworks and practices, and these in turn are most likely to succeed when they are inspired by an understanding of how they will benefit the community and are encouraged and supported by both the leadership of elected officials and senior managers in the municipality.

Alignment: Climate change targets and actions are more likely to succeed where they align with community goals, aspirations and policies for public health, fiscal efficiency, self-reliance, economic prosperity, resilience, inclusiveness, full employment and community planning and development.

Leverage: The key to local government success in lowering community emissions is in its ability to leverage its control and influence over decisions, investments and behaviours in the community that determine emissions levels.

Engagement and Empowerment: Successful low carbon community transition requires grassroots citizen involvement and financial investment (municipality + private sector). Active citizen, household, business and investor engagement is the best route to successful energy and emissions action.

Implementation: Climate literacy for municipal leadership and staff, and community stakeholder relations that are mutually empowering are key to achieving the multiple benefits of the transition to low carbon communities.

Integration: The transition to a low carbon future requires embedding the low carbon objective in all aspects of community planning, policy, and infrastructure investments.

Opportunities: Taking advantage of opportunities can play a key role in developing momentum in the transition to a low carbon community. Such opportunities may be direct—such as financial support available from federal and provincial governments—or indirect—such as a proposal to redevelop a brownfield site or social housing, public health or youth employment initiatives.

Inclusivity: Energy and emissions plans need to involve multiple city government departments, stakeholders and communities, with attention to marginalized groups, in all phases of planning and implementation.

[11] SSG (2018) Community Emissions Reduction Planning: A Guide for Municipalities. Prepared for the Government of Ontario. Available at: https://prod-environmental-registry.s3.amazonaws.com/2018-04/Community%20Emissions%20Reduction%20Planning%20Guide.pdf

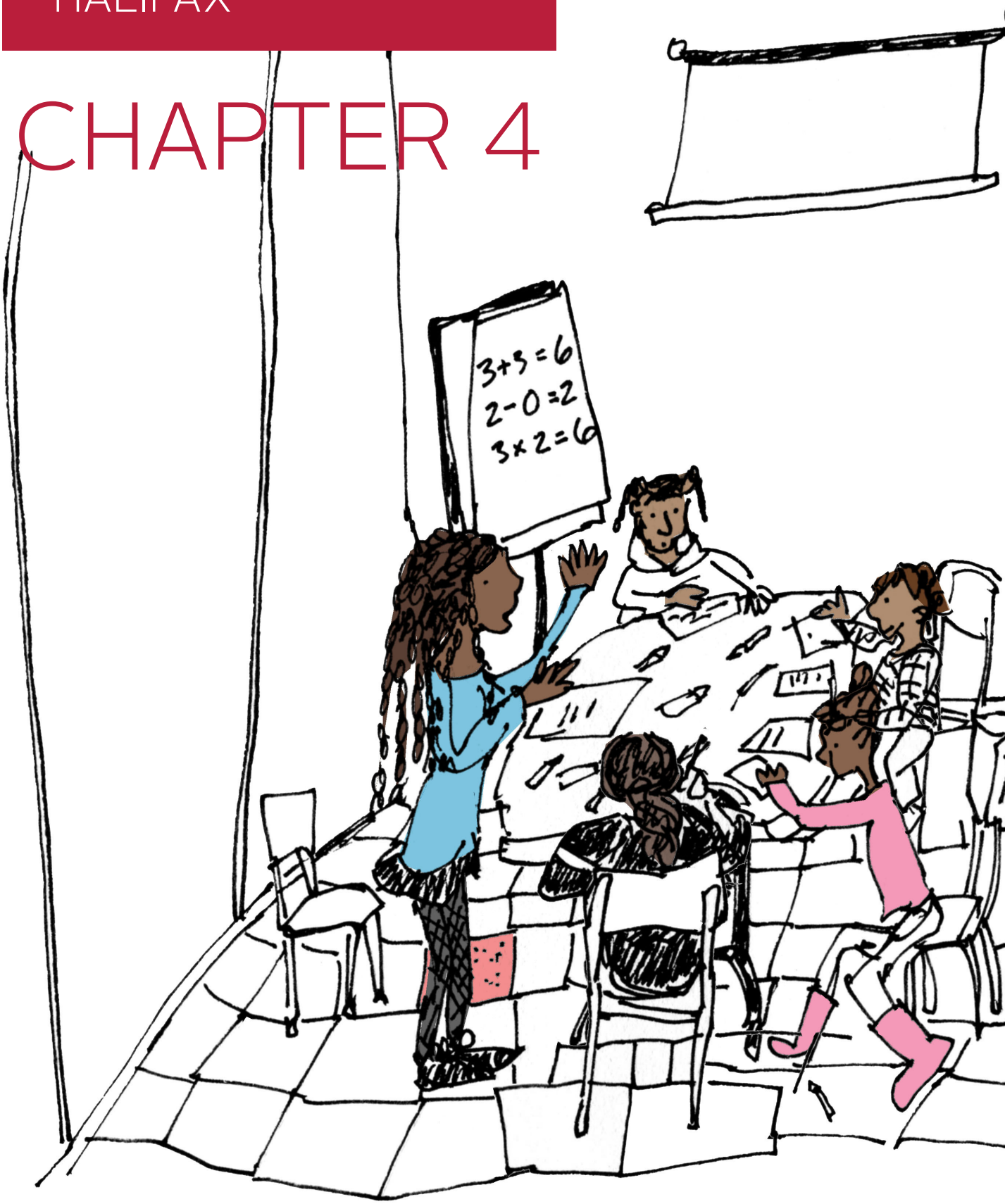
Equity: The climate action plan needs to ensure that its activities equitably address the risks of climate change and share the costs and benefits of action across the municipality. Considerations include impact on access to services, household incomes, economic opportunities, investment in infrastructure and others.

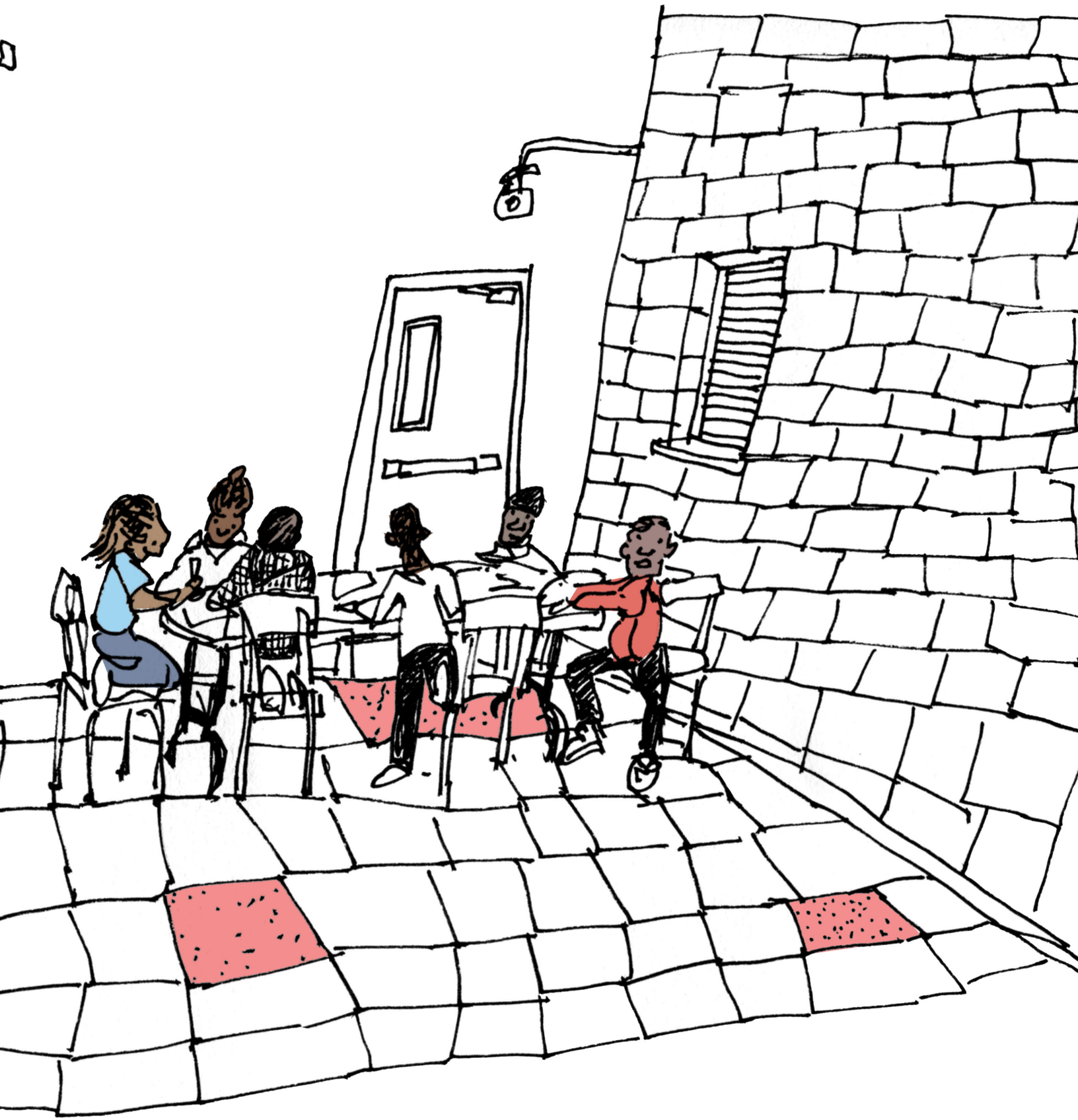
Innovation: Energy and emissions planning is an evolving field and the need for innovation is urgent in order to develop and secure pathways to deep GHG emissions reductions. Innovation requires a willingness to take risks, to fail, and to learn.

Accountability: Transparency is key to ensuring that energy and emissions plans are accountable. Transparency includes following an open decision-making process, and setting goals that can be measured, reported, independently verified, and evaluated. Using transparent modelling and assumptions instills trust in the justification for actions and policy changes.

DECARBONIZING HALIFAX

CHAPTER 4





4. Decarbonizing Halifax

4.1 The Pathway

A low carbon pathway was constructed with actions that align with the 1.5°C pathway. Actions from multiple sectors were modelled, including buildings, energy supply, transportation, water, wastewater and solid waste. The pathway consists of four aspects:

Baseline year: The year 2016 was used as the baseline, aligning with the census. Bottom-up data for buildings (size, shape) and transportation (driving distances) was calibrated with observed energy consumption data from utilities and other sources for this year to ensure that the model meaningfully portrays the energy system in Halifax.

Business As Usual (BAU) scenario: A BAU scenario was developed that accounts for changes in Halifax out until 2050 including an increasing population, new dwellings and workplaces, evolving transportation patterns, decreased GHG emissions from the electricity grid, federal fuel efficiency standards, the impact of climate change on heating and cooling requirements in buildings, and other factors.

Actions: Actions represent physical changes to the energy system or to activities that reduce GHG emissions. Each action is represented as a wedge.

Remaining emissions: The remaining GHG emissions constitute the pathway for a decarbonized Halifax after the actions have been implemented.

Modelling for the HalifACT 2050 plan was completed using demographic, building, transportation, and energy use data, analyzed in the CityInSight model. This model is an integrated energy, emissions, and finance model that allows for a deeper understanding of the relationships between energy use, emissions, and population behaviour. CityInSight allows for detailed analysis of the impacts of actions to reduce energy use and GHG emissions in both time and space and allows for complex interactions between actions to more accurately reflect the impact of potential actions on the future.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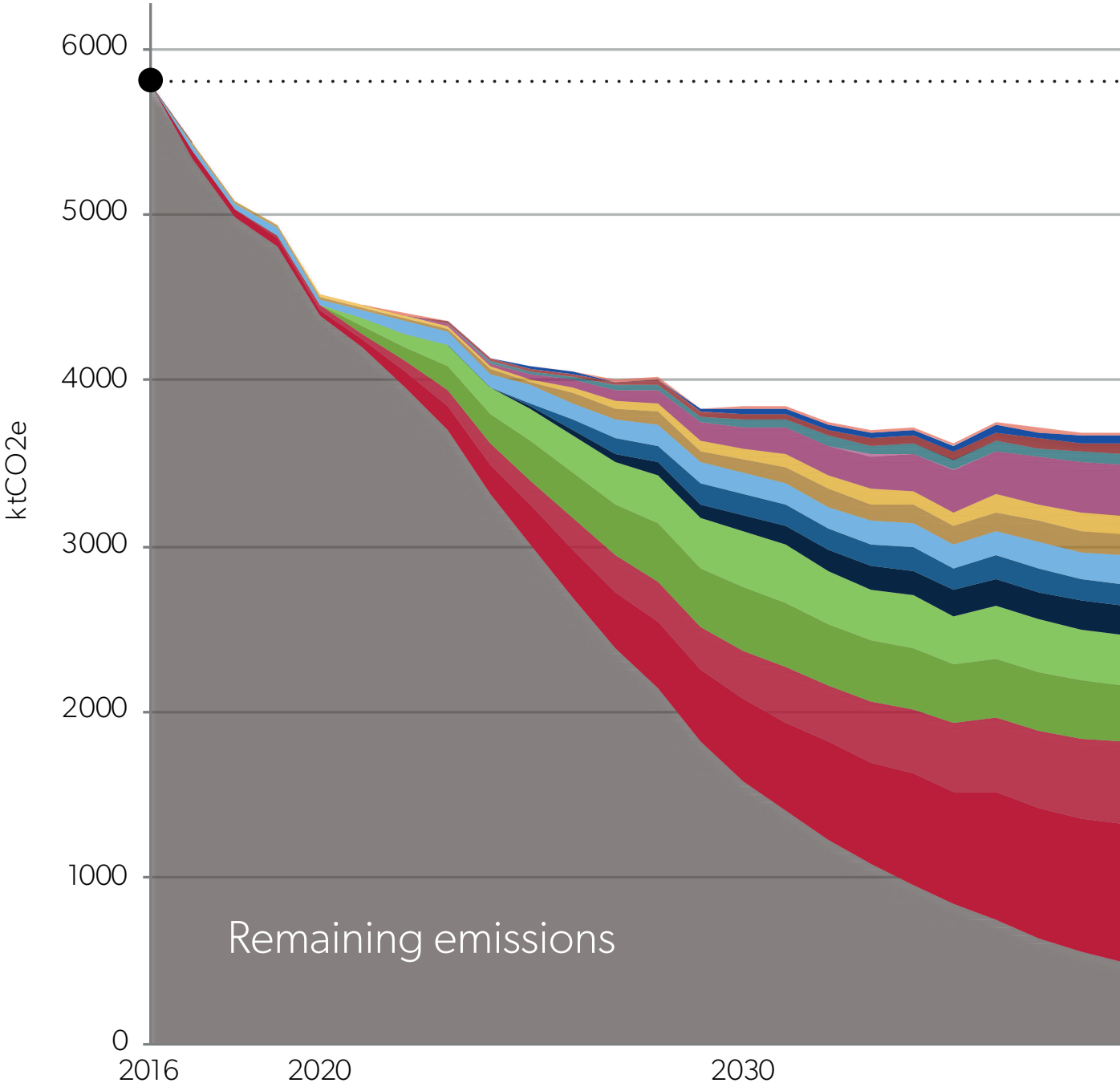
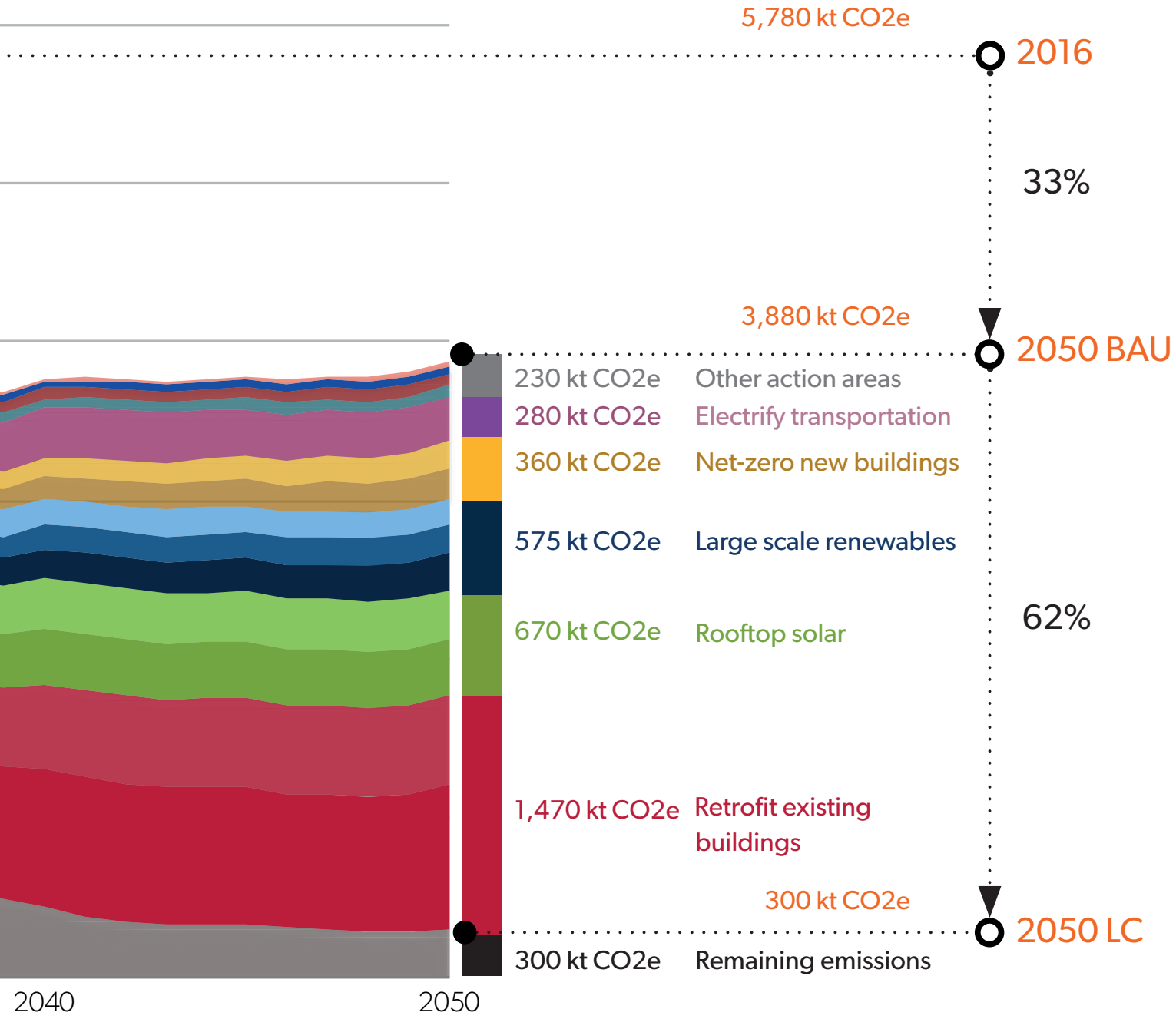


Figure 4. Pathway to reduce GHG emissions aligned with 1.5°C


5,780 kt CO2e
2016
33%
3,880 kt CO2e
2050 BAU
230 kt CO2e
Other action areas
280 kt CO2e
Electrify transportation
360 kt CO2e
Net-zero new buildings
575 kt CO2e
Large scale renewables
670 kt CO2e
Rooftop solar
62%
1,470 kt CO2e
Retrofit existing buildings
300 kt CO2e
2050 LC
300 kt CO2e
Remaining emissions
2040
2050

In 2016, fuel and electricity consumption in residential, commercial and industrial buildings accounted for 70% of all energy use in Halifax and 77% of total GHG emissions. Actions in the building sector include deep energy retrofits, fuel switching heating and water systems to electricity, implementing green building standards to reduce the GHG intensity of new buildings, and improving industrial process energy use. These actions collectively achieve a reduction of 1,830 kilotonnes of carbon dioxide equivalent ($ktCO_2e$) by 2050 ("Net-zero new construction" and "Retrofit existing buildings" wedges in Figure 4).

The expansion of transit and the switch to electric vehicles provides an additional 280 $ktCO_2e$ of emissions reductions by 2050 ("Electrify transportation" wedge in Figure 4).

The total impact of new renewable electricity generation reaches 1,255 $ktCO_2e$ by 2050. This new carbon-free generation consists of rooftop solar photovoltaics (PV)[12], larger-scale solar and wind installations, and the expansion and decarbonization of district energy systems.[13] Remaining GHG emissions in 2050 are reduced by 95% over 2016.

4.2 Alignment with 1.5°C

While the steep decline scenario includes major efforts to improve energy efficiency and to shift to renewable sources with current-day technology, 5% of emissions still remain in 2050, and the 1.5°C carbon budget is exceeded by 8 $MtCO_2e$. This gap indicates that Halifax will need to do more than what is in the pathway. Delay has the effect of increasing the gap and decreasing the likelihood of achieving Halifax's 1.5°C carbon budget.

Three strategies are possible to address the 8 $MtCO_2e$ gap, which will be addressed in subsequent updates of HalifACT 2050. First, electricity for the community can be decarbonized more quickly. Second, new and emerging technologies can be deployed, such as green hydrogen.[14] Third, negative emissions actions that absorb and store carbon dioxide can be used to help close the gap (e.g. increasing tree canopy, restoring ecosystems and injecting carbon dioxide into concrete).

4.3 An Economic Stimulus

4.3.1 BUSINESS OPPORTUNITIES

The transition to a low carbon world involves investments across the economy in building retrofits, renewable energy, energy storage, transit systems and active transportation infrastructure. These investments, which are incremental to business as usual investments, total $22 billion over 30 years and will stimulate economic activity for existing and new businesses. To put this in perspective, this investment is an annual stimulus equivalent to 4% of Halifax's annual GDP of approximately $17 billion.[15] Much of the investment, for example in building retrofits, would be directed to local businesses and suppliers. Figure 5 shows these investments by economic sector.

[12] A technology that produces electricity from solar radiation.

[13] District energy systems use a central energy plant to provide efficient heating, cooling, and hot water to a group of buildings.

[14] Hydrogen fuel that is produced through renewable electricity.

[15] Statistics Canada reports that Metropolitan Halifax's GDP was $17.3 billion. See: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610042301

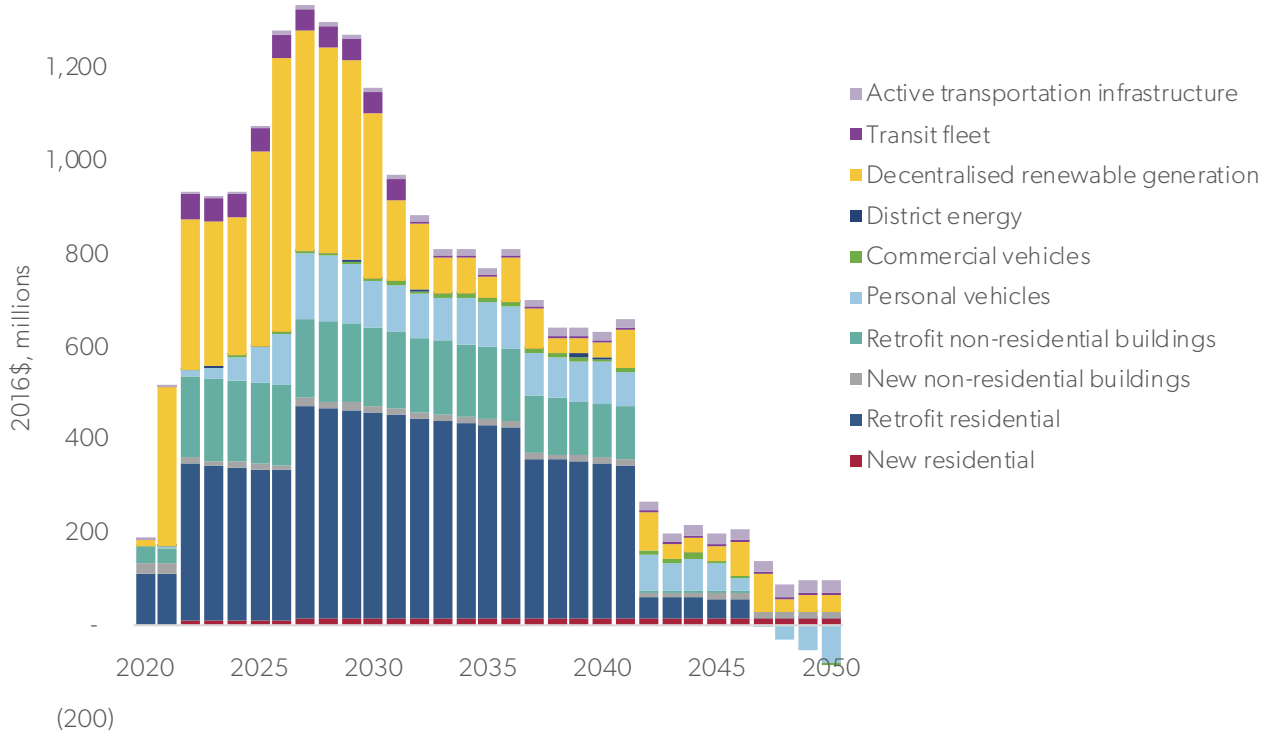


Figure 5. Low carbon investments by economic sector

4.3.2 REDUCING COSTS

A low carbon future is a lower cost future.

Low carbon investments generate financial returns. As a package, the investment is more than offset by cost savings, resulting in a net benefit of $22 billion, or $8.7 billion using a social discount rate of 3%.[16] The savings result from avoided energy costs, avoided operations and maintenance costs, avoided carbon pricing costs, and increased energy generation revenues. Each investment has a different financial return profile, depending on the savings or revenue generated, and future projections of avoided costs.

One of the largest savings occurs from avoided fuel and electricity costs. In 2016, total energy costs paid by the residents, businesses, and all other organizations in Halifax totalled $1.5 billion. Under a Business As Usual scenario, these are projected to increase to $1.73 billion by 2050. Through full implementation of the low carbon scenario, energy costs are reduced by $1.2 billion in 2050, most of which result from reduced consumption of gasoline and fuel oil. Figure 6 shows these energy savings over time.

[16] Discounting reflects the idea that people would rather have $100 now than $100 in ten years. The Government of Canada recommends 3% in circumstances where environmental and human health impacts are involved. Environment and Climate Change Canada. (2016).

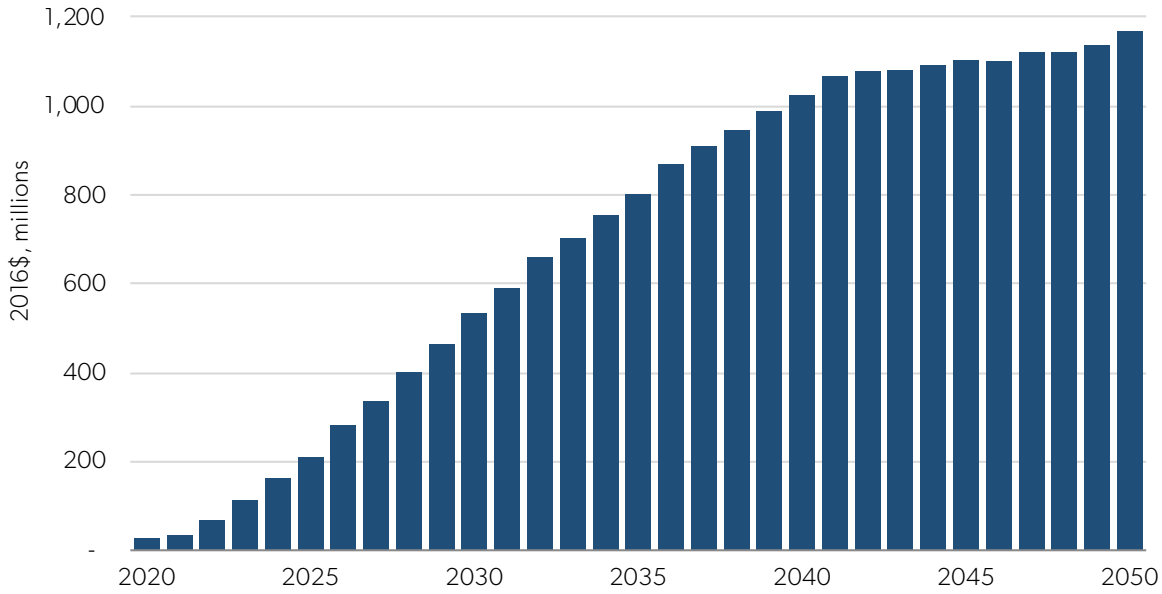


Figure 6. Annual savings in energy expenditures in Halifax from the low carbon pathway

Table 2 shows a breakdown of energy costs between 2020 and 2050 if the low carbon pathway is followed. These significant savings will improve the lives of residents and the strength of the economy by providing opportunities to use these savings to innovate, reinvest, save and enjoy.

Table 2. Impact of the low carbon pathway on energy costs

ENTITY	2020	2050
Energy costs per household	$5,220	$1,458
Businesses	M$315	M$117
Industries	M$55	M$45
Institutions	M$175	M$82

4.3.3 JOB CREATION

The transition requires many people to be engaged in work with new and existing jobs. New employment will result from the implementation of HalifACT 2050, with approximately 170,000 person years of employment generated between 2020 and 2050, an average of 5,500 annually, compared to the Business As Usual scenario. Figure 7 shows this additional employment by job category.

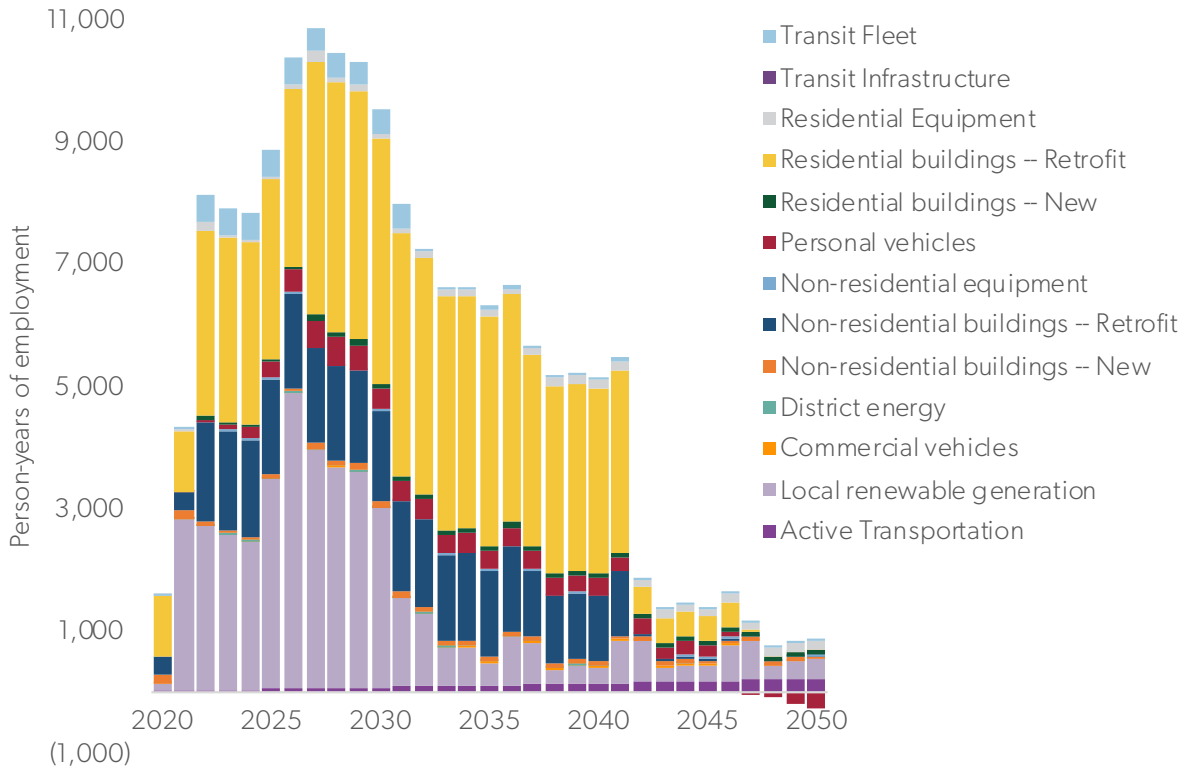
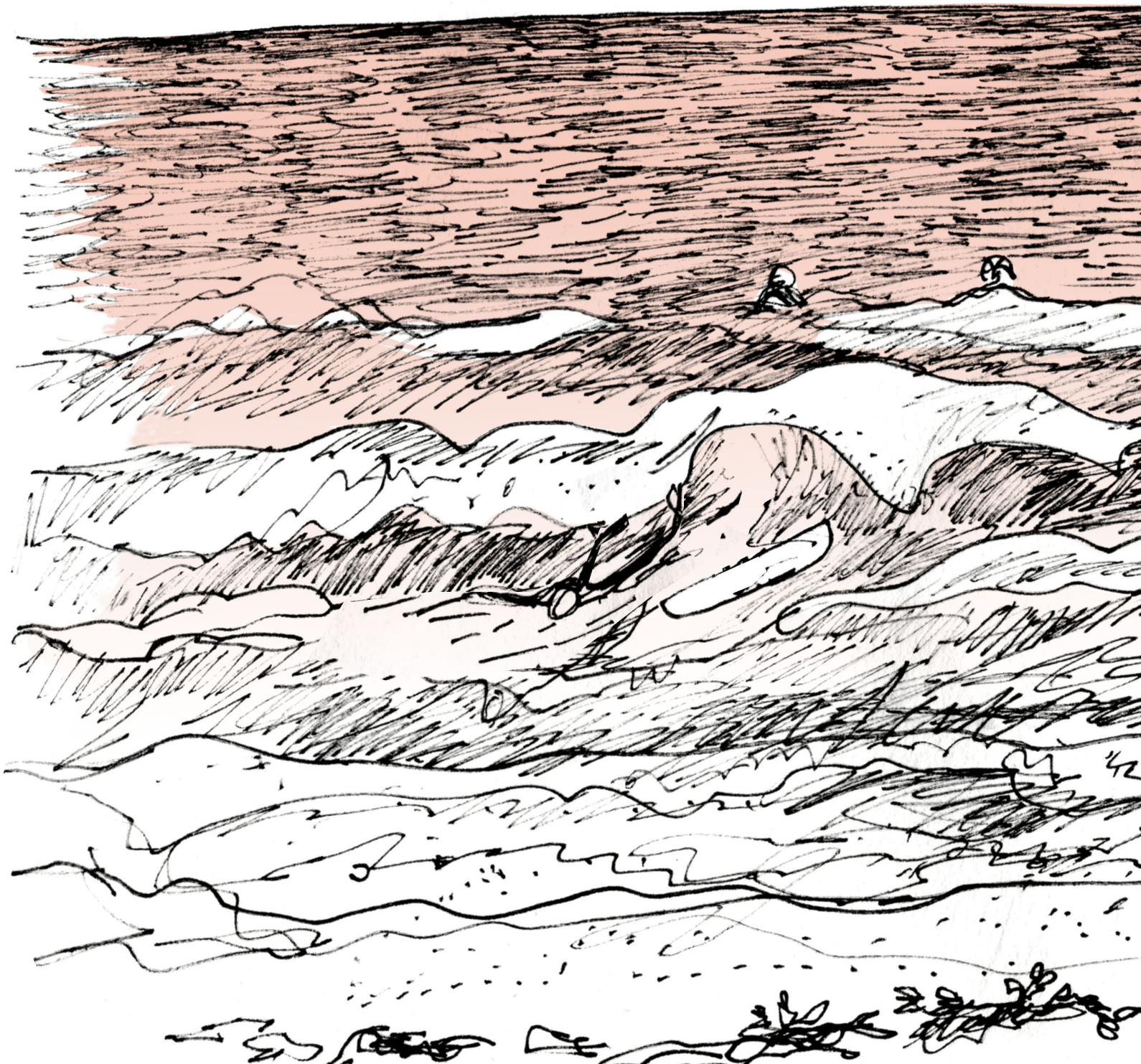
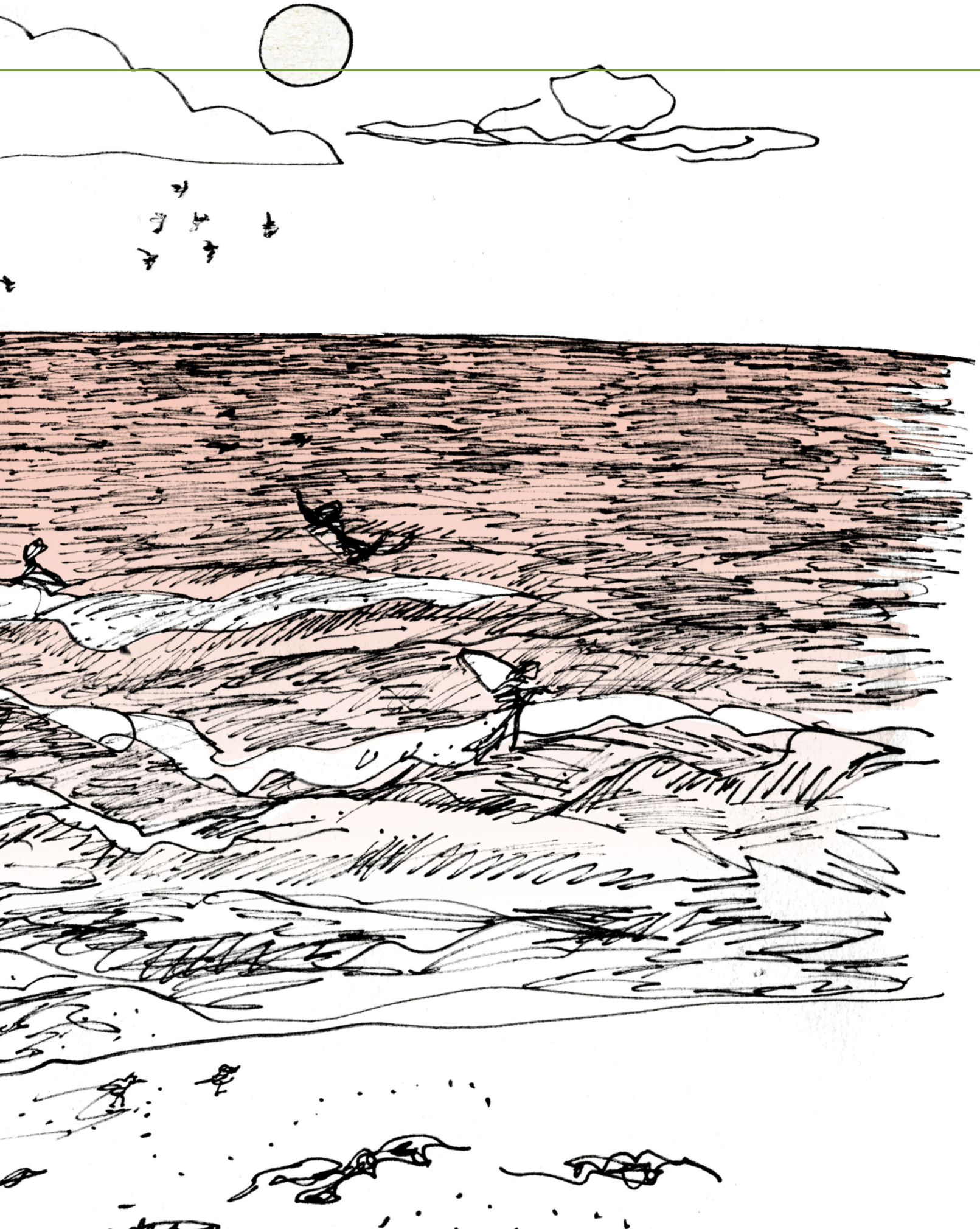


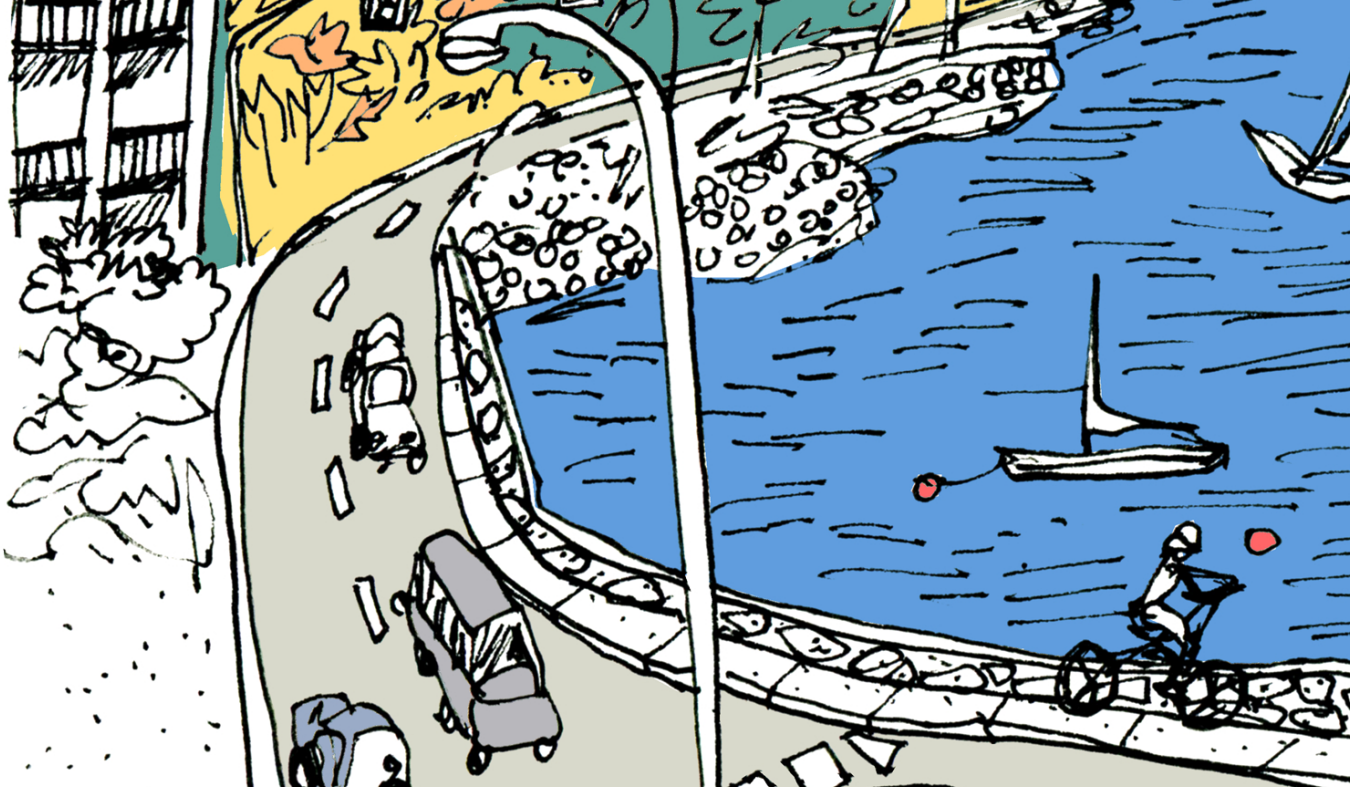
Figure 6. Person-years of employment by sector resulting from the low carbon pathway

THE ACTIONS

CHAPTER 5







5. The Actions

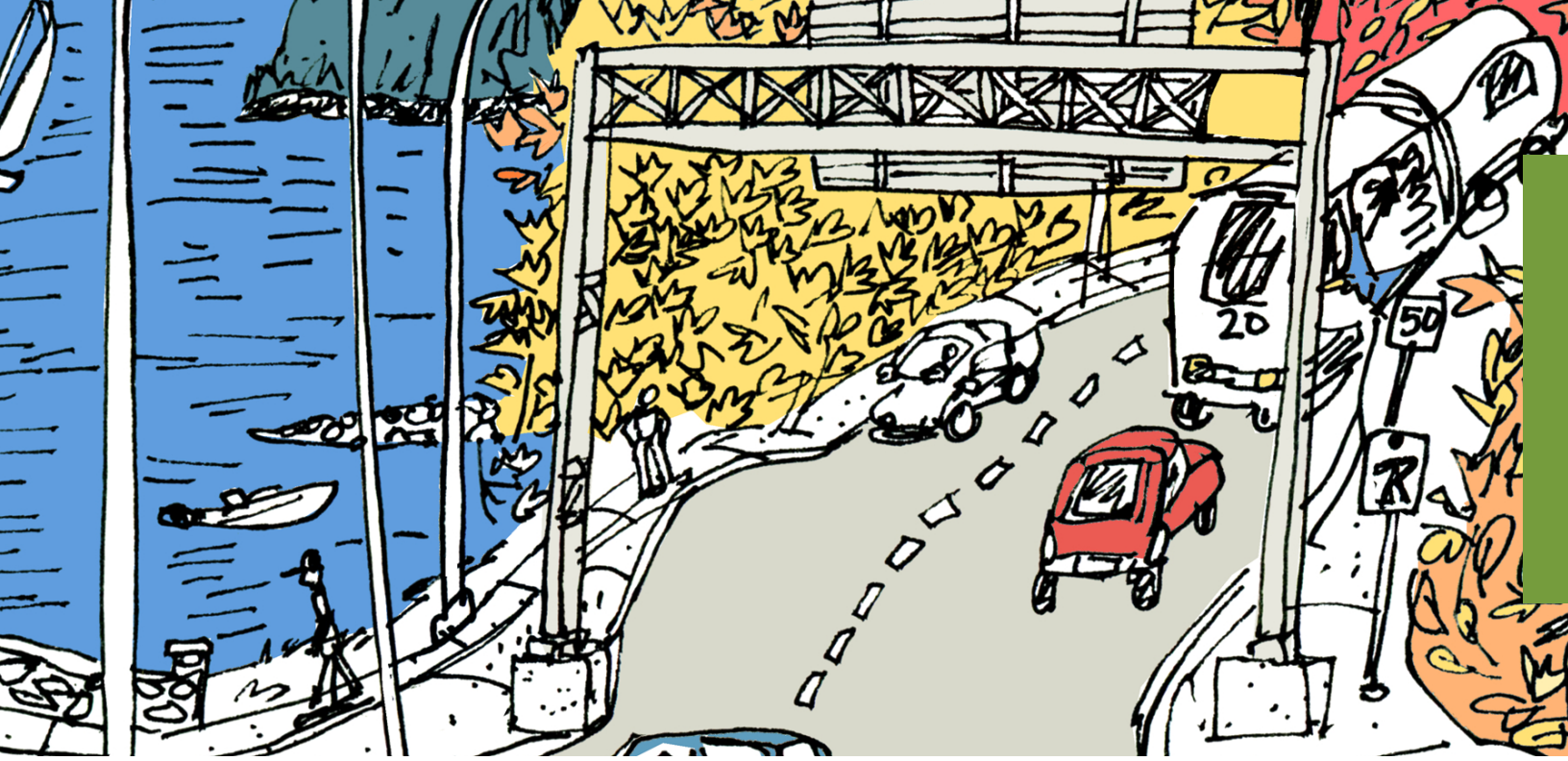
And now for the exciting part – the actions we can take collectively as a community to achieve our climate action goals from now until 2050. Actions are grouped by three main themes: decarbonized and resilient infrastructure, prepared and connected communities, and governance and leadership.

5.1 Actions Summary

DECARBONIZED AND RESILIENT INFRASTRUCTURE			
Efficient Buildings	Renewable Energy	Decarbonizing Transportation	Greening Government Operations
Water	Planning	Critical Infrastructure and Services	Coastal Preparedness
Natural Areas and Green Infrastructure Assets			

PREPARED AND CONNECTED COMMUNITIES			
Food	Community Capacity	Emergency Management	Business Economy

GOVERNANCE AND LEADERSHIP			
Monitoring and Reporting	Carbon Accounting	Mainstreaming Climate into Municipal Operations	Governance and Capacity for Action



Timelines for Action

In a perfect world we would get started on all 46 actions immediately, but we need to be realistic and consider resource constraints and other barriers to implementation. The timing and length of actions can be adapted to respond to changes in policy, technology and funding. We have assigned start times to each action as defined here:

Immediate: action to begin right away	
Short: action should be initiated within 2-3 years	
Medium: action should be initiated in the next 4-5 years	
Long: action should be initiated in the next 6-10 years	
Ongoing: action has been initiated and will continue throughout the life of the plan	

5.2 Decarbonized and Resilience Infrastructure

5.2.1 EFFICIENT BUILDINGS

	ACTION	TARGET OR OBJECTIVE	TIMING
1	Develop, adopt and apply a standard for net-zero and climate resilient new construction	Net-zero new construction by 2030	
2	Develop a retrofit program to enable and fast-track deep energy and climate resilience retrofits in residential and non-residential buildings	Retrofit all existing buildings by 2040	
3	Develop an industrial coalition and support program for improving industrial process efficiency	Improve industrial process efficiency 75% by 2040	

Buildings accounted for approximately 70% of total energy use in Halifax in 2016, and 77% of total emissions. Retrofitting residential and non-residential buildings, ensuring that new buildings are more efficient, and working to improve industrial processes are all necessary components of a successful energy transition for Halifax.

Enhanced performance of new buildings and the improvements made to existing buildings will also make buildings more resilient to future climate impacts such as severe storms, flooding and heat. To maximize the benefit, the retrofit program will prioritize members of the community who are considered most vulnerable to climate impacts.

These programs will be delivered in collaboration with the Municipality, private homeowners, businesses, other levels of government, and industrial partners. By working together to achieve the targets described above, building energy demand can be decreased by 60%, and GHG emissions by 92%.

Making New Buildings as Efficient as Possible

The design of new buildings can maximize energy performance by considering solar orientation, building shape, energy performance of the envelope and roof, and high-efficiency equipment.

In contrast, a retrofit is constrained by design decisions made in the past, especially orientation and building type. Retrofit programs also need to consider factors such as disrupting households or employees and working with and around existing components of a building or home.

As a result, there are physical limitations on the level of energy performance that can be achieved through deep retrofits and the avoided costs of building better now result in an imperative to maximize energy performance in new construction.

5.2.2 RENEWABLE ENERGY

	ACTION	TARGET OR OBJECTIVE	TIMING
4	Expand programming for rooftop solar systems and energy storage	Install 1,300 MW of rooftop solar PV with storage by 2030	
5	Develop partnerships for large-scale solar and wind generation	Significantly expand local community-scale renewable energy generation: • 300 MW ground mount solar PV by 2050 • 280 MW wind by 2050 • 100% renewable district energy by 2050	
6	Develop a district energy initiative to decarbonize and expand district energy		
7	Actively support, advocate and partner with Nova Scotia Power, the Province, and others to decarbonize the provincial electricity grid		

Many of the actions and recommendations to reduce GHG emissions across Halifax require switching from higher-carbon fuels, like fuel oil and gasoline, to zero carbon electricity. Halifax already has a residential rooftop solar program, Solar City, which will be adapted and expanded to include deep energy retrofits and climate resilience measures. In addition, community-scale solar and wind generation will increase the supply of local renewable energy, while also stimulating the local economy and building on local business expertise. Halifax has existing district energy networks that will need to be transitioned to 100% renewable energy sources by 2050.

District Energy: A Path to Renewable Heat

District energy systems are mature technology that use centralized heating plants to heat or cool multiple buildings connected to a distribution network. The distribution system enables a plug and play approach to adopting new renewable sources of heat as technology evolves. Potential sources include waste heat from industrial processes, ground source heat pumps and deep water cooling.[17]

District energy systems are most effective when they serve energy-dense areas. A preliminary rule is that areas with an energy density of greater than 150 megajoules per square metre (MJ/m^2) are viable sites for district energy.[18] Typically this defines an area that includes large buildings with multiple uses, high residential density and compact neighbourhoods.

By including energy storage with renewable generation, communities will be more resilient to power outages from extreme weather events, and will be better able to supply essential services to the community.

[17] Hast, A., Syri, S., Lekavicius, V., Galinis, A. (2018). District heating in cities as a part of a low-carbon energy system. Energy, 152, 627–639, https://doi.org/10.1016/j.energy.2018.03.156.

[18] Moller, B., & Werner, S. (2016). Quantifying the potential for district heating and cooling in EU member states. http://www.heatroadmap.eu/resources/STRATEGO%20WP2%20-%20Background%20Report%206%20-%20Mapping%20Potential%20for%20DHC.pdf.

5.2.3 DECARBONIZING TRANSPORTATION

	ACTION	TARGET OR OBJECTIVE	TIMING
8	Expand transit and active transportation infrastructure	Plan and build the transit and active transportation infrastructure needed to achieve the 2030 mode share targets in the Integrated Mobility Plan	
9	Collaborate with local organizations and businesses to develop a community-wide EV strategy	By 2030, 100% of new vehicle sales are electric	
10	Prepare for and catalyze electric vehicle uptake through planning and policy		

Halifax covers a large geographic area and as a result, communities and citizens are heavily reliant on public and private transportation for daily life. Switching to electric vehicles for private, public, and commercial transportation will reduce fuel costs, improve air quality, and reduce maintenance requirements. Wide-spread adoption of electric vehicles will require planning for and building charging infrastructure throughout Halifax, and coordination with local partners and industry specialists to prepare for a shift from gasoline to electricity.

By expanding transit and active transportation networks, more community members will be able to choose lower-carbon transportation methods, reducing congestion, improving air quality, and improving the physical and mental health of residents.

5.2.4 GREENING GOVERNMENT OPERATIONS

	ACTION	TARGET OR OBJECTIVE	TIMING
11	Adopt a commitment, develop a detailed and costed infrastructure plan, and finance implementation to achieve net-zero municipal operations by 2030	Achieve net-zero municipal operations by 2030	

Municipalities are on the frontline of climate action, as the infrastructure and services they operate are directly exposed to the impacts of climate change. As a result, municipalities around the world are taking leadership on reducing GHG emissions and adapting their operations.

Halifax's leadership role will include retrofitting and future-proofing existing municipally-owned buildings and requiring that new municipal buildings achieve net-zero emissions, beginning in 2020. Targets include electrifying the municipal fleet, including ferries, by 2030, developing a waste strategy to reduce residential waste and increase waste diversion, to generate renewable electricity in municipally-owned projects, and to purchase local zero-carbon electricity. These actions combine to achieve net-zero municipal operations by 2030.

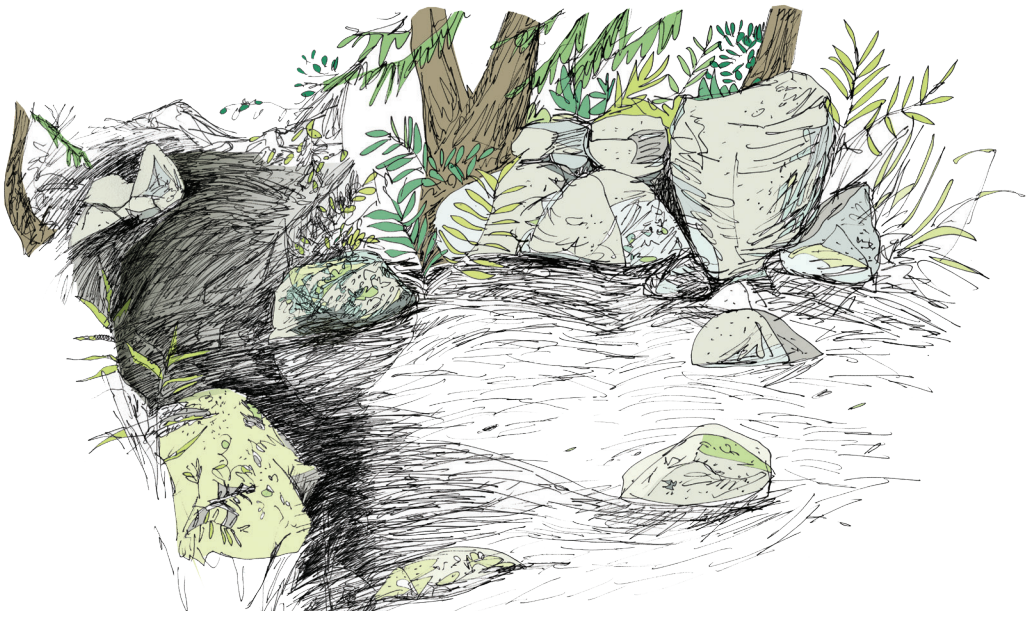
5.2.5 WATER

ACTION		TARGET OR OBJECTIVE	TIMING
12	Adopt a commitment and develop a detailed plan to achieve net-zero water and wastewater operations by 2030	Achieve net-zero water and wastewater operations by 2030	
13	Develop a holistic, integrated, and climate-informed water supply strategy	Future proof water systems and supply	
14	Develop a holistic, integrated, and climate-informed stormwater management plan and program		

Water and wastewater management in the future will require the management of energy and emissions, as well as future-proofing to ensure water supplies and infrastructure are adapted to future climate conditions and risks. Community-wide water conservation measures will include infrastructure improvements and water use behavioural changes, as well as reducing the amount of stormwater entering the wastewater system through sewer separation and promoting on-site infiltration and water retention.

Biogas recovery from wastewater will need to be used to generate electricity to replace other fuel sources, while also reducing the amount of GHG emissions released from wastewater.

Water resources require future-proofing to ensure a reliable supply of fresh water during emergencies, and as a result of changes in precipitation patterns and temperature. Management of water supplies, including stormwater, wastewater, and freshwater, will incorporate climate considerations. Green infrastructure is a core component of effective stormwater management. An integrated approach to water management will involve close coordination between the Municipality, the Halifax Regional Water Commission and the public.



5.2.6 CRITICAL INFRASTRUCTURE AND SERVICES

ACTION		TARGET OR OBJECTIVE	TIMING
15	Conduct a high-level risk assessment (HLRA) with internal and external stakeholders for utilities, transportation, water, health facilities and telecoms	Reduce risk to critical infrastructure	
16	Conduct a detailed spatially-based risk and vulnerability analysis of municipally-owned and -operated critical infrastructure at the asset class and system level		
17	Install zero-emissions back-up power in critical infrastructure		
18	Develop inspection procedures for high-risk infrastructure to identify resulting damage from extreme events		
19	Develop or update codes and design standards for new municipal and private infrastructure that reflect future climate impacts		

Halifax depends upon a complex network of infrastructure. These systems function to produce and deliver a reliable flow of services that are critical to support economic prosperity and social wellbeing. These systems include energy, telecommunications, transportation, water supply, wastewater treatment, solid waste management, buildings and food systems.

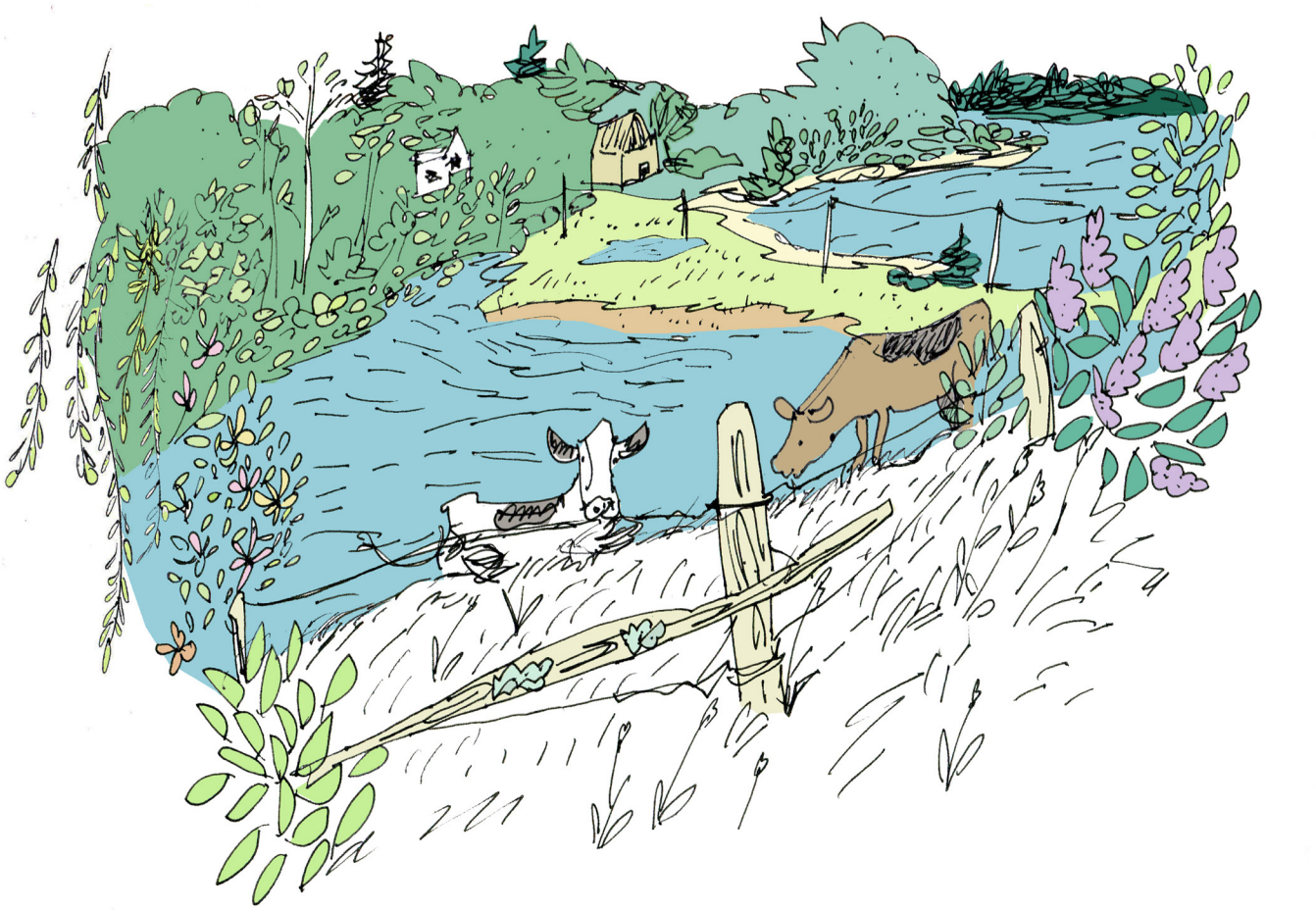
Critical infrastructure needs to withstand the impacts of climate change, both in the near and long term. This objective requires proactively protecting and strengthening infrastructure to ensure it can withstand increasingly extreme storms and climbing average temperatures amongst other impacts that come with climate change. By improving the resilience of infrastructure now, the reactive resources needed for emergency response or to repair or rebuild from future impacts are reduced.

5.2.7 NATURAL AREAS AND GREEN INFRASTRUCTURE

ACTION		TARGET OR OBJECTIVE	TIMING
20	Fund and implement the Green Network Plan and Urban Forest Master Plan	Protect, restore, maintain and expand natural areas and green infrastructure assets	
21	Continue the naturalization program through pilot projects, public education and awareness to support the development of a region-wide naturalization program		
22	Develop and implement a region-wide tree planting and re-greening program		

Natural areas and green infrastructure increase water infiltration and reduce runoff, reduce the heat island effect,[19] improve water quality, provide shade and areas for reprieve, and sequester carbon. Examples of natural areas and green infrastructure include parks, trees, shrubs, urban forests, green roofs and walls, gardens, bioswales,[20] natural channels, watercourses, ponds, and constructed wetlands.

Naturalization is an ecological approach to landscape management that enhances biodiversity and improves ecosystem health and resilience in an urban environment. Naturalization reduces maintenance requirements and costs, as systems are self-renewing and resilient, and provides more naturalized space to residents and wildlife. Halifax Regional Council provided direction to expand naturalization efforts in parks and rights-of-way areas in January 2019. Both the Urban Forest Master Plan and the Green Network Plan highlight the benefits that are associated with increased naturalization and biodiversity.



[19] The heat island effect occurs when closely-packed buildings and paved surfaces amplify and trap heat in dense urban areas. These surfaces trap heat more effectively than natural ecosystems. Urban areas also generate heat through furnaces, air conditioners and vehicles, contributing to the problem.

[20] Bioswales are engineered channels designed to gather stormwater runoff. They typically are covered in plants and vegetation and allow runoff to enter back into the groundwater supply while also reducing overland flow.

Green Infrastructure

Stormwater best management practices (BMPs), such as green infrastructure, mimic natural processes to manage stormwater water at the source and create healthier urban environments. Recognizing this, the Municipality is working collaboratively with Halifax Water to develop stormwater management standards that will capture and treat stormwater on-site for high-density residential, institutional, commercial and industrial developments. Further work will include applying these new standards to the public right-of-way through the Municipal Design Guidelines. The reimagining of Spring Garden Road in downtown Halifax offers the opportunity to integrate ecological processes into an urban setting in a way that has not yet been tested in the municipality.

5.2.8 PLANNING

ACTION		TARGET OR OBJECTIVE	TIMING
23	Integrate climate into land use planning policies and processes	Plan and build a low-carbon resilient region	
24	Plan for the deployment of carbon-neutral district energy and microgrid systems		
25	Increase land protection and conservation on private lands through partnerships, collaboration and municipal planning requirements		
26	Acquire more land to preserve natural areas and ecosystem health in alignment with the Green Network Plan		

Land use planning plays a critical role in designing and building communities that are prepared and adapted to climate change, while also maintaining the physical and mental wellbeing of residents. Planning policies through the Regional Plan and municipal planning strategies can provide direction to reduce sprawl and allow for the efficient use of land, energy, and transportation systems. These strategies should also emphasize green spaces, urban forests, and community spaces that further reduce urban heat island effects and improve the environmental health of communities.

For land protection, strategies include protecting green spaces that already exist through conservation and land use planning, restoring and maintaining what already exists through careful management and ecosystem restoration, and expanding natural areas and green infrastructure. Available municipal tools for protection can include amending land use bylaw regulations, open space subdivision, zoning, and through development agreement between the developer and the Municipality. Additional tools that could be explored in partnership with other stakeholders include land donation, easements, and voluntary preservation. The Municipality will continue to strategically acquire lands that provide ecological value and preserve biodiversity. The current Regional Plan review provides an opportunity to strengthen the Municipality's role in acquiring and protecting lands that will both sequester carbon to mitigate climate impacts and increase adaptive capacity.

Additionally, land use planning can help avoid development in hazard-prone or high-risk areas to reduce exposure to climate hazards through land-use bylaw setbacks, buffers and coastal elevations, and ensure that new development is climate-ready.

Conservation and Climate Action – A Perfect Pairing

We will not succeed in addressing climate change if we do not protect and enhance the natural environment we depend on for survival. Natural areas like forests and wetlands produce oxygen, filter the air we breathe, clean our drinking water, hold flood waters, regulate climate and absorb carbon dioxide, a greenhouse gas. Valuing these important functions economically is critical to their consideration in decision-making. Natural capital allows for this analysis, defined as "the stock of natural resources (finite or renewable) and ecosystems that provide direct or indirect benefits to the economy, our society, and the world around us."[21] By assigning value to things like flood control and climate regulation, these natural assets can be considered more meaningfully in cost benefit analyses and decision-making.

5.2.9 COASTAL PREPAREDNESS

	ACTION	TARGET OR OBJECTIVE	TIMING
27	Conduct a detailed spatially-based risk and vulnerability analysis of Halifax's coastal, waterfront, and shoreline area	Better prepare for climate related coastal changes and impacts	
28	Develop a coastal-specific adaptation strategy with coastal communities		

Halifax's coast, waterfront and shoreline areas are at increased risk of climate impacts; specifically, increasing risk of damage to coastal infrastructure, property, and natural areas and assets from inundation, saltwater intrusion, and coastal erosion due to sea-level rise, storm surge and extreme events.

Current policy requires a vertical setback from the coast for ground floor residential properties in the municipality for safety purposes. The Province of Nova Scotia recently enacted a new piece of legislation, the Coastal Protection Act, which will further protect coastal properties. The Municipality has procured a new Digital Elevation Model to allow for detailed flood risk modelling and land use vulnerability assessments.

In order to protect assets, manage coastal environments, and reduce exposure to climate risks, a detailed risk and vulnerability analysis of coastal, waterfront and shoreline areas will be completed, and a coastal-specific adaptation strategy will be implemented to protect and manage at-risk natural and infrastructure assets.

[21] TD Economics. 2014. Valuing the world around us: an introduction to natural capital. Special Report. November 20, 2015. Retrieved from https://www.td.com/document/PDF/economics/special/NaturalCapital.pdf

Cumulative Impact of Small Measures

One green roof, or one tree, while providing co-benefits[22] and reducing flooding and heat impacts, will only do so on a small scale. When deployed at a large scale, for example 10,000 green roofs or 100,000 trees, the cumulative impact to reduce risk more broadly and provide benefits become much more significant, specifically if they are deployed in areas prone to flooding and the heat island effect. For green infrastructure, the whole is truly more than the sum of its parts.

5.3 Prepared and Connected Communities

5.3.1 EMERGENCY MANAGEMENT

ACTION		TARGET OR OBJECTIVE	TIMING
29	Develop climate event evacuation plans: flooding, wildfire and coastal storm surge	Better prepare for increased climate-related emergencies	
30	Improve emergency management communication and coordination across EMO agencies and organizations		

The impacts of climate change are expected to affect the emergency management sector's capacity to support preparedness, response and recovery efforts. As extreme events increase, so will the demands on full-time and volunteer emergency service personnel and non-government organizations. Demands are likely to increase from both chronic stresses, such as higher average temperatures, and acute shocks, specifically extreme events such as heat waves and flooding, as a result of the growing impacts on human health.

Climate impacts are expected to be greater for vulnerable people and populations, including seniors, children, those experiencing social isolation, individuals with chronic conditions and disabilities, and socially or economically marginalized individuals.

In addition to preparing for an increase in extreme climate events, ongoing investment to increase the resilience of infrastructure and to provide supportive service to emergency management will alleviate the pressures on emergency management staff and infrastructure.

[22] Benefits that are additional to the primary objective (e.g. to energy efficiency and emissions reductions).

5.3.2 COMMUNITY CAPACITY

ACTION		TARGET OR OBJECTIVE	TIMING
31	Create Disaster Support/Community Resilience Hubs for community self-sufficiency	Enhance the capacity of neighbourhoods to prepare for and recover from climate events	
32	Make emergency management training widely available to residents and businesses		
33	Undertake climate planning sessions with neighbourhood organizations to develop local climate plans and coordinate mitigation and adaptation efforts		
34	Work purposefully, meaningfully, and collaboratively, with the Mi'kmaq and other groups seeking reconciliation, including African Nova Scotian communities	Engage deeply and collaboratively	

More resilient neighbourhoods make a more resilient city. While comfort centres exist across the municipality and are critically important for emergency management, neighbourhoods that invest in connections, capacity building, and resources on a sustained basis are better able to withstand crises and address many of the chronic socioeconomic stresses that increase climate vulnerability. Increasing the built and social capacity of neighbourhoods not only empowers them to be more independently resilient, but contributes to the resilience of the region as a whole.

Each community will identify priorities and leaders to build capacity and connections with other communities to share resources, training, knowledge and solutions. The Municipality will help support capacity building and foster engagement and connectivity across communities.

5.3.3 FOOD

ACTION		TARGET OR OBJECTIVE	TIMING
35	Improve food security and food systems resilience	Create and implement a Food Action Plan, and include climate change as a core component	

Climate change poses increased risks to agriculture and food systems, including adverse impacts on agricultural crops (decreased crop yield and decreased nutritional quality of crops grown), increased food prices, contaminated water and food supplies, increases in new and existing pests and diseases, and damage and disruption to food supply and distribution infrastructure from extreme events.

Additionally, food production and distribution contribute to GHG emissions, for example through methane produced by livestock (mainly cattle), manure and fertilizers, pasture management, energy for agricultural vehicles and machinery, conversion of forests, grasslands and other carbon 'sinks' into cropland, and energy used in food processing, transport, packaging and retail.

In December 2019, Halifax Regional Council endorsed the Halifax Food Charter in principle and committed to supporting the development of a Food Action Plan with the Halifax Food Policy Alliance. A focus of this plan is to address climate change, and funding its implementation will improve food systems resilience, reduce emissions from food, and build food security for those most vulnerable to the impacts of climate change.

5.3.4 BUSINESS AND ECONOMY

ACTION		TARGET OR OBJECTIVE	TIMING
36	Expand workforce and technology development programs and funding to grow skills and trades for decarbonization and resilience	Prepare and leverage business for the transition	
37	Develop a resilient decarbonized businesses program to support businesses to reduce emissions and prepare for climate impacts		

The transition to a low carbon and climate resilient future will generate professional and skilled labour positions and stimulate local economies. The Municipality will prepare for and catalyze this workforce by engaging with key stakeholders.

Incremental Capital Costs

Investments in existing and new infrastructure are made on an ongoing basis. Vehicles are replaced at the end of life, roofs are replaced on buildings, boilers are replaced, and so on. The low carbon pathway identifies when that infrastructure component will be replaced and substitutes a low carbon option. For example, when a vehicle is being replaced at the end of its life, an electric vehicle is purchased instead of a gasoline vehicle. The financial implication is that the upfront cost is the difference on the price tag between a gasoline vehicle and an electric vehicle, which is called an incremental cost. There are two trends that influence the financial implications of incremental investments:

- Low carbon investments generally result in cost savings over the lifetime of the investment. This leads to a net benefit, even with a higher upfront cost.
- The incremental costs of the low carbon investment are declining over time. For example, some analysts indicate that electric cars will be at price parity with conventional vehicles by 2026.

A Climate Ready Halifax

The technical pathways (combined set of policies and actions) for reducing GHG emissions are readily available today. But there is great uncertainty about how best to prepare for climate change, including the scale and location of the impacts. A climate ready organization is able to proactively adapt to rapidly and drastically changing conditions and provide stability and security in tumultuous times.

5.4 Coordinated Governance & Leadership

5.4.1 MAINSTREAMING CLIMATE INTO MUNICIPAL OPERATIONS

ACTION		TARGET OR OBJECTIVE	TIMING
38	Integrate climate into financial decision-making by incorporating climate-related financial disclosure; a cost of carbon and a social cost of carbon[23]; a municipal carbon budget; a climate lens to capital and business planning and asset management	Integrate climate thinking into municipal decision-making and governance	
39	Explore and establish new mechanisms for financing climate action		
40	Incorporate Environmental, Social, Governance (ESG) principles into the management of municipal funds		

Climate change is having, and will continue to have, a negative financial impact on Halifax. Decarbonizing and adapting to the impacts of climate change will require major investments, and mobilizing funding commensurate with the challenge will be difficult at many levels. However, the cost of inaction will only grow over time. Every dollar invested proactively can save as much as four[24] to six[25] dollars on recovery. Many decision-makers do not yet recognize the choice they face between paying predictable costs today for mitigation and adaptation, compared to delaying action and paying higher and unpredictable costs later to try and cope with the impacts of climate change.

Halifax will establish new mechanisms for financing climate action, while simultaneously rethinking its own municipal fund investment strategies. Embedding climate resilience considerations into financial decision-making will ensure that these investments contribute to reducing emissions and reducing risk throughout the region.

5.4.2 GOVERNANCE AND CAPACITY FOR ACTION

ACTION		TARGET OR OBJECTIVE	TIMING
41	Establish a central Climate Change Office in the Municipality	Integrate climate thinking into municipal decision-making and governance	
42	Significantly increase staff capacity for implementation		

[23] An estimate, in dollars, of the economic damages that would result from emitting one additional unit of greenhouse gases into the atmosphere. The social cost of carbon puts the effects of climate change into economic terms to help decisionmakers understand the economic impacts of decisions that increase or decrease emissions.

[24] Godschalk, D. R., Rose, A., Mittler, E., Porter, K., & West, C. T. (2009). Estimating the value of foresight: aggregate analysis of natural hazard mitigation benefits and costs. Journal of Environmental Planning and Management, 52(6), 739-756.

[25] National Institute of Building Sciences (2017). Natural Hazard Mitigation Saves: 2017 Interim Report.

Halifax can lead on climate change. This will require institutionalizing climate thinking throughout the organization to build the human and technical resource capacity needed to implement climate action both within the organization, and across the municipality.

In order to lead and implement climate action, Halifax will increase staffing throughout the organization, and work closely with key partners across the region. Staff members can be distributed throughout the organization, reporting back to a centralized climate entity with a mandate to unify and streamline the climate response.

Adaptive management: A safe space for innovation, risk and failure

Adaptive management is a style akin to an explorer who has a sense of direction but no clear route. It requires searching and exploring, watching out for possibilities and interrelationships, however unlikely they may seem. Tackling the climate crisis requires an adaptive management style.[26]

5.4.3 MONITORING AND REPORTING

ACTION		TARGET OR OBJECTIVE	TIMING
43	Develop an Annual Indicators Report and report annually on progress	Monitor and report on climate action and impact	

In order to track progress, measure success, evaluate programs and activities, and plan effectively, Halifax will need to monitor and report on:

- Climate and climate events;
- Implementation of actions, and the effectiveness of these actions; and
- Capacity and learning within the Municipality's staff and operations.

By reporting regularly on appropriate measures and indicators, Halifax will be able to understand and report on progress, and apply the approach of adaptive management to evolving climate impacts and risks. Halifax will take advantage of new opportunities, technologies and innovations and will help direct capacity building into appropriate actions and areas.

[26] M. Clarke, M. Stewart, J. (1997). Handling the Wicked Issues—A Challenge for Government, p. 15.

5.4.4 CARBON ACCOUNTING

ACTION		TARGET OR OBJECTIVE	TIMING
44	Develop a values-based framework for carbon offsets	Get ready for neutrality and step up the carbon scope	
45	Develop a consumption-based emissions inventory		
46	Include embodied carbon in new construction standards for buildings		

The implementation of broad-sweeping emissions reductions and efficiency programs and policies will nearly eliminate Halifax's GHG emissions by 2050. Halifax's ability to address its remaining emissions will likely improve in the next 30 years, but negative emissions and offsets will likely need to be considered. The Municipality will consider the development of a values-based framework for carbon offsets that includes guidelines for future policies and programs, and a mandate to explore emerging opportunities.

Current GHG emissions inventories, including the one used as the basis for this plan, are limited to energy use and emissions produced within the geographical boundary of Halifax. The expansion of the emissions framework to include emissions associated with goods and services generated and produced outside of Halifax, and the carbon emissions embodied within new construction, will identify additional opportunities for GHG emissions reductions.

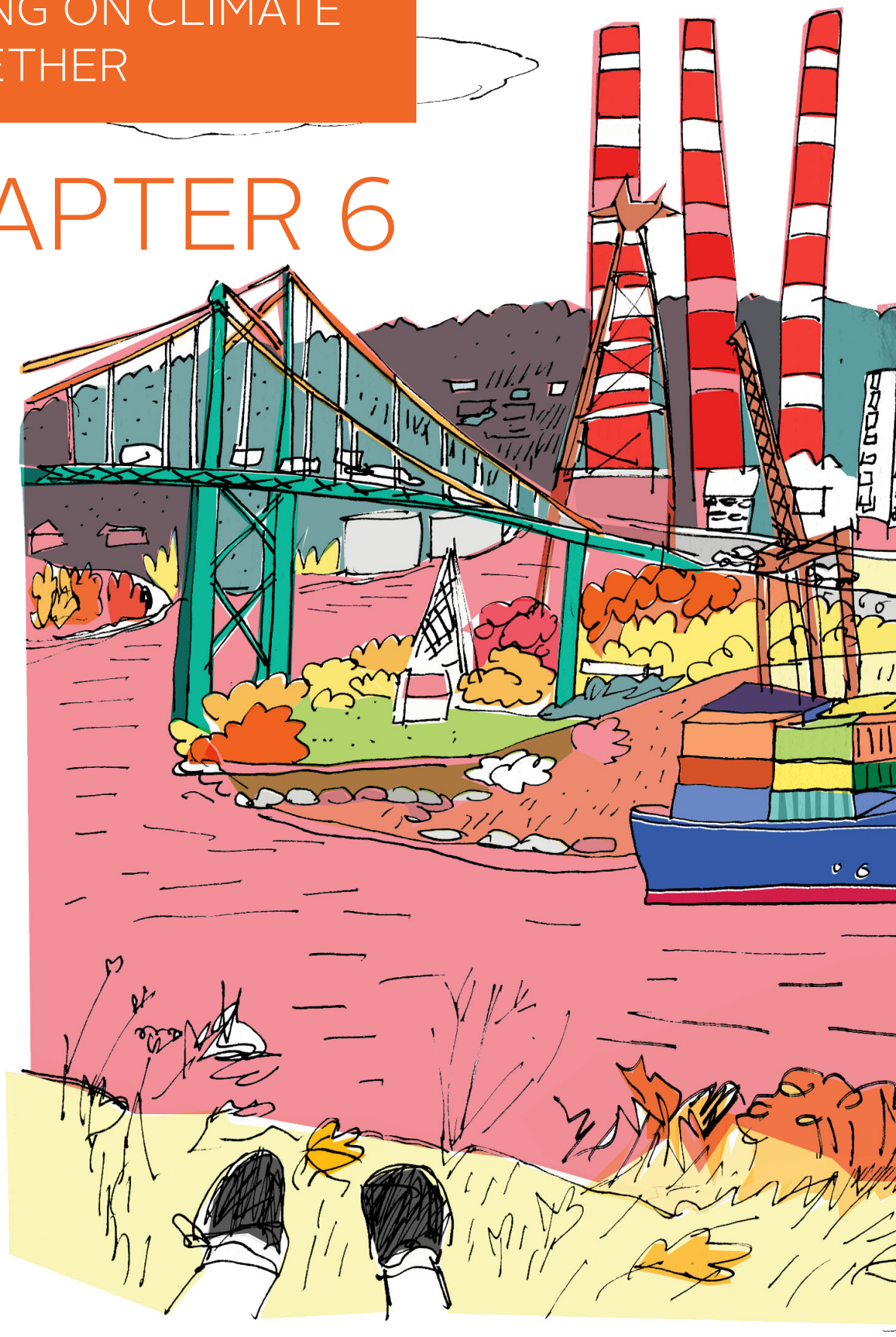
Municipal Carbon Budget

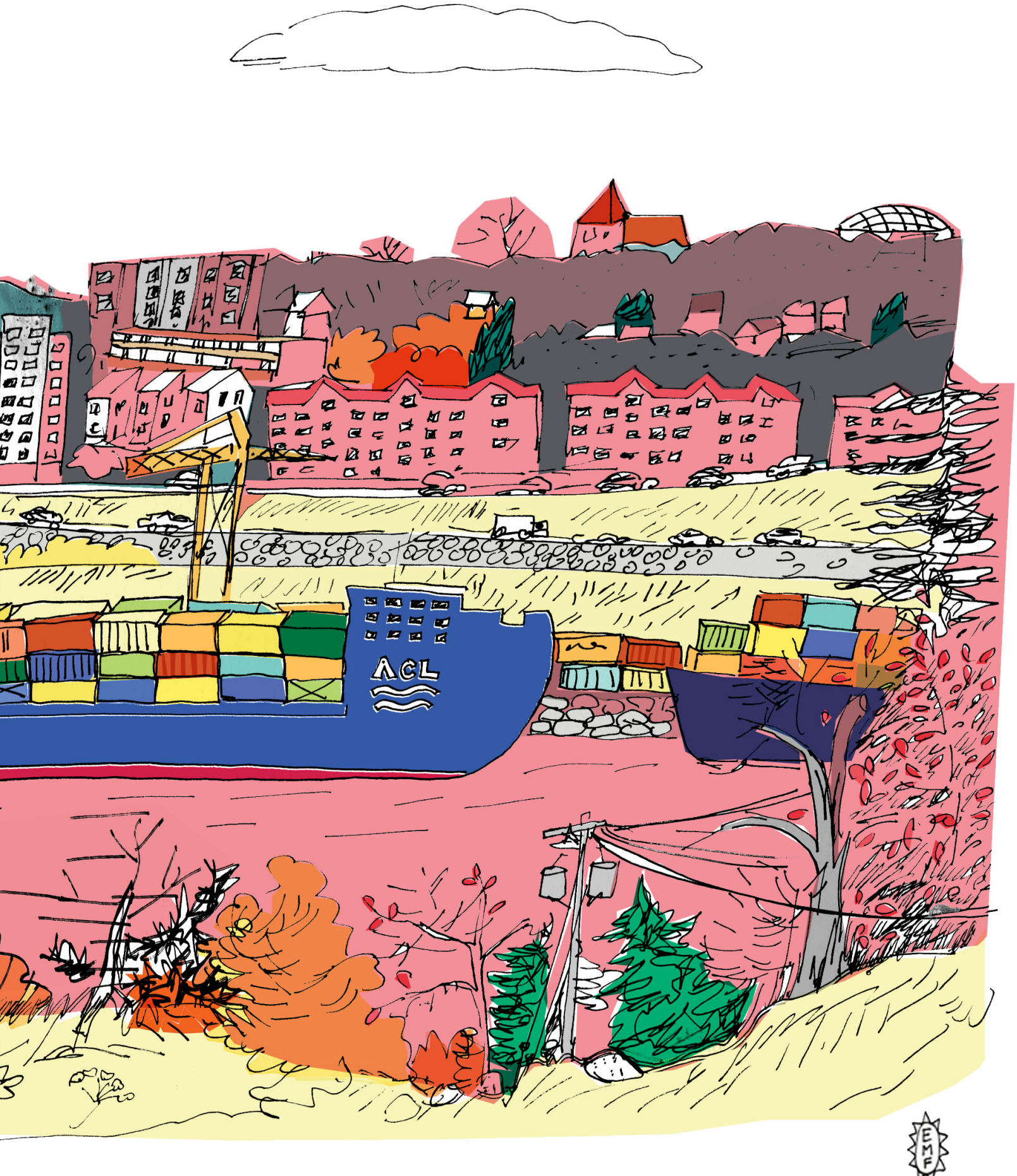
The City of Oslo in Norway has adopted a Climate Budget as an efficient governance system in order to achieve its GHG mitigation targets.[27] The main goals of the Climate Budget are to evaluate the impact of actions, and to require all municipal bodies to submit regular status reports on the actions under their responsibility. The Budget requires collaboration between departments in order to achieve the annual targets. The reporting process is aligned with the standard financial budget reporting cycle. Fourteen indicators are published three times each year on the city's Climate Barometer, which provides an early indication of progress.

[27] City of Oslo, 2019. City of Oslo Climate strategy and climate budget. https://www.oslo.kommune.no/politics-and-administration/green-oslo/best-practices/oslo-s-climate-strategy-and-climate-budget/#gref

ACTING ON CLIMATE TOGETHER

CHAPTER 6

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6. Acting on Climate Together

The level of effort and timelines of this plan are ambitious and unprecedented. Halifax will mobilize its resources to support the implementation of the actions in HalifACT 2050, allocating responsibilities across the organization, and in many cases coordinating with partner organizations and other levels of government. In the next five years, Halifax will focus on seven priority actions that enable Halifax to remain within the low carbon pathway. These actions are as follows:

1. Retrofit and renewable energy programming
2. Retrofit municipal buildings to be net-zero ready and climate resilient
3. Electrification of transportation
4. Net-zero standards for new buildings
5. Framework for assessing and protecting critical infrastructure
6. Capacity building for climate adaptation; and,
7. Financing strategy to operationalize the HalifACT 2050 plan over 30 years.

Given the urgency of the issue and the scope of the solutions, multiple partners, both internal and external to the Municipality, are needed to effectively implement the actions outlined in this plan. New ways of working are required that allow us to work collaboratively, test and refine ideas with nimbleness, and easily track progress in addressing this complex problem. We will continue to test and explore different approaches to enable collaboration with community partners.

Reporting, measurement, and evaluation processes will increase the understanding of impacts of climate change and the scope and effectiveness of interventions. The project team will track climate and climate events, action implementation and effectiveness, and capacity and learning indicators and report on progress on a yearly basis. This process enables a safe space for trying new approaches and taking risks and ensures transparency for the broader community and stakeholders.

Every great challenge presents great opportunities. As much as climate change presents risks, the actions that reduce GHG emissions and increase resilience can save money, increase community wellbeing and improve environmental sustainability. Imagine the future of Halifax, should this plan be implemented - a more equitable, vibrant and cohesive city.

This plan is a pathway to a resilient and low carbon community, and there will be many twists and turns and decision points along the way as new technologies emerge, economies transform, science progresses, and society evolves. However, the time to act is now. Halifax will work in the spirit of cooperation, adaptive management, urgency, equity and hope to collectively and meaningfully tackle the climate crisis. Join us.