City of Richmond

Minutes

Planning Committee

Date:	Wednesday, April 4, 2018
Place:	Anderson Room Richmond City Hall
Present:	Councillor Linda McPhail, Chair Councillor Bill McNulty Councillor Chak Au Councillor Alexa Loo Councillor Harold Steves (entered at 4:19 p.m.)
Also Present:	Councillor Carol Day
Call to Order:	The Chair called the meeting to order at 4:00 p.m.

MINUTES

It was moved and seconded
That the minutes of the meeting of the Planning Committee held on March 20, 2018, be adopted as circulated.

CARRIED

NEXT COMMITTEE MEETING DATE

April 17, 2018, (tentative date) at 4:00 p.m. in the Anderson Room

COMMUNITY SERVICES DIVISION

1. **HOUSING AGREEMENT BYLAW NO. 9850 TO PERMIT THE CITY OF RICHMOND TO SECURE AFFORDABLE HOUSING UNITS AT 9211/9251/9271/9291 ODLIN ROAD (POLYGON BERKELEY)**
(File Ref. No. 08-4057-05; 12-8060-20-009850) (REDMS No. 5782536; 5771223)

It was moved and seconded
That Housing Agreement (9211/9251/9271/9291 Odlin Road) Bylaw No. 9850 be introduced and given first, second and third readings to permit the City to enter into a Housing Agreement substantially in the form attached hereto, in accordance with the requirements of section 483 of the Local Government Act, to secure the Affordable Housing Units required by the Rezoning Application RZ 17-778596.

CARRIED

PLANNING AND DEVELOPMENT DIVISION

2. **APPLICATION BY POLYGON DEVELOPMENT 218 LTD. FOR REZONING AT 3551, 3571, 3591, 3611, AND 3631 SEXSMITH ROAD FROM SINGLE DETACHED (RS1/F) TO RESIDENTIAL/LIMITED COMMERCIAL (RCL4)**
(File Ref. No. 12-8060-20-009836; RZ 17-778835) (REDMS No. 5741270; 5773064)

Suzanne Carter-Huffman, Planner 3, reviewed the application, highlighting that (i) 11 units will be allocated for affordable housing, (ii) the developer will provide a contribution towards the future construction of the Capstan Station, the City's Public Art Fund, and community amenity space in the form of two affordable work-only artist studios, (iii) the proposed development will include frontage improvements and site servicing upgrades, (iv) the proposed development will be District Energy Utility ready, and (v) the proposed building height will be approximately 40.5 metres.

Discussion ensued with regard to increasing the proposed building height and the current building height restrictions under the City Centre Area Plan and Transport Canada regulations.

It was moved and seconded
That Richmond Zoning Bylaw 8500, Amendment Bylaw 9836, which makes minor amendments to the "Residential/Limited Commercial (RCL4)" zone specific to 3551, 3571, 3591, 3611, and 3631 Sexsmith Road and rezones 3551, 3571, 3591, 3611, and 3631 Sexsmith Road from "Single Detached (RS1/F)" to "Residential/Limited Commercial (RCL4)", be introduced and given first reading.

CARRIED

3. **PROPOSED OFFICIAL COMMUNITY PLAN (CITY CENTRE AREA PLAN) AMENDMENT AT 6551 NO. 3 ROAD (RICHMOND CENTRE SOUTH REDEVELOPMENT PLAN) – REQUEST TO ENDORSE AN APPLICANT-LED PUBLIC CONSULTATION PROCESS**
(File Ref. No. CP 16-752923) (REDMS No. 5779435 v. 4)

With the aid of a visual presentation, (Copy on-file, City Clerk's Office), Ms. Carter-Huffman, Planner 3, briefed Committee on the proposed development, highlighting the following:

- the proposed development will be focused on the south side of the mall and will consist of residential units, new streets, open spaces, and expanded retail space;
- the first phase is anticipated in 2019 and will include demolition of the existing parkade and some retail spaces;
- the proposed development will not include a rezoning application since the subject site was previously zoned for high density use;
- the proposed development will include frontage improvements to Minoru Boulevard and No. 3 Road, improvements to cycling lanes, and improved vehicle access through the connection of local streets;
- underground parking is proposed for the site;
- the developer is proposing to allocate 5% of the residential units toward affordable housing, including a mix of family-friendly units;
- a central public plaza is proposed;
- the proposed development will be built to connect a future District Energy Utility;
- completion of the project is expected in 2026; and
- public consultation will include mail notification, newspaper advertisements, a public display inside the current mall, open houses and surveys through Let's Talk Richmond.

Cllr. Steves entered the meeting (4:19 p.m.).

In reply to queries from Committee, staff noted that (i) staff will be consulting with Richmond School District No. 38, (ii) there are no proposed plans to extend the Canada Line, (iii) the proposed parking will be fully underground, (iv) proposed road improvements will include new fully signalized intersections along Minoru Boulevard, and (v) residential parking will include provisions for electric vehicle charging and options for electrical vehicle charging hubs.

It was moved and seconded
That staff be authorized to oversee an applicant-led public consultation process with respect to possible changes to the City Centre Area Plan arising from the proposed Richmond Centre South Redevelopment Plan.

CARRIED

4. **RELEASE OF AGRICULTURAL LAND COMMISSION DECISION – AGRICULTURAL LAND RESERVE NON-FARM USE APPLICATION AT 18791 WESTMINSTER HIGHWAY (AG 14-668409; APPLICANT – NANAKSAR GURDWARA GURSIKH)**
(File Ref. No. AG 14-668409) (REDMS No. 5788439)

Wayne Craig, Director, Development, briefed Committee on the non-farm use application, noting that the Agricultural Land Commission (ALC) has approved the application to allow for overflow parking, with specific conditions and a time limit, and that the City will be working with ALC staff and the applicant to fulfill those conditions.

It was moved and seconded
That the memorandum titled "Release Of Agricultural Land Commission Decision – Agricultural Land Reserve Non-Farm Use Application At 18791 Westminster Highway (Ag 14-668409; Applicant – Nanaksar Gurdwara Gursikh)," dated March 27, 2018, from the Director, Development, be received for information.

CARRIED

Discussion then ensued with regard to the Metro Vancouver Climate 2050 Discussion Paper (attached to and forming part of these minutes as Schedule 1).

As a result of the discussion, the following **referral motion** was introduced:

It was moved and seconded
That the Metro Vancouver Climate 2050 Discussion Paper, dated April 2018, be referred to staff.

CARRIED

5. **MANAGER'S REPORT**

None.

ADJOURNMENT

It was moved and seconded
That the meeting adjourn (4:29 p.m.).

CARRIED

Certified a true and correct copy of the Minutes of the meeting of the Planning Committee of the Council of the City of Richmond held on Wednesday, April 4, 2018.

Councillor Linda McPhail
Chair

Evangel Biason
Legislative Services Coordinator

metrovancouver

5.1 ATTACHMENT 1

Schedule 1 to the Minutes of the Planning Committee meeting of Richmond City Council held on Wednesday, April 4, 2018.

Climate 2050 Discussion Paper

April 2018

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SERVICES AND SOLUTIONS FOR A LIVABLE REGION

Contents

Climate Change: Our Region's Challenge

Climate Change is both a global challenge and a local challenge, and it is already affecting our planet and our region in profound ways. Meeting the climate challenge requires bold leadership, creative thinking, and extensive collaboration. Cities and regional governments are at the forefront of global action on climate change. Much of the infrastructure as well as policies and initiatives that impact our neighbourhoods and daily lives are managed and coordinated through cities.

Climate projections for the 2050 timeframe include warmer temperatures and more extreme weather events. This region will experience longer, hotter, drier summers, while the fall and winter seasons will be warmer and wetter with decreased snowpack.

In 2008, the MVRD Board adopted a regional target of 80% reduction in greenhouse gas emissions below 2007 levels by 2050. This target was subsequently included in the *Metro 2040* plan (2011) and the *Integrated Air Quality and Greenhouse Gas Management Plan* (2011).

Metro Vancouver is well positioned to take action on climate change and is already pursuing innovative ways to reduce greenhouse gas emissions from its own operations, and is investing in the climate resilience of its own assets and infrastructure. Through strategic policies and programs, it is supporting its member jurisdictions, businesses, and residents to take their own actions to reduce emissions and adapt to the changing climate.

Proposed Climate 2050 Strategy

Metro Vancouver's 2015 to 2018 Board Strategic Plan places a strong emphasis on climate action, including a strategic direction to incorporate strategies and actions into all Metro Vancouver functions to mitigate and adapt to climate change, and to develop and implement a regional climate action strategy.

The intended purpose of the Climate 2050 strategy is to guide climate change policy and action.

Enhanced policies and actions are needed to protect the region's infrastructure, ecosystems, and people from climate impacts, and achieve meaningful greenhouse gas (GHG) reductions in the region by 2050. All levels of government and the private sector need to explore new approaches to doing business in order to create a robust and resilient low-carbon future.

This discussion paper provides context for the development of the Climate 2050 strategy. It summarizes the impacts that climate change is projected to have on this region, identifies the main sources of GHG emissions, articulates targets adopted by the Metro Vancouver Board, and describes Metro Vancouver's current actions on climate change. It also proposes a vision statement and guiding principles for regional climate action.

Climate Change Impacts in Our Region

Climate change impacts are already visible in our region, and will become more marked in the near future. Even if global greenhouse gas emissions were cut drastically tomorrow, our region – and the rest of the globe – will inherit the impacts of the previous 150 years of human generated GHG emissions, and the climate will continue to change.

Metro Vancouver's Climate Projections Report[1] provides details of the projected impacts of climate change in this region. There is confidence in the projections through to the 2050s. However, projections to 2080 and beyond are more uncertain, because the impacts in the latter part of this century are highly dependent on how successful the global community is at reducing greenhouse gas emissions in the next couple of decades. This underscores the importance of taking action now. (See Appendix 2 for more information on global climate change data and trends).

Climate Change Projections

At its foundation, climate change is projected to drive changes to weather patterns. The "new normal" for the region may be very unlike the past. Climate projections for the 2050 timeframe are described below.

- **Warmer temperatures:** with increasing daytime and nighttime temperatures, there will be more hot summer days and fewer winter days with frost or ice.
- **Longer summer dry spells:** summer rainfall will decline by nearly 20%, with increased likelihood of extended drought periods.
- **Wetter fall and winters:** although on average the total annual rainfall is expected to increase by just 5%, there will be a large increase in rainfall during fall and winter.
- **More extreme precipitation events:** more rain will fall during the wettest days of the year and the frequency of extreme rainfall events will increase.
- **Decreased snowpack:** the deep spring snowpack in the mountainous watersheds is expected to decrease by over 50% compared to present day.
- **Sea level rise:** in addition to these weather-related changes predicted in our region, warming global temperature will bring a projected 0.5 meters of sea level rise by 2050, which will impact coastal communities in our region.

Anticipated Climate Change Impacts

Across our region, changing weather patterns and sea level rise are expected to impact many regional services and lead to new concerns. Adaptation responses, including significant investment by the public and private sectors, will be required to upgrade our infrastructure, protect our ecosystems, and prepare for the impacts of climate change.

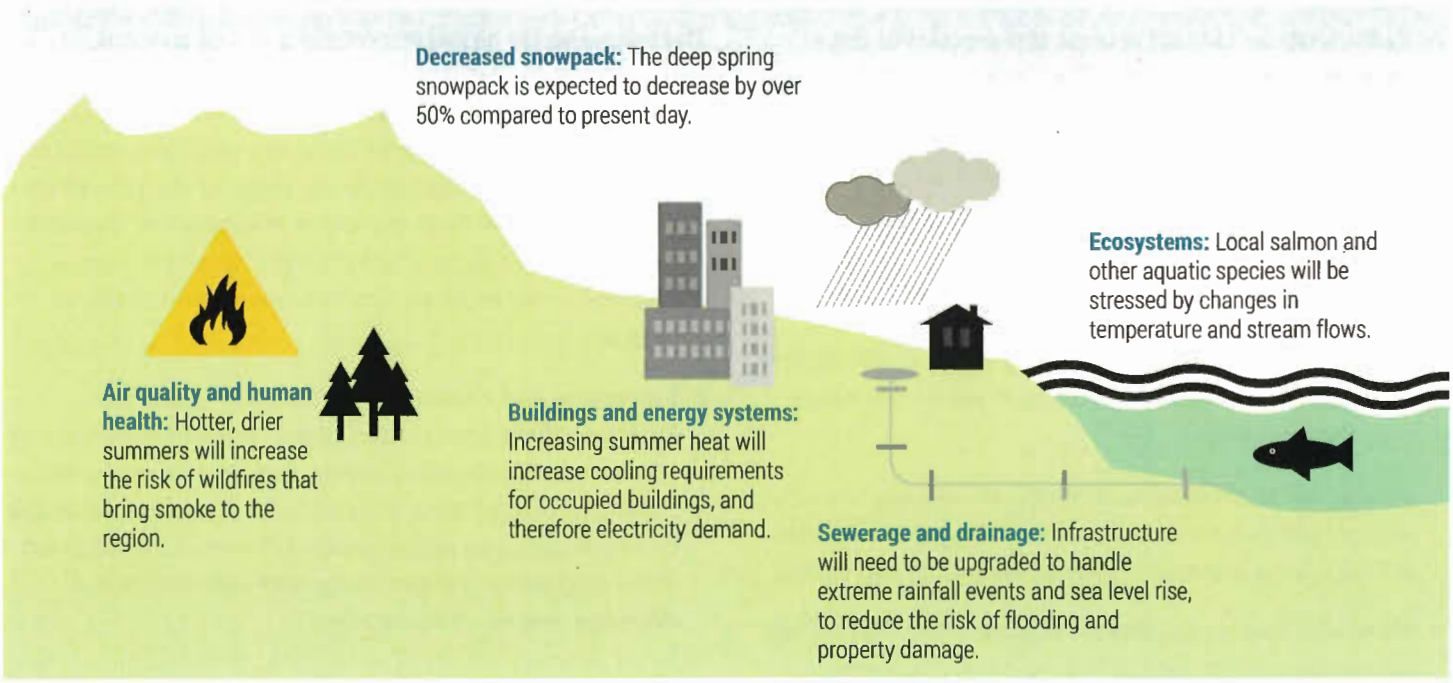
The following list highlights critical areas of concern.

- **Drinking water supply and demand:** Reduced snowpack and hotter, drier summers could put strain on the existing water supply during times of the year when temperatures are high and water is in greatest demand. The risk of landslides affecting water quality in supply reservoirs may increase due to extreme precipitation events.
- **Sewerage and drainage:** Wastewater treatment facilities will be impacted by higher influent volumes and sea level rise, increasing energy required for pumping. Sewers near the Fraser River and the ocean will be at risk of flooding due to sea level rise. Infrastructure will need to be upgraded to maintain current expectations of drainage and flood protection.

1 Climate Projections for Metro Vancouver, 2016

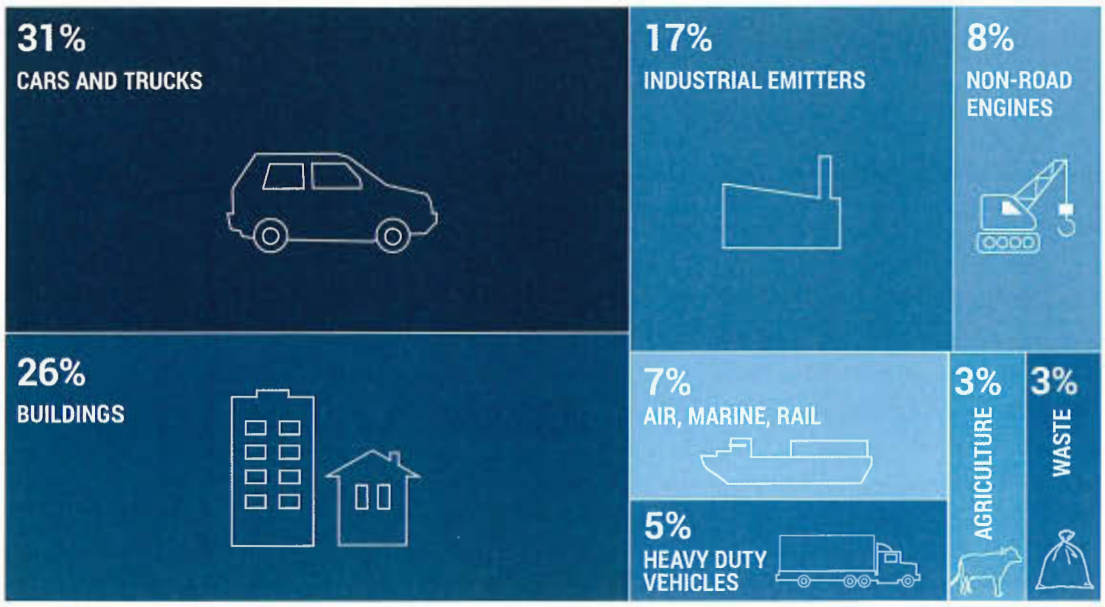
- **Ecosystems and agriculture:** As the climate shifts, it will disrupt the fragile equilibrium in our natural environment. The plants, trees, and animals within the ecosystems that have historically thrived in our region will be impacted.
- **Air quality and human health:** Increases in the number, extent and duration of wildfires will impact air quality in the Lower Fraser Valley. Air pollution expected in the Metro Vancouver region will include smoke from distant fires, and increases in ground-level ozone. Health impacts related to heat stress will also increase in a population not accustomed to higher temperatures.
- **Buildings and energy systems:** Increasing summer heat will increase cooling requirements for occupied buildings, and therefore electricity demand. This in turn will impact the provincial energy infrastructure, which is designed for peak winter demand. Energy efficiency and passive cooling will become increasingly important in buildings, and the business case to build and retrofit to high efficiency standards will improve.
- **Transportation, recreation and tourism:** Warmer winters and less frost may improve road safety and increase the opportunities to walk or cycle year round. However, warmer temperatures will mean less snow in the local mountains, which is a concern for the winter sport recreation industry.
- **Communities and infrastructure – flood risk:** sea level rise, storm surge, more extreme rainfall and changes in river hydrology all combine to increase the risk of flooding in Metro Vancouver communities. Most dikes were built in the 1970s and 1980s, and they were not designed to withstand the level of floods now projected. A major flood in this region could have direct and indirect losses estimated at $20-30+ billion, four to five times the losses from the Alberta floods of 2013. Flooding presents a risk to people, homes, businesses and infrastructure.

EXAMPLES OF CLIMATE CHANGE IMPACTS



Regional Sources of Greenhouse Gas Emissions

Every five years, Metro Vancouver compiles an emissions inventory which quantifies greenhouse gas emissions from the various sources across the region. Only a small fraction of the emissions are directly associated with the corporate activities of Metro Vancouver and its member jurisdictions. Metro Vancouver has an opportunity to influence regional emissions, particularly through its planning and policy functions, and through its role as a regional forum for its member jurisdictions.



The above figure provides a summary of how different sources contributed to the regional "carbon footprint" (about 15 million tonnes in 2015), based on the Emissions Inventory for the Lower Fraser Valley.[2]

2 2015 Lower Fraser Valley Emission Inventory

Regional Greenhouse Gas Reduction Target

In parallel with preparing for the unavoidable impacts of climate change, Metro Vancouver also recognizes its role in driving reductions in regional greenhouse gas emissions, the main cause of climate change. Metro Vancouver can advance our region's leadership in greenhouse gas reduction through innovative urban planning, targeted policy and regulation, and adoption of new low carbon technologies.

Scientists have indicated that the global community must reduce its emissions by 70% from 2010 levels by 2050

In the most recent Intergovernmental Panel on Climate Change (IPCC) report[3] , scientists have indicated that the global community must reduce its emissions by 70% from 2010 levels by 2050, and emissions levels should be near zero by 2100. This level of reduction is needed to stay within a 2°C rise in global temperature, in order to reduce the risk of catastrophic impacts of climate change.

In 2008, the MVRD Board adopted a regional target of 80% reduction in greenhouse gas emissions below 2007 levels by 2050. This target was subsequently included in the *Metro 2040* plan (2011) and the *Integrated Air Quality and Greenhouse Gas Management Plan* (2011).

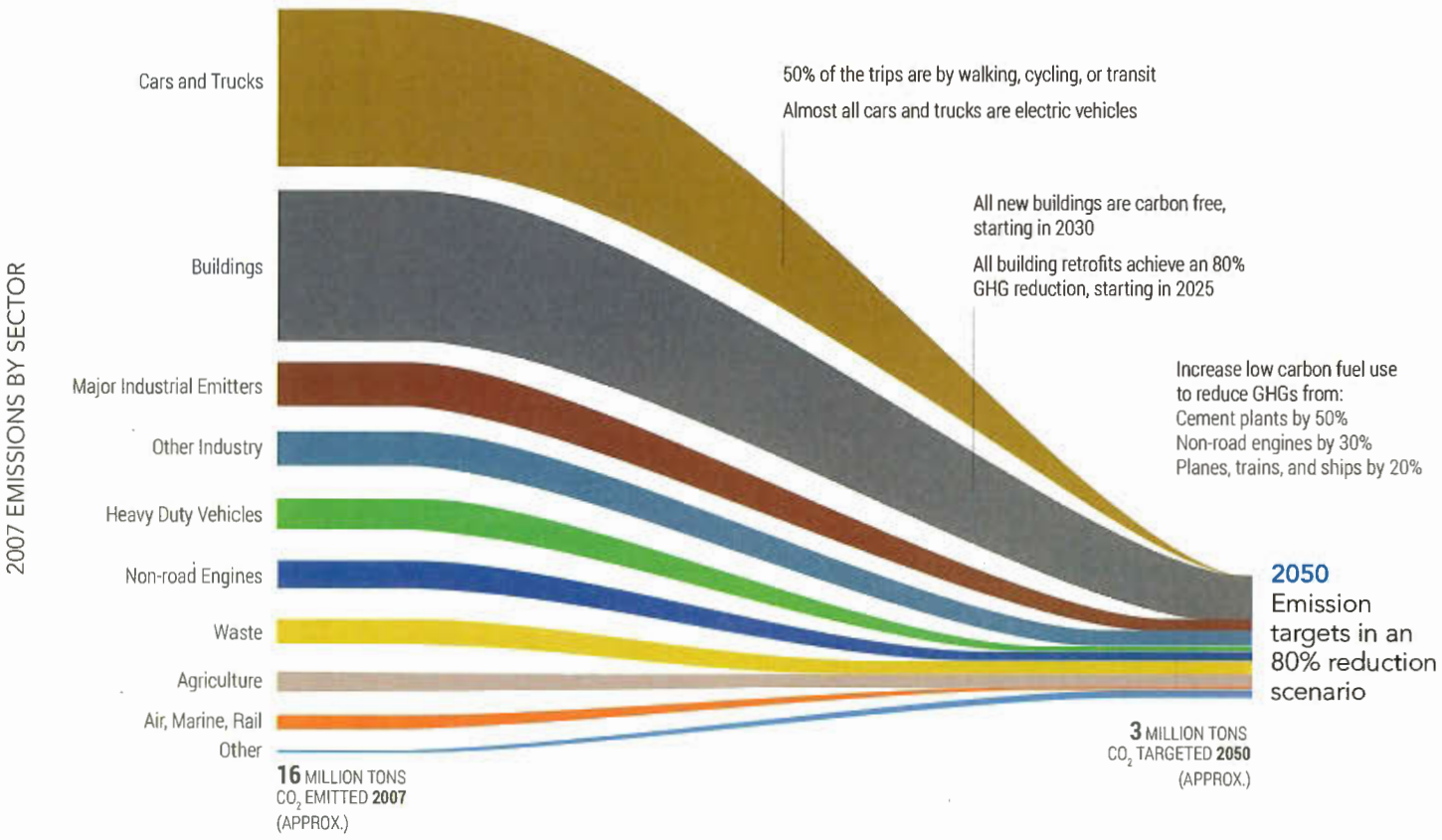
Regional emissions are influenced by policies and actions undertaken by all orders of government, as well as by individual decisions made by businesses and residents. There are some indications that the combined efforts to reduce emissions are having an impact – total greenhouse gas emissions in the region have remained steady for the past decade even in the face of population and economic growth. The challenge in the coming years will be to reduce emissions substantially even as the population and economy continue to grow.

3 IPCC, 2014: Summary for Policymakers

Getting to 80% by 2050

Reaching the 80% reduction target by 2050 (from 2007 levels) will require unprecedented greenhouse gas emission reductions across most sectors, with some sectors becoming essentially "zero emissions". In order to illustrate the magnitude and scope of the change necessary to reach an 80% greenhouse gas reduction target, below is one possible scenario demonstrating how the region could reach the greenhouse gas reduction target by 2050.

SCENARIO FOR GETTING TO 80% GHG REDUCTION BY 2050



Metro Vancouver's role in climate change

Metro Vancouver is well positioned to establish policies and take actions that protect the region's infrastructure, ecosystems, and people against climate impacts in our region. Metro Vancouver is pursuing innovative ways to reduce greenhouse gas emissions, and is investing in the climate resilience of its own assets and infrastructure. Through strategic policies and programs, Metro Vancouver is supporting its member jurisdictions, businesses, and residents to take their own actions to reduce emissions and adapt to the changing climate.

Planning for the future of our region is another of Metro Vancouver's core roles. It has become critical to consider climate change in all planning endeavors, because the impacts of climate change are already affecting our region in profound ways and are projected to increase over coming decades. Changes in weather patterns and rising sea level will impact many core regional services, including drinking water supply, liquid waste management, air quality management, and regional parks. Negative impacts on our communities, businesses, agriculture, and transportation systems, as well as disruption to sensitive ecosystems, can also be expected.

Authority and Mandate

Metro Vancouver's 2015 to 2018 Board Strategic Plan places a strong emphasis on climate action, including a strategic direction to incorporate strategies and actions into all Metro Vancouver functions to mitigate and adapt to climate change, and to develop and implement a regional climate action strategy. Metro Vancouver's actions on climate change will fall under the areas of delivery of core services, planning for the future, and acting as a regional forum.

Metro Vancouver's authority and mandate to address climate change flows from several areas of legislation and policy. The *Green Communities Act (Bill 27)* requires regional growth strategies to include targets for reducing greenhouse gas emissions and proposed policies and actions for achieving those targets. Under the *Environmental Management Act*, Metro Vancouver has the delegated authority to provide the service of air pollution control and air quality management and may, by bylaw, prohibit, regulate and otherwise control and prevent the discharge of air contaminants. Also under the Act, as regulatory instruments Waste Management Plans can address strategic and operational requirements that are specific to a local government's solid waste and liquid waste services such as responding to climate impacts and reducing GHG emissions.

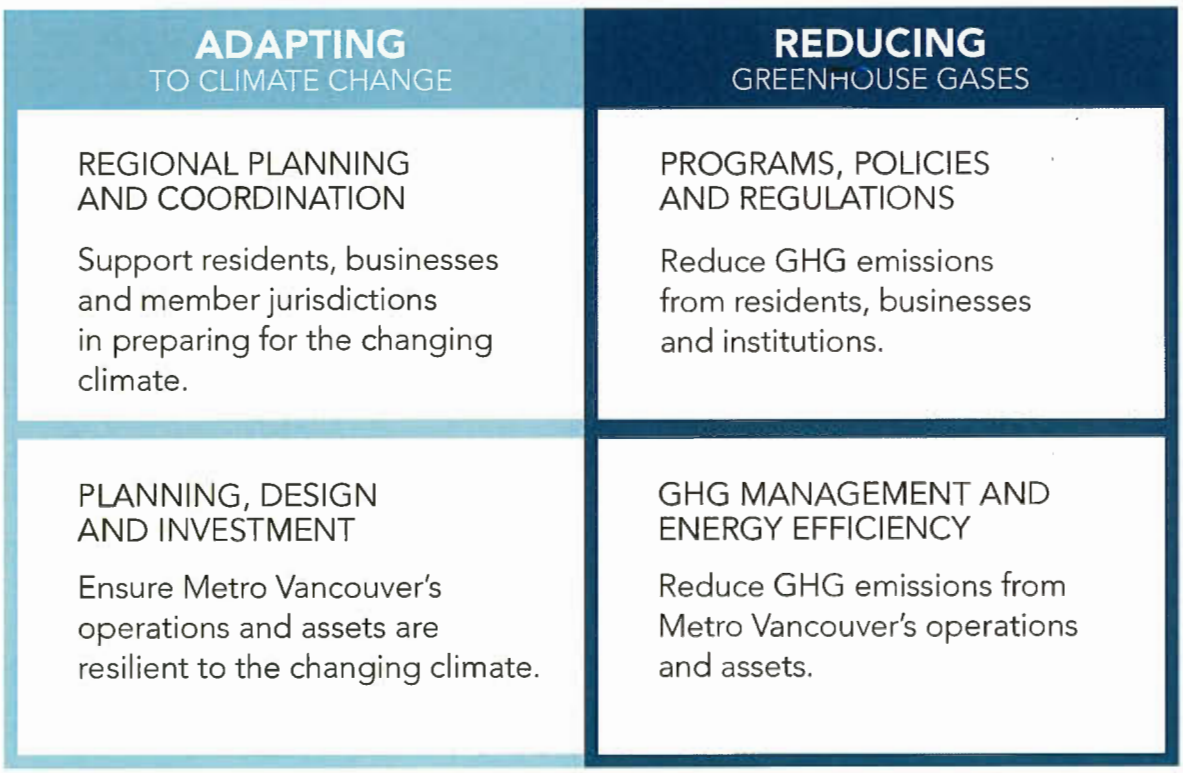
In addition, in 2009, Metro Vancouver signed the *BC Climate Action Charter*, making the voluntary commitment to take actions to become carbon neutral in its corporate operations and reduce community-wide emissions by creating more complete, compact and energy efficient rural and urban communities. Further discussion of Metro Vancouver's role and authority is included within the Issue Area Summaries in Appendix 1.

Current Climate Actions

For more than 15 years, Metro Vancouver has taken a leadership role in the region's response to climate change, and climate actions are embedded in its existing management plans. Many climate-related actions and initiatives have been taken in close collaboration with the member jurisdictions. Metro Vancouver has adopted foundational policies such as those in *Metro 2040*, the regional growth strategy, which sets the vision and land use framework to encourage compact, complete communities and support low carbon forms of transportation like walking, cycling and transit. Metro Vancouver has also delivered a number of regional programs to reduce greenhouse gas emissions from vehicles, buildings, and businesses.

Within the water, liquid waste and solid waste utilities, Metro Vancouver has shown corporate leadership by reducing greenhouse gases from its own operations and recovering resources and energy from its waste streams, as well as planning for the impacts of climate change on our infrastructure.

Metro Vancouver has established regional climate projections to inform planning for major infrastructure projects that will be impacted by climate change over the coming decades. The climate projections will be revised at regular intervals, to ensure that decisions that might be impacted by climate change are informed by the best available information for the region. Further discussion of Metro Vancouver's current climate actions is included within the Issue Area Summaries in Appendix 1.



Participation in Climate Action Networks

Metro Vancouver is connected with international organizations with a focus on local government climate action including ICLEI – Local Governments for Sustainability and UN-Habitat's Cities and Climate Change Initiative . These are in addition to Metro Vancouver's membership with the Federation of Canadian Municipalities (FCM) , which provides a convening forum for discussion and programs and support for municipalities planning for climate action. Two FCM initiatives that are relevant for Metro Vancouver are the Partners for Climate Protection Program and the Municipalities for Climate Innovation Program.

Metro Vancouver and local member municipalities also have a variety of connections to effective local government climate action initiatives, including: BC Municipal Climate Leadership Council; BC Regional Adaptation Collaborative Program; Global Covenant of Mayors for Climate & Energy; and Renewable Cities.

Vision Statement

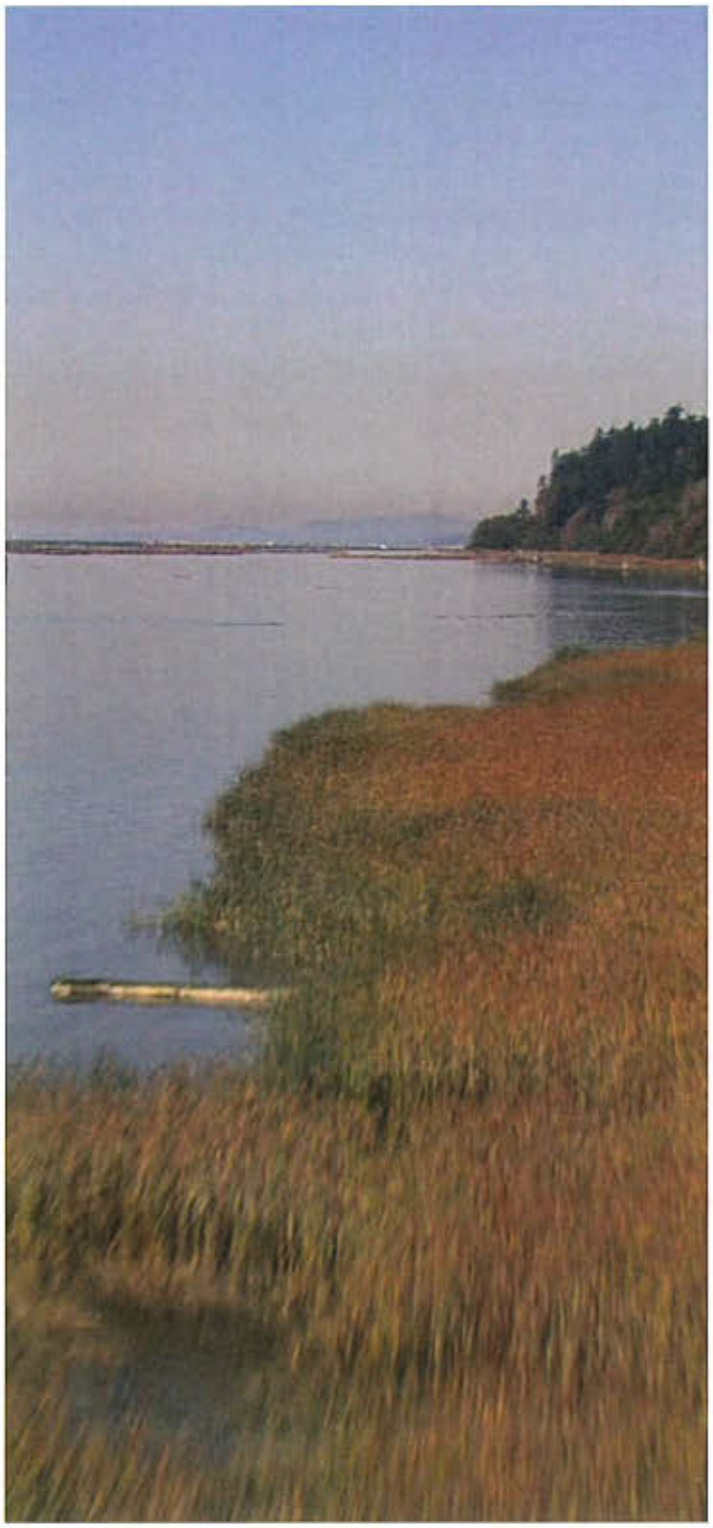
Metro Vancouver has played a leadership role in the region's response to climate change over the past 15 years. Metro Vancouver's vision statement for Climate 2050 embodies the need for our region to both reduce emissions of greenhouse gases and prepare for the changes from a warming climate.

Climate 2050's vision statement recognizes direction from Metro Vancouver's 2015 to 2018 Board Strategic Plan to incorporate strategies and actions into all Metro Vancouver functions to mitigate and adapt to climate change.

CLIMATE 2050 VISION STATEMENT

Metro Vancouver demonstrates bold leadership in responding to climate change

- Ensuring our infrastructure, ecosystems, and communities are resilient to the impacts of climate change
- Pursuing a regional target of 80% reduction in greenhouse gas emissions from 2007 levels by 2050.



Guiding Principles

To guide the Climate 2050 Strategy, the following principles have been identified that reflect Metro Vancouver's mandate and role and the specific climate challenges of our region. These principles are based on the United Nations-Habitat principles for local-level climate action, which were established to encourage consistent and comparable approaches to developing effective climate action planning by local and regional governments around the world.[4]

THE CLIMATE 2050 STRATEGY IS:

- **Ambitious** – Demonstrate global and local leadership by ambitiously tackling our local climate challenges.
- **Dynamic** – Evolve our approach to respond to new information, support innovation, and take advantage of opportunities.
- **Evidence-based** – Inform decision-making with the most current scientific knowledge and local understanding to assess vulnerability and emissions.
- **Relevant** – Design actions to respond to Metro Vancouver's unique challenges and opportunities and deliver local benefits.
- **Comprehensive** – Undertake climate actions across Metro Vancouver's functions and support actions across sectors and communities.
- **Integrated** – Ensure actions are integrated with other municipal and regional policy priorities and are coordinated with Provincial and Federal initiatives.
- **Fair** – Seek solutions that equitably address the risks of climate change, share the costs and benefits of action, and support a livable and affordable region, including responsibility to future generations.
- **Actionable** – Propose actions that can realistically be implemented given Metro Vancouver's mandate, finances and capacities; if necessary evaluate changes to mandate.
- **Inclusive & Collaborative** – Involve Metro Vancouver's members, strategic partners and communities in the planning and implementation of the Climate 2050 Strategy.
- **Transparent & Verifiable** – Follow an open decision-making process, and set goals that can be measured, reported, verified, and evaluated.

4 The United Nations-Habitat principles were generated through a robust, global, multi-stakeholder process including climate action NGOs, academics, engineering and planning associations, and public agencies, and have been endorsed by multiple global organizations including ICLEI-Local Governments for Sustainability, UCLG (United Cities and Local Governments), and FCM (Federation of Canadian Municipalities), among many others. See: http://e-lib.iclei.org/wp-content/uploads/2016/02/Guiding-Principles-for-City-Climate-Action-Planning.pdf

Conceptual Framework

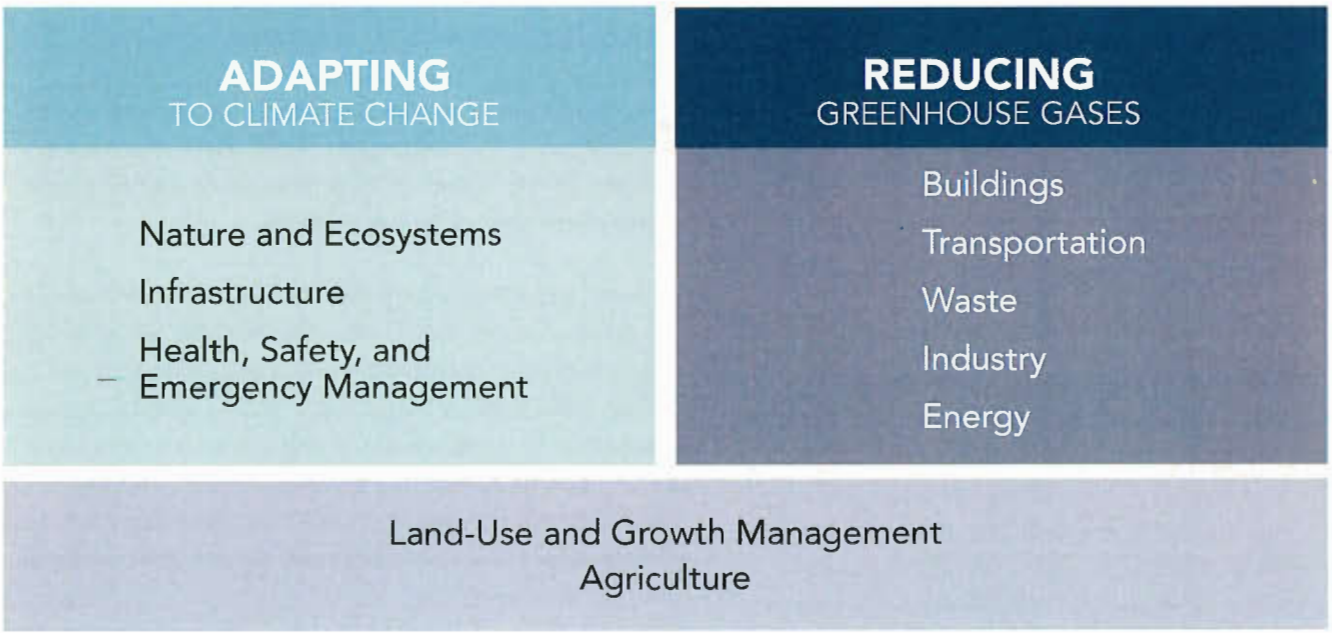
Issue Areas

The Climate 2050 Strategy will be organized around ten Issue Areas, intended to provide logical groupings of climate actions, while recognizing the range of climate change-related initiatives and specific circumstances in Metro Vancouver's populous and diverse region. In some cases, two issue areas may apply to a given activity. For example, progressive waste management also offers opportunities to generate low carbon, renewable energy.

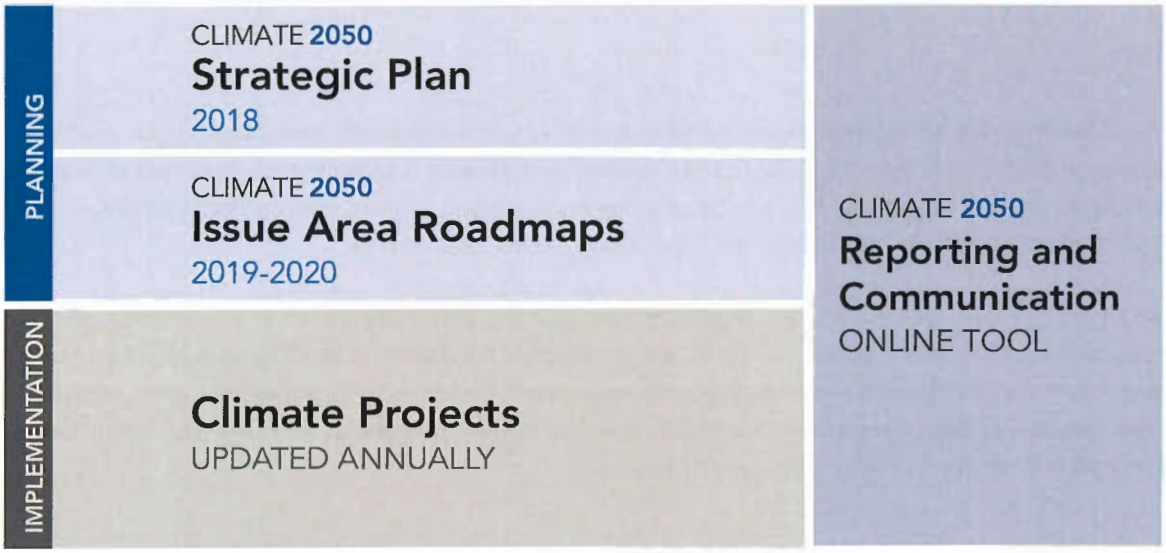
Three Issue Areas are primarily related to adapting to climate change, and these reflect the functions and responsibilities under Metro Vancouver's mandate that will be significantly impacted by changing weather patterns and sea level rise. Five Issue Areas are primarily related to reducing greenhouse gases, and reflect the major emissions sources in the region and opportunities for low carbon alternatives. Two additional Issue Areas, Land-Use and Growth Management, and Agriculture, cut across both climate adaptation and mitigation.

The Climate 2050 strategy will establish a framework to develop and implement dynamic Roadmaps for future climate action by Metro Vancouver, organized around the Issue Areas.

The Issue Areas are shown below, and further descriptions of each Issue Area can be found in Appendix 1.



Framework of the Climate 2050 Strategy



THE FOUR COMPONENTS OF THE CLIMATE 2050 STRATEGY WILL BE:

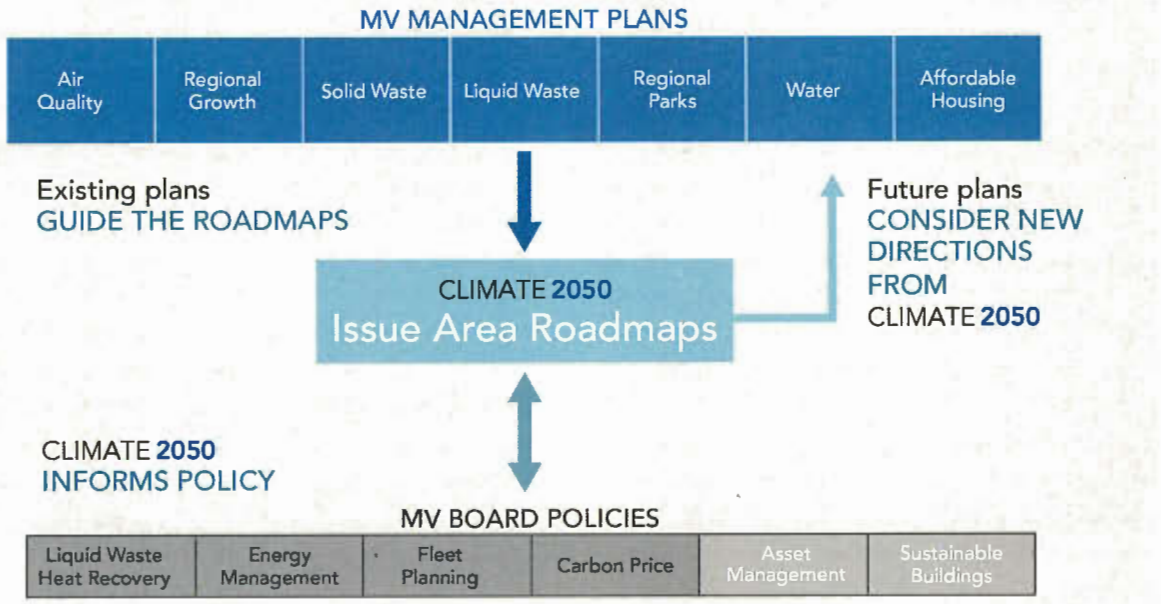
Climate 2050 Strategic Plan: The Strategic Plan sets out the 30-year vision for Metro Vancouver's climate policies and actions, lays out guiding principles, and describes a dynamic approach. It will include a discussion of the roles and responsibilities of Metro Vancouver and others as they relate to climate change. The Plan will also include summaries for each of the key issue areas that will form the foundation for the development of the Issue Area Roadmaps (see below). The aim is for the Strategic Plan to be finalized in 2018.

Climate 2050 Issue Area Roadmaps: The Issue Area Roadmaps will set out how Metro Vancouver will achieve the 30-year vision of a resilient, low carbon region. They will outline in more detail the regional and corporate goals, strategies, actions, and performance metrics for each Issue Area. Over time, the Roadmaps will evolve dynamically in response to new technologies and innovation, policies of senior governments, or other emerging factors. The Issue Area Roadmaps will be consulted on and developed in 2019 and 2020, following adoption of the Climate 2050 Strategic Plan.

Climate Projects: The roadmaps will guide the development of specific climate projects for Metro Vancouver. Projects will be identified and approved through regular annual work plans, budgets, and 5-year financial plans. Staff will report to the Metro Vancouver standing committees and Boards to seek guidance and approval for major Climate Projects.

Climate 2050 Reporting and Communication Tool: All of the above components of the Climate 2050 Strategy will be supported by an online reporting and communication tool. This dynamic hub for climate actions will feature illustrative examples of current actions from both Metro Vancouver and its members, facilitate sharing of best practices, provide feedback opportunities, contain background and reference materials, and report on targets and measures.

Relationships to Other Plans and Policies



Climate 2050 will be closely linked to Metro Vancouver's other plans and policies. Once the Climate 2050 Strategic Plan is adopted, its vision and guiding principles will inform the development of Issue Area Roadmaps that will guide actions and projects across the organization. The Roadmaps will build on climate actions that have already been adopted in the existing management plans while also proposing new directions that can be considered in future management plans, consistent with the respective authorities for each. The Roadmaps may also propose revisions or implementation actions for existing climate related policies, or the development of new Board policies that can help guide decision-making around specific climate related issues impacting the organization.

Dynamic Approach: a living, breathing plan

Recognizing the magnitude of the climate challenge, the evolving nature of climate science, and the need for policy responses to be adaptive, a dynamic approach is needed in the development and implementation of Climate 2050.

The Roadmaps will be developed with a five-year planning horizon, but they can be updated more often if opportunities or approaches arise that can accelerate progress towards the goals. These time frames are intended to synchronize with annual budget and work plan cycles and five year financial plans. Performance metrics will be identified in the Roadmaps to track progress towards the goals.

In addition, the Climate 2050 Reporting and Communication Tool will be a dynamic online hub that will contain the most up to date information on the implementation of the Climate 2050 Strategic Plan, as well as information on key actions of others, including member jurisdictions.

Roles and Responsibilities of Other Orders of Government

The **Provincial Government** adopted the BC Climate Leadership Plan in 2016 and has established a new BC Climate Solutions and Clean Growth Advisory Council to advise on future climate policy. The Provincial government sets transportation policy that affects Provincial roads and highways, as well as energy policy (including the mandate of BC Hydro). It has established the Provincial carbon tax, it sets building standards through the building code, and it regulates certain industries key to reducing emissions. It also collects tax revenue for large infrastructure investments such as transit, roads, bridges and dikes.

The **Federal Government** adopted the Pan-Canadian Framework on Clean Growth and Climate Change as the national climate change plan. It has jurisdiction over policies to set standards and regulate the design and manufacture of many products that directly or indirectly contribute greenhouse gas emissions (e.g., vehicles, appliances, buildings, industrial and commercial equipment). It is responsible for regulating emissions on Federal lands, including ports, airports, and rail corridors, and shipping lanes. The Federal government has also set a national carbon price to help drive down greenhouse gas emissions, and established several funding mechanisms related to the Pan-Canadian Framework, including the Clean Energy Fund, the Green Municipal Fund, the Clean Growth Hub, and the Low Carbon Economy Fund.

First Nations in the Metro Vancouver region provide services to their communities that will be impacted by climate change. A number of First Nations in the region have adopted sustainability and/or land use plans that include their response to climate change. The Tsawwassen First Nation is a member jurisdiction and has similar authority and powers as other member jurisdictions with respect to climate change.

Member Jurisdictions are also taking actions to ensure their communities are adapting to climate change and reducing GHG emissions. Many have adopted climate action plans. They are using their land-use planning authority to encourage the growth of compact communities and investments in transit and cycling infrastructure that enables low carbon transportation. They are also responsible for enforcing the building code and can adopt the BC Energy Step Code to encourage lower carbon buildings. Members have a key role in preparing for the impacts of climate change, including investments in stormwater infrastructure and dikes, and responding to emergencies such as flooding in their communities. All of the municipalities in Metro Vancouver have shown leadership by signing the *BC Climate Action Charter* for local governments.

TransLink is responsible for long-term investments in transit and regional road and bridge infrastructure that enable low carbon transportation options. It is also responsible for regional transportation demand management programs that encourage residents to choose low carbon forms of transportation. Through its management of and investment in the transit fleet it can also reduce greenhouse gas emissions from transit vehicles.

The **major energy utilities** in the region (BC Hydro and Fortis BC) are responsible for energy supply and distribution. They are responsible for policies and infrastructure investments that will increase the supply of low carbon energy to the region. They administer energy conservation incentives to encourage residents and businesses to reduce their energy demand and indirectly reduce greenhouse gas emissions. Energy utilities will also play a key role in ensuring that our energy infrastructure is resilient to the impacts of climate change both inside and outside the region.

Summary

The Climate 2050 strategy will be an overarching climate action strategy for Metro Vancouver.

It will outline Metro Vancouver's vision and goals to both reduce greenhouse gas emissions and adapt to climate impacts. It will describe Metro Vancouver's role in taking action on climate change, and provide strategic direction on how to integrate climate change considerations in all decisions and policies.

The Climate 2050 strategy will establish a framework to develop and implement dynamic roadmaps for future climate action by Metro Vancouver, and will facilitate learning and sharing of best practices with our members and others.

Transparency and collaboration is a guiding principle for the Climate 2050 process. Metro Vancouver is committed to an open decision-making process, and to setting goals that can be measured, reported, and evaluated. In addition to working closely with its member jurisdictions, Metro Vancouver recognizes that businesses, residents, and other stakeholders have a critical role in achieving climate goals. The next step in the Climate 2050 process will be engagement with key stakeholder groups, including but not limited to member jurisdictions, First Nations, Provincial Government, Federal Government, TransLink, and the energy utilities.

While Metro Vancouver has been undertaking climate action planning and responses for over 15 years, more comprehensive and strategic action is needed to continue on and enhance the improvement trajectory it has started on.

Addressing the challenge of climate change requires bold leadership, creative thinking, and extensive collaboration.

All levels of government, as well as the private sector, will need to explore new approaches to doing business in order to create a robust and resilient low-carbon society.

YOUR FEEDBACK ON THE CLIMATE 2050 DISCUSSION PAPER

Metro Vancouver welcomes and invites feedback to inform the development of the Climate 2050 Strategic Plan. This Discussion Paper includes many of the elements that will be included in the Strategic Plan. Although feedback on any content in the Discussion Paper is appreciated, Metro Vancouver is specifically seeking comments on the following;

BACKGROUND INFORMATION AND CONTEXT

Which background information do you think is most important to understanding the context and rationale for taking action to address climate change? Were there any key pieces of information missing? (page 5)

VISION STATEMENT

Please provide any feedback on the Vision. Does it reflect the level of response to climate change you expect from Metro Vancouver? (page 13)

GUIDING PRINCIPLES

Please provide any feedback on the Guiding Principles. Do they reflect the criteria that Metro Vancouver should consider when evaluating climate goals, strategies and actions? (page 14)

ISSUE AREAS

Do the issue areas reflect logical and comprehensive groupings of climate goals, strategies, and actions you would expect Metro Vancouver to undertake? Are they properly described? Have we missed any issue areas or would you combine some issue areas? (page 15)

STRATEGIC PRIORITIES

What do you see as the strategic priorities in the issue areas you are most familiar with?

Note that there will be future engagement opportunities on the specific goals, strategies and actions that will form Issue Area Roadmaps (as described on page 16). Climate 2050 is intended as a dynamic, evolving climate action strategy that will be responsive to innovation, new ideas and emerging technologies over the next 30 years.

You have the following opportunities to provide feedback: online feedback forms, open comments to a dedicated email account, participation in a public dialogue or stakeholder forum, and direct feedback to Metro Vancouver staff. Details about consultation events will be posted on the Climate 2050 webpage. Feedback may be provided by email at Climate2050@metrovancouver.org or by telephone through 604-432-6200.

Comments and suggestions will be compiled into a summary report for consideration by the Metro Vancouver Board, and will be made publically available in Fall 2018. To ensure your comments are fully considered please provide feedback before June 30, 2018.

Thank you for taking the time to provide your valuable feedback. For more information, visit metrovancouver.org and search Climate 2050, or call 604-432-6200.

APPENDIX 1: Issue Area Summaries

This Appendix contains ten Issue Area Summaries, which are intended to provide logical groupings of climate actions, while recognizing the range of climate change-related initiatives and specific circumstances in Metro Vancouver's populous and diverse region. Each Issue Area Summary includes the following information:

Introduction

- Describes the how the activities within the Issue Area contribute to GHG emissions and/or are impacted by climate change, and describes some of the potential opportunities to reduce GHG emissions and/or respond to impacts.

Metro Vancouver's role and authority

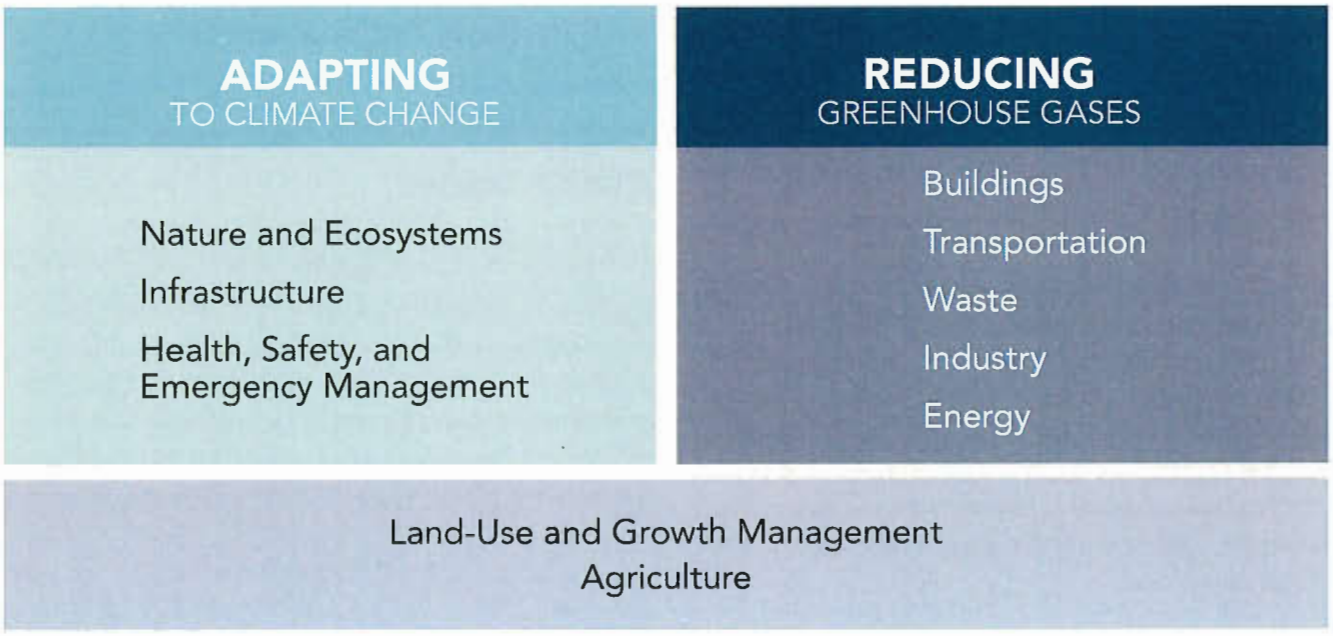
- Describes Metro Vancouver's legislated authority and regional government roles, as they relate to reducing GHG emissions and responding to the impacts of climate change.

Metro Vancouver's current climate actions

- Provides a few examples of the current climate actions that Metro Vancouver is taking in this Issue Area. This list is intended to be illustrative, (to support dialogue), and is not meant to be comprehensive.

Current climate actions of other orders of governments and key stakeholders.

- Provides a few examples of the current climate actions that other orders of government and key stakeholders are taking in this Issue Area. This list is intended to be illustrative, (to support dialogue), and is not meant to be comprehensive.



Nature and Ecosystems

Metro Vancouver is a region with a rich and diverse natural environment that provides essential ecosystem services including stormwater management, pollination, flood management, and cooling that addresses urban heat island effects. Forests and wetlands and other ecosystems contribute to the regulation of the global climate by removing and storing carbon dioxide from the atmosphere.

However, the health of these ecosystems is deteriorating and is vulnerable to further degradation, especially with a changing climate. Many species and ecosystems in the region are at risk of being impacted or displaced entirely due to climate change because they cannot adapt fast enough. Metro Vancouver is building ecological resilience by conserving habitat as part of the regional parks network, and considering ecosystems in decision making.

Metro Vancouver's Authority and Role

Under the *Local Government Act*, Metro Vancouver develops and stewards *Metro Vancouver 2040: Shaping our Future* (*Metro 2040*), the regional growth strategy, which sets a regional policy framework for containing and directing growth, protecting important lands, and supporting the efficient provision of urban infrastructure. Containing urban growth helps protect important lands for conservation and recreation, agricultural and rural uses, which also provide valuable ecosystem services.

Metro Vancouver delivers local government services to Electoral Area A, which includes Barnston Island and communities along Howe Sound, Indian Arm and the west side of Pitt Lake, and this role includes managing the ecosystems in these largely rural areas. Metro Vancouver manages the region's water supply areas, which comprise large tracts of natural areas and sensitive ecosystems that are essential for maintaining the quantity and quality of the region's drinking water.

Metro Vancouver develops regional datasets (e.g., sensitive ecosystems, land cover, carbon storage, agricultural land use) that are used to monitor regional ecological health in the face of climate change and inform decision-making.

Metro Vancouver's *Ecological Health Plan* identifies Metro Vancouver's roles in protecting and enhancing ecological health in relationship to delivery of core utility services and functions. Metro Vancouver, through its actions, also supports the efforts of its members, residents, and environmental organizations to protect and enhance local ecosystems.

Metro Vancouver operates a system of regional parks and greenways. The system comprises approximately 14,500 hectares of land, including 23 regional parks, 5 greenways, 3 regional park reserves, and 2 ecological conservancy areas. Through the regional parks system, Metro Vancouver helps to protect important natural areas and provides opportunities for the region's residents and visitors to connect with, enjoy and learn about nature and ecology. Metro Vancouver invests in a re-vegetation program in its regional parks which restores degraded sites, enhances biodiversity, and promotes ecosystem resilience.

Examples of Metro Vancouver's current climate actions

URBAN FOREST CLIMATE ADAPTATION FRAMEWORK

Metro Vancouver conducted a study in 2016 to identify the climate risks facing urban forests, assess regional vulnerability of the existing urban forest and develop guidelines for building resilience and maximizing the adaptation benefits of urban trees. The information informs urban forest planning and climate adaptation strategies.

GROW GREEN GUIDE

Metro Vancouver, in collaboration with UBC Botanical Garden, developed the Grow Green Guide – an online resource for residents to grow eco-friendly lawns and gardens. The website recommends plants that are suitable for this region, and are waterwise, non-invasive, and support biodiversity.

IMPROVING ECOLOGICAL HEALTH AND CARBON SEQUESTRATION POTENTIAL AT BURNS BOG

Metro Vancouver, in partnership with the University of Victoria, is testing ways to enhance ecological recovery in coastal bogs that have been damaged by clearing for agriculture. This study is examining the potential for peat restoration at Burns Bog, with potential to reduce methane emissions and restore the bog's ability to sequester carbon.

INVASIVE SPECIES MANAGEMENT

Metro Vancouver actively controls priority invasive species within our watersheds, regional parks and other Metro Vancouver lands. Metro Vancouver also supports region-wide efforts to manage invasive species by coordinating the Regional Planning Advisory Committee - Invasive Species Subcommittee, and working with partners to develop locally-relevant best management practices and educational materials.

SUSTAINABILITY INNOVATION FUNDS

The Metro Vancouver Board created the Sustainability Innovation Funds to provide financial support for innovative projects that contribute to the region's sustainability. Three separate funds exist, for projects in the areas of liquid waste, water, and the broader MVRD mandate. The funding criteria includes partnerships with member jurisdictions, academia, and community groups. These funds have supported a number of ecosystem enhancement and education projects including the Grow Green Guide and the Burns Bog projects mentioned above, as well as the Roof to Creek Natural Drainage and Habitat Learning Landscape at Kanaka Creek Regional Park.

Examples of climate actions of others

FEDERAL GOVERNMENT PROGRAMS

Federal responsibility includes protection and management of all marine species, most fish species, migratory birds, nationally significant wildlife areas (e.g., Alaksen and Widgeon Valley), recovery strategies for endangered species, research on wildlife issues of national importance, and international wildlife treaties and issues.

INTEGRATED STORMWATER MANAGEMENT PLANNING

Most member jurisdictions of Metro Vancouver have initiated Integrated Stormwater Management Planning (ISMP) for watersheds in their community. These plans aim to incorporate drainage, environment, and land use planning functions within a watershed in order to address potential stormwater impacts on a community.

GREEN SHORES INITIATIVE

The Green Shores Initiative of the Stewardship Centre for BC promotes practices that restore and protect the natural shoreline in developed areas. Shoreline restoration and protection approaches can benefit ecosystems, and help maintain the beauty of shorelines for communities; they can also be a cost-effective way to address sea level rise.

MUNICIPAL NATURAL ASSETS INITIATIVE

The Municipal Natural Assets Initiative (MNAI) provides scientific, economic and municipal expertise to support and guide local governments in identifying, valuing and accounting for natural assets in their financial planning and asset management programs, and in developing leading-edge, sustainable and climate resilient infrastructure.

Infrastructure

Local government infrastructure is foundational to the region's economy and its residents' quality of life. The reservoirs, pipes, pumps, treatment plants, roads, power lines, dikes, and other built infrastructure provide essential services such as drinking water, sewage treatment, stormwater drainage, solid waste disposal, the transportation network, and energy to residents and businesses. The region's water, wastewater and drainage infrastructure is vulnerable to anticipated climate change impacts such as increasing frequency of extreme precipitation events that will increase localized flooding and may overwhelm sewer systems, and heat and drought that will challenge the drinking water system.

Incorporating climate change considerations into local government infrastructure planning, design and operation can help maintain these essential services in the face of climate impacts. By considering climate change, local governments can invest in actions that improve infrastructure and contribute to the overall resilience of the region. By jointly considering climate risks with other physical risks such as seismic events, local government may be able to find cost efficiencies and more effective approaches to infrastructure upgrades.

In addition, the construction and operation of infrastructure contributes to greenhouse gas emissions in the region. Innovation in infrastructure design, upgrades, and operation can significantly reduce greenhouse gas emissions.

Metro Vancouver's Authority and Role

Metro Vancouver plans, designs, builds, operates and maintains utility infrastructure for its member jurisdictions. This infrastructure provides services related to drinking water, wastewater, drainage, and solid waste. These services are provided through two legal entities: the Greater Vancouver Water District and Greater Vancouver Sewerage & Drainage District.

The funds to build, operate and maintain this regional infrastructure are primarily provided through a fee system with Metro Vancouver's member jurisdictions. In order for Metro Vancouver to cost-effectively plan and optimize the value of its infrastructure investments, it is necessary to anticipate and prepare for the impacts of climate change.

Examples of Metro Vancouver's Current Actions

DESIGNING FOR SEA LEVEL RISE

When designing new infrastructure or upgrading existing infrastructure, Metro Vancouver considers the specific climate change impacts projected for the region, such as sea level rise and increasing storm surge for a variety of existing and future low-lying utility assets. For example, anticipated sea level changes have been taken into account in designing the new North Shore Wastewater Treatment Plant, where all critical equipment is placed above projected flood levels. The same considerations are designed into the upgrades to the Annacis Island Wastewater Treatment Plant. Infrastructure replacement and renewal provides opportunities to adapt to anticipated climate changes.

SEWERAGE AREA VULNERABILITY ASSESSMENTS

Metro Vancouver has completed vulnerability assessments for two of its five sewerage areas: the Vancouver Sewerage Area (2008) and the Fraser Sewerage Area (2009). These vulnerability assessments help Metro Vancouver understand and plan for the impacts of climate change on sewerage infrastructure including sewage collection systems and wastewater treatment plants.

DESIGNING DRAINAGE AND SEPARATED SEWERS FOR FUTURE PRECIPITATION

Metro Vancouver works with its member jurisdictions to study anticipated rainfall changes due to climate change and then translate this information into criteria for assessing and designing regional drainage and municipal stormwater systems. Using new data and sophisticated techniques, Metro Vancouver is currently updating the future rainfall scenarios in Climate Change (2050) Adjusted IDF Curves: Metro Vancouver Climate Stations. This updated information can guide the separation of combined sewers that convey sewage and stormwater in the same pipe and the design of new storm sewers for the climate change adjusted rainfall requirements.

COMPREHENSIVE REGIONAL WATER SYSTEM PLAN

Metro Vancouver is developing a Comprehensive Regional Water System Plan that outlines a strategy to the start of the next century including enhanced resilience to climate change. Vulnerability assessments indicate that phased storage upgrades will be required to account for factors such as reduced snowpack and hotter, drier summers. The timing and scope of upgrades have been developed for a range of plausible future climate scenarios.

WATER CONSERVATION AND REUSE

Metro Vancouver delivers drinking water to member jurisdictions for distribution to homes and business. Significant regional and local government efforts are planned or underway to limit non-essential use of treated drinking water (including changes to lawn watering regulations in the regional Drinking Water Conservation Plan). Conservation will become even more important as the summer climate becomes hotter and drier. Opportunities for reuse of greywater and rainwater are also being considered by Metro Vancouver and local governments to reduce the need for potable water. Minimizing waste of drinking water improves the region's water resiliency by allowing for additional supply capacity to cope with impacts from a changing climate.

METRO VANCOUVER'S WATER CONSERVATION CAMPAIGNS

The "We Love Water" conservation campaign promotes mindful and responsible use of drinking water, reducing stress on the region's drinking water infrastructure. Residents are encouraged to use a little less water by adopting simple habits around their homes, while increasing their awareness and pride in the region's water system.

Examples of climate actions of others

LOCAL GOVERNMENT CLIMATE ADAPTATION PLANS

Various member jurisdictions have developed climate adaptation plans that include actions to improve the resilience of their infrastructure. A few examples of infrastructure-related actions in the plans include:

CITY OF VANCOUVER'S CLIMATE ADAPTATION STRATEGY (2012)

- minimize rainfall related flooding and associated consequences;
- implement an Integrated Stormwater Management Plan;
- separate combined sewers;
- complete a coastal flood risk assessment and develop a city-wide sea level rise adaptation response; and
- update flood-proofing policies including Flood Construction Levels.

CITY OF SURREY'S CLIMATE CHANGE ADAPTATION STRATEGY (2013)

- reach consensus on a regional approach to flood management;
- update planning and development standards for floodplains; and
- deliver proactive climate analysis and management practices for city infrastructure.

DISTRICT OF NORTH VANCOUVER'S CLIMATE CHANGE ADAPTATION STRATEGY (2017)

- ensure critical municipal functions are served by robust power systems and provide alternatives where systems are vulnerable; and
- increase the resilience of municipal assets to more frequent and severe extreme weather and sea level rise.

LOWER MAINLAND FLOOD MANAGEMENT STRATEGY

The Fraser Basin Council is facilitating the Lower Mainland Flood Management Strategy (LMFMS) initiative to better protect communities along the lower Fraser River and south coast from a major flood. Participants include the federal and provincial governments, local governments and non-governmental entities in the region. The costs of recovering from a major flood event far outweigh the costs of implementing effective flood mitigation, showing the critical importance of a regional strategy and major investments in flood mitigation. The LMFMS will include a regional flood strategy and recommendations for action, including cost-sharing options for flood mitigation.

SURREY'S COASTAL FLOOD ADAPTATION STRATEGY

The City of Surrey is developing a Coastal Flood Adaptation Strategy to explore the impacts of climate change on Surrey's coastline and the long-term adaption options available to the City. Land use and managed retreat from high-risk areas are being considered.

Health, Safety, & Emergency Management

Climate change is expected to increase health and safety risks for people living and working in the region. All orders of government will need to enact policies and implement projects to reduce exposure to these risks, as well as to increase capacity to respond to emergency situations.

Climate change will likely increase the frequency and/or severity of extreme events such as storms, flooding, mudslides, heat waves, and wildfires. More frequent and severe extreme events will increase a range of health and safety risks such as:

- injury and death from heat related illnesses, including to outdoor workers;
- respiratory illnesses associated with wildfire smoke or increased smog formation; and
- increased risk to life, safety and health due to flooding or precipitation.

In addition, rising temperatures could change the incidence and types of diseases that are present in the region.

These changes will place additional burdens on the regional health care and emergency management systems. Furthermore, the impacts of climate change are not felt equally. Some populations are more vulnerable than others. For example, the very young, the elderly, or people with underlying health issues can be more vulnerable to heat or smoke exposure. Lower income and homeless people will likely have fewer options to protect themselves from extreme weather events and have few resources to recover from their impacts.

Local governments can help mitigate risks to health and safety and build resilience through increased emergency management planning and response services. Businesses and residents will also need to better prepare for emergencies related to extreme weather events.

Metro Vancouver's Authority and Role

Metro Vancouver works with and represents member jurisdictions through the Integrated Partnership for Regional Emergency Management (IPREM). IPREM was formed to coordinate regional emergency management planning activities between the Provincial government and local government.

Metro Vancouver is directly responsible for emergency planning and response in Electoral Area A, which includes the University Endowment Lands and other unincorporated areas of the regional district.

Metro Vancouver provides emergency planning and response services to manage risk associated with its regional water and liquid waste functions and has an emergency management plan and emergency response plans that are designed to address, and respond to, flood risk, wildfire, and other natural hazards; all MV Emergency Plans are updated annually based on the latest hazard, risk and vulnerability information available.

Metro Vancouver protects its employees' health and safety through its Safety, Security and Emergency Management program, as required under the Workers Compensation Act.

Under authority in the *Environmental Management Act*, Metro Vancouver monitors air quality in the region and notifies the public when air quality has deteriorated due to, for example, smoke from wildfires or elevated levels of ground-level ozone.

Examples of Metro Vancouver's Current Climate Actions

AIR QUALITY MANAGEMENT

Air quality data is available to the public in real time, via the online tool airmap.ca, which provides the latest air quality and weather data from the Lower Fraser Valley air quality monitoring network. Metro Vancouver issues air quality advisories and bulletins to advise residents when air quality deteriorates in communities in the region. These actions help the public respond and take precautionary measures to minimize exposure during degraded air quality events. Metro Vancouver has also partnered with the Province of BC and other agencies to provide meteorological data to facilitate emergency response and help improve emergency planning. This data is also helpful in tracking the impacts of climate change in all areas of the province.

DISASTER DEBRIS MANAGEMENT PLAN

The Regional Engineers Advisory Committee, with support from IPREM, released the Joint Municipal Regional Disaster Debris Management Operational Plan for Metro Vancouver region and members in 2017. The Plan will enable the member jurisdictions to collaborate and coordinate the efforts, resources, and communications specific to disaster debris, to maintain continuity and recover from emergencies in the region.

FLOOD RISK PLANNING FOR BARNSTON ISLAND

Metro Vancouver is planning for flood risk on Barnston Island, which falls within Electoral Area A. Risk is managed through emergency preparedness education and through restrictive covenants at the time of issuance of new building permits.

WILDFIRE PREVENTION

The probability of human-caused wildfires in the water supply areas is low due to restrictions on public access, fuels management in interface areas and fire prevention regulations which limit operational activities during fire season. However there is increasing probability of fires in these forested areas due to warmer temperatures and less precipitation during the dry season.

Examples of climate actions of others

MANAGING URBAN HEAT ISLAND EFFECTS

Buildings, roads and other infrastructure in urban areas trap more heat than open land and vegetation, creating "heat islands". A number of member jurisdictions are addressing urban heat island effects. For example, the City of Surrey is increasing tree canopy coverage and the use of alternative paving surfaces in parking lots, as well as increasing the use of high albedo (i.e., lighter-coloured, reflective) surfaces on buildings and paving materials.

VULNERABILITY MAPPING

Vancouver Coastal Health and the Fraser Health Authority are working with researchers at UBC to map areas where vulnerable populations intersect with the impacts of a changing climate (e.g., heat, flooding and air quality).

EXTREME HEAT RESPONSE PLANNING

The health authorities and the BC Centre for Disease Control are assisting local municipalities in extreme heat response planning, to help ensure vulnerable populations receive needed assistance and to identify infrastructure that can help communities keep cool during these kinds of events. For example, the Surrey Fire Service is tasked with building community capacity to respond effectively in an emergency. It is reviewing and supporting implementation of the Surrey-White Rock Extreme Heat Response Plan, looking at gaps in emergency prevention and response, and ensuring emergency response capacity keeps pace with the need for services, all with consideration of increasing climate impacts.

CITY OF VANCOUVER ADAPTATION STRATEGY

The City of Vancouver adopted an adaptation strategy in 2012. Health- and safety-related actions under the strategy include developing a policy for back-up power for city operations and exploring the potential for providing air conditioned spaces in non-market housing. To help implement the strategy, the City also hired a Chief Resiliency Officer in 2017.

Buildings

Buildings generate greenhouse gas (GHG) emissions from burning fossil fuels, primarily natural gas, for space and water heating. The GHG emissions from buildings are second only to transportation, accounting for approximately one third of all regional GHG emissions.

Buildings can reduce GHG emissions through improvements to energy efficiency, energy recovery, and by switching to low carbon energy systems (e.g., electric heat pumps, solar, renewable natural gas). Local governments can reduce emissions from new residential and commercial buildings through building code and development policy that encourages more energy efficient design and the use of low carbon energy. Encouraging or requiring building and home owners to take actions to reduce GHG emissions when retrofitting existing buildings is a major challenge. Actions taken today to reduce building GHG emissions will have a long-term impact because buildings are long-lived assets; many that exist today will still be here in 2050.

Local government policy and industry leadership has resulted in a number of buildings in the region achieving net zero certification, meaning these buildings produce as much energy as they use.

Climate change will increase the incidence of extreme heat events, increase average summer temperatures and the need to cool buildings. Governments, utilities, and building owners need to consider how this will impact building design and energy use, and in response, modify policy and planning for energy demand, and building management. Increased risk of flooding due to climate change needs to be considered in the design and siting of new buildings and the retrofit of existing buildings. Also see the Land-Use and Growth Management Issue Area for further discussion of land-use planning for climate impacts.

Metro Vancouver's Authority and Role

Metro Vancouver derives its authority to develop programs, policies and regulations to address emissions from buildings from two pieces of legislation.

- B.C.'s *Environmental Management Act* gives the Metro Vancouver Regional District the authority to "provide the service of air pollution control and air quality management and, for that purpose, the board of the regional district may, by bylaw, prohibit, regulate and otherwise control and prevent the discharge of air contaminants". Under this authority, Metro Vancouver develops and implements plans, policies, regulations and projects that improve air quality and reduce greenhouse gas emissions.
- Metro Vancouver administers Boilers and Process Heaters Emission Regulation Bylaw 1087, which regulates small to medium-sized industrial, commercial and institutional boilers and process heaters. It requires that all natural gas or propane fired units greater than 3 MW and less than 50 MW and all biomass fired units less than 50 MW must be registered with Metro Vancouver and operated with proper emissions control. The bylaw includes emission limits on common air contaminants, and sets out monitoring and reporting requirements. Application of this bylaw controls emissions of the air contaminants from specified boilers and heaters in buildings.

Metro Vancouver Housing Corporation (MVHC) manages a portfolio of 49 housing sites which emit 2000 tonnes of GHGs annually. It is responsible for the operation and maintenance of the buildings, as well as renewal, which provides opportunities to reduce energy use and GHG emissions. MVHC is currently constructing 230 LEED Gold housing units in the City of Vancouver and is planning another redevelopment in the City of Surrey which will also be designed to reduce GHG emissions.

In addition, Metro Vancouver's *Integrated Air Quality and Greenhouse Gas Management Plan* includes actions to support residents and businesses to reduce GHG emissions from buildings.

Examples of Metro Vancouver's current climate actions

STRATA ENERGY ADVISOR PROGRAM

Metro Vancouver will launch a strata energy advisor program in 2018 to reduce GHG emissions from residential strata (condo) buildings in the region. This program provides energy advisor services to strata councils and property managers to reduce energy consumption and greenhouse gas emissions from strata buildings. Program participants will have access to free energy assessments and professional advisors as they undertake energy upgrades to their buildings.

RATEOURHOME.CA

Metro Vancouver launched RateOurHome.ca in 2016 to provide public education on home energy and promote home energy labelling. By providing home energy information during the design, construction and sale of new and existing homes, labelling gives home sellers and buyers a tool to make more informed decisions about home energy performance. By supporting voluntary public disclosure of home energy labels, RateOurHome.ca is enabling the reduction of greenhouse gas emissions in detached houses and townhomes.

LEED PLATINUM HEAD OFFICE BUILDING

In 2017, Metro Vancouver relocated to a new head office in Burnaby. The building's design is certified LEED Platinum (core and shell), and the building is expected to produce significantly fewer GHG emissions and have lower operating costs than a conventionally-designed building of similar size.

METRO VANCOUVER HOUSING CORPORATION ENERGY MANAGEMENT

MVHC incorporates energy efficiency and GHG emissions reductions into its building maintenance and renewal projects. Since 2016, MVHC has completed energy efficiency upgrades of space heating boilers, domestic hot water heaters, furnaces, laundry equipment, lighting systems, and water fixtures. These improvements are expected to reduce MVHC annual GHG emissions by approximately 10% (225 tonnes CO_2e/year).

SUSTAINABLE BUILDING AND INFRASTRUCTURE POLICY

Metro Vancouver is developing a Sustainable Building and Infrastructure Policy to help ensure sustainability objectives (including GHG emissions reduction) are included in the design of Metro Vancouver's buildings and infrastructure, as well as major renovation projects.

SUSTAINABILITY INNOVATION FUNDS

The Metro Vancouver Board created the Sustainability Innovation Funds to provide financial support for innovative projects that contribute to the region's sustainability. Three separate funds exist, for projects in the areas of liquid waste, water, and the MVRD mandate. The funding criteria includes partnerships with member jurisdictions, academia, and community groups. The Strata Energy Advisor and RateOurHome.ca initiatives described above have received funding under this program.

Examples of climate actions of others

BC ENERGY STEP CODE

The *BC Energy Step Code* is a voluntary provincial standard enacted in April 2017 that provides an incremental and consistent approach to achieving more energy-efficient buildings that go beyond the requirements of the base *BC Building Code*. It does so by establishing a series of measurable, performance-based energy-efficiency requirements for construction that builders can choose to build to, and communities may voluntarily choose to adopt in bylaws and policies. A number of Metro Vancouver municipalities have already adopted specific steps of the *BC Energy Step Code* into their own bylaws.

BOMA BEST

BOMA BEST Sustainable Buildings certification recognizes excellence in energy and environmental management and performance in commercial real estate. The program is managed by the Building Owners and Managers Association of Canada (BOMA Canada) and is delivered by the eleven Local BOMA Associations throughout Canada. There are more than 250 BOMA BEST certified buildings in Metro Vancouver.

HOME AND BUSINESS ENERGY INFORMATION WEBSITES AND ADVISORS

Energy Save New West (City of New Westminster), Energy Save Richmond (City of Richmond), and BC Energy Coach are online portals that provide residents and businesses access to information, advisors and incentives to help them complete energy upgrades to their homes and businesses.

UTILITY INCENTIVES

BC Hydro and Fortis BC offer a variety of incentives for home owners and businesses to improve the energy efficiency of their buildings. Energy efficiency improvements can reduce GHG emissions while saving home and business owners' money. Some energy efficiency improvements also have the co-benefit of improving the thermal comfort of buildings (i.e., warmer in the winter and cooler in the summer) and/or the indoor air quality through better ventilation systems.

CLIMATE SMART

Climate Smart helps businesses and non-profits learn how to measure and reduce their carbon footprints. The training program incorporates classroom learning, web-based software, and one-on-one support. They work with small and medium-sized businesses, providing training and user-friendly web-based software to measure GHG emissions and plan projects that reduce emissions.

Transportation

Transportation emissions come from the movement of goods, materials and people, whether by land, air, or sea. In this region, transportation is the single largest source of greenhouse gas (GHG) emissions, accounting for 42% of the regional total.

Within the transportation sector, the dominant emission contributor is cars and light trucks. Today, there are 1.4 million cars and trucks operating across the Metro Vancouver region, travelling 19 billion kilometres in a year. Collectively, these vehicles emit more than 4.7 million tonnes of greenhouse gases in 2015, which is nearly one-third of the regional total. Achieving our targets in this sector will require making walking, biking and transit easier and more attractive, and transitioning the remaining kilometres to zero emission vehicles.

In 2011, about 70% of the region's trips were made in personal motor vehicles, accounting for 77% of the total kilometres travelled. Non-motorized modes (walking and cycling) accounted for 13% of trips in 2011, while making up only 2% of the kilometres travelled. Transit use accounted for 14% of trips and 20% of kilometres travelled. Significant effort will need to be made to shift kilometres travelled to non-vehicular modes to reduce emissions.

Metro Vancouver can play a significant role through the Regional Growth Strategy (see Land Use and Growth Management Issue Area). A key challenge is that although land use changes are impactful in reducing greenhouse gas emissions, they require a long time horizon to result in significant change. By 2050, even with a significant shift towards walking, biking and transit, vehicles are forecast to still be responsible for a majority of kilometres travelled in this region. To achieve significant GHG reductions, transitioning to zero emission vehicle technology is essential, and there are only two vehicle lifetimes between now and 2050 to do so.

GHG emissions from goods movement is dominated by heavy duty trucks which account for 5% of total regional emissions, or about 750,000 tonnes annually. These vehicles range from small cube vans delivering goods purchased online, to large semi-trailer trucks hauling containers from the port. Emissions from heavy trucks have declined slightly over the past decade. Additionally, there are promising zero emission technologies on the horizon for different vehicle classes. The movement of goods into, out of, and across our region has historically increased as the economy has grown. This poses a particular challenge for achieving greenhouse gas reduction targets while maintaining business competitiveness.

Planes, trains and ships collectively account for 7% of the region's total greenhouse gas emissions. Emissions from aircraft have remained relatively constant in the past decade, while emissions from the rail sector have declined slightly. The marine sector has recorded the highest growth of the goods movement sectors and is projected to keep growing over the next few decades. Unlike on-road vehicles, zero emissions technology for these sectors is at a much more nascent stage of development, although there are some promising advances in renewable fuels.

Also see the Land-Use and Growth Management Issue Area for further of discussion of transportation planning for climate impacts.

Metro Vancouver's Authority and Role

Metro Vancouver derives its authority to develop programs, policies and regulations to address transportation emissions from two pieces of legislation:

- B.C.'s *Environmental Management Act* gives the Metro Vancouver Regional District the authority to "provide the service of air pollution control and air quality management and, for that purpose, the board of the regional district may, by bylaw, prohibit, regulate and otherwise control and prevent the discharge of air contaminants". Under this authority, Metro Vancouver develops and implements plans, policies, regulations and projects that improve air quality and reduce greenhouse gas emissions.
- The *Local Government (Green Communities) Statutes Amendment Act, (Bill 27)* 2008 made it clear that addressing greenhouse gas emissions is, in part, the responsibility of local government by requiring that regional growth strategies include targets for reducing greenhouse gas emissions, and by giving local government more powers to help them reduce greenhouse gas emissions, conserve water and energy, and work towards creating more compact and sustainable communities. Metro Vancouver's role is to develop and steward Metro Vancouver 2040: Shaping our Future (the regional growth strategy), which contains regional greenhouse gas reduction targets, as well as actions which facilitate increased use of transit, multiple-occupancy vehicles, walking, and cycling.

In addition, the MVRD Board has approval authority over the use of Federal Gas Tax funds (Greater Vancouver Regional Fund) transferred to the region. TransLink is the sole eligible recipient of these funds (approximately $130 million per year is transferred to the region), and must submit an application describing how the proposed investments support *Metro 2040* and the *Integrated Air Quality and Greenhouse Gas Management Plan*.

Metro Vancouver's *Integrated Air Quality and Greenhouse Gas Management Plan* is an example of a management plan that includes actions to reduce GHG emissions from various sectors.

Examples of Metro Vancouver's Current Actions

ELECTRIC VEHICLE OUTREACH CAMPAIGNS

Lack of awareness of electric vehicles is a key barrier to adoption. Since 2014, Metro Vancouver has been addressing this barrier through the development and delivery of EV-related outreach campaigns. These include Emotive: The Electric Vehicle Experience, a public outreach campaign that raises awareness of electric vehicles throughout BC. Metro Vancouver also develops outreach programs targeted at specific audiences that are facing questions related to EVs and EV charging. EVcondo.ca is a web resource aimed at strata councils, property managers and residents dealing with EV charging in multi-family dwellings. EVWorkplace.ca is aimed at encouraging employers to consider providing EV charging for staff.

FLEET PLANNING AND ACQUISITION POLICY

The Metro Vancouver Board adopted this policy in 2016 to enable Metro Vancouver's fleet to transition to low carbon vehicles. This policy involves setting a Low Emissions Vehicle Standard for each vehicle class on an annual basis which ranks vehicle technologies. The Standard ranks vehicle technologies based on their greenhouse gas emissions and establishes a Gold, Silver and Bronze standard for each year. The Policy allows for the purchase of the highest standard possible that meets operational needs while taking into account lifecycle costs.

TRANSIT-ORIENTED AFFORDABLE HOUSING STUDY

In 2017, Metro Vancouver, in partnership with BC Housing, BC Non-Profit Housing Association, TransLink and Vancity, completed a study to expand the region's understanding

of the constraints and opportunities related to building new rental housing, particularly affordable housing for households earning less than $50,000 per year, in transit-oriented locations across the region. One of the key findings is that renter households, especially those earning less than $50,000, are more likely to use transit. This finding points to a transit ridership value proposition for accommodating affordable rental housing in transit-oriented locations.

REGIONAL PARKING STUDY

Metro Vancouver and TransLink are jointly undertaking research on residential parking demand and supply in select apartment buildings across the region. This research will help inform municipal and developer practices on appropriate parking requirements, in particular in sites located close to the Frequent Transit Network. The project will be completed in 2018.

SUSTAINABILITY INNOVATION FUNDS

The Metro Vancouver Board created the Sustainability Innovation Funds to provide financial support for innovative projects that contribute to the region's sustainability. Three separate funds exist, for projects in the areas of liquid waste, water, and under the broader umbrella of the MVRD mandate. The funding criteria includes partnerships with member jurisdictions, academia, and community groups. Since 2014, a number of transportation-related projects have received funding, including: the Smart Drive Challenge, Transit Oriented Affordable Housing Fund, and DC Fast Charger Demonstration at Metro Tower 3.

Examples of climate actions of others

ELECTRIC VEHICLE CHARGING BYLAWS

A number of member jurisdictions are adopting bylaws that require new developments to have electric vehicle charging infrastructure in a certain percentage of stalls. City of Vancouver led the way with adoption of an EV charging requirement in 20% of stalls in multi-family dwellings in 2011. Since that time, District of North Vancouver, City of Richmond, District of West Vancouver, City of North Vancouver and City of Port Coquitlam have adopted EV charging requirements. In 2017, City of Richmond became the first municipality in Canada to require that 100% of parking stalls in new residential developments feature an outlet for EV charging, followed by the City of Port Coquitlam and the City of Vancouver in 2018.

CAR SHARE PARKING INCENTIVES

A number of member jurisdictions have innovative measures to facilitate the increased use of car shares in new developments. Some municipalities have made it a mandatory requirement in certain areas or under certain zoning (for example, City of Vancouver in Southeast False Creek, or District of North Vancouver in Seylynn). Other municipalities encourage car share stalls by providing incentives, typically in the form of reduced off-street parking requirements (for example, City of New Westminster and City of Richmond).

TRANSLINK

TransLink operates several programs which invest in measures to reduce greenhouse gas emissions. The TransLink Tomorrow program explores new transportation options for Metro Vancouver, many of which could lead to reductions in greenhouse gas emissions. Some recent climate-related projects include a three-month electric bus trial, a trial vanpool program and mobility hubs that combine driving, transit, and car share. TransLink's TravelSmart outreach program engages with businesses, schools, seniors and newcomers to promote and facilitate smarter travel options.

PROVINCE OF BC ELECTRIC VEHICLE PROGRAMS

The Provincial Government has invested millions into a variety of electric vehicle programs. These programs mostly focus on providing funding incentives towards the purchase of vehicles or charging stations. The Province also manages the Electric Vehicles & HOV Lanes program, which allows EV owners to obtain a decal which enables single occupant travel in HOV lanes.

Waste

Decomposition of organic waste in landfills and wastewater treatment plants produces methane, which is a potent greenhouse gas (GHG) with 25 times the global warming impact of carbon dioxide. Additionally, the fossil fuels used to manufacture, transport, and ultimately dispose of the goods consumed in the region produce GHG emissions; these emissions are sometimes referred to as embodied emissions.

Programs supported or implemented by Metro Vancouver and its partners to reduce, reuse, and recycle waste (including organics diversion from households and businesses) marks a shift from thinking about the waste as an end product toward seeing waste as a potential resource. Efforts to constrain the total amount of waste ending up at regional facilities should reduce both direct and embodied GHG emissions. In 2017, Metro Vancouver achieved a 62% diversion rate from landfill, which was primarily achieved by a reduction of organics going to landfill.

The next level waste strategy is the transition to a circular economy, which is essential if economic growth is to be sustained. Planetary processes and systems are being pushed to their limits as supplies of non-renewable resources and regenerative capacity of renewable resources are exhausted. Shifting from the traditional take-make-waste throughput model of economic production to a take-make-reuse circular model means retaining the value of products, materials, and resources in the economy through closed production and consumption loops. The transition to a circular economy is consistent with a low-carbon, low-waste economy as a result of increased use of renewable energy and the more efficient use of resources throughout the supply chain of products.

Diverting organics from landfills and capturing methane at waste management facilities can be an effective GHG reduction strategy. The captured gas can be upgraded to renewable natural gas, and used to directly replace natural gas.

This issue area focusses on approaches and technologies to reduce GHG emissions generated from waste, while the Energy Issue Area explores opportunities such as the use of biogas, biosolids and waste heat to replace fossil fuels and offset GHG emissions elsewhere.

Metro Vancouver's Authority and Role

Metro Vancouver is responsible for long term planning and implementation of waste management in the region. Metro Vancouver's Integrated Solid Waste and Resource Management Plan was approved by the Province in 2011. Goals include Reducing the Waste Generated by households, and an aspirational target to divert 80% of the region's waste away from disposal by 2020.

Waste management activities by Metro Vancouver and its member jurisdictions includes solid waste collection and disposal, organics diversion, and recycling of papers, plastics, glass, and other materials. Metro Vancouver enforces disposal bans for organics and recyclable materials, where the hauler must pay a surcharge of 50% on the cost of disposal if a waste load contains excessive amounts of recyclable materials.

Metro Vancouver owns and operates a Waste to Energy facility that recovers energy and metals from solid waste. In addition, Metro Vancouver has five wastewater treatment plants that produce and use significant amounts of energy, and which produce residual biosolids that need to be managed.

Examples of Metro Vancouver's current climate actions

DIVERSION OF ORGANICS AND WOOD WASTE

Metro Vancouver's organics and wood waste diversion activities, which include the operation of processing facilities, enforcement of disposal bans, and development of public education campaigns, have resulted in:

- over 400 thousand tonnes per year of organics (yard trimmings, food scraps, food-soiled papers) diverted away from landfills, and into composting or digestion facilities; and
- over 230 thousand tonnes per year of clean wood diverted away from landfills, and into recycling as products or fuel.

LANDFILL GAS CAPTURE PROJECT (COQUITLAM)

Metro Vancouver manages a landfill gas collection system at the closed Coquitlam landfill, which captures and destroys methane that is still being generated by the buried waste. The initial landfill gas collection system was designed and constructed in 1993, and an upgrade was completed in 2012 including the installation of new extraction wells and pipes to collect and transport the gas to a flare. The gas contains approximately 50% methane, and destruction of this gas reduces the GHGs emitted from the landfill.

USE OF BIOSOLIDS AS BIOCOVER/BIOFILTER

Biosolids (residual material from wastewater treatment) can be combined with other material and used as a landfill biocover or biofilter that reduces fugitive emissions of methane. Metro Vancouver is a partner on biocover and biofilter pilot projects at a number of landfills in the province, using biosolids from Metro Vancouver wastewater treatment plants. This can be a cost effective approach to reducing GHG emissions at smaller landfills that are not required to have active gas collection systems under provincial regulations, but which can still be a significant source of GHG emissions.

NATIONAL ZERO WASTE COUNCIL

The National Zero Waste Council (NZWC) is a leadership initiative bringing together governments, businesses and non-government organizations to advance waste prevention in Canada. The Council was founded by Metro Vancouver in collaboration with the Federation of Canadian Municipalities in 2013. The mission of the Council is to act collaboratively with business, government and the community, at the national and international level, as an agent of change for waste prevention and reduction in the design, production and use of goods. This will involve aligning actions and policies in Canada with global best practices and to identify the opportunities to advance the transition to a circular economy.

ZERO WASTE CONFERENCE

Metro Vancouver has hosted an annual Zero Waste Conference. Eliminating waste and creating value are essential pillars in a new way of doing business and developing policy; this represents the new norm for addressing waste in every facet of our lives. The Zero Waste Conference has grown in size and in profile as the venue to discuss waste prevention and the opportunities for establishing circular economy systems in Canada.

METRO VANCOUVER'S SOLID WASTE CAMPAIGNS

Metro Vancouver delivers public campaigns aimed to influence behaviours and reduce emissions through waste reduction (Create Memories Not Garbage, Love Food Hate Waste) and waste diversion (Food Scraps Recycling).

Examples of climate actions of others

PROVINCIAL LANDFILL GAS MANAGEMENT REGULATION

This regulation requires landfill gas management systems to capture and destroy at least 75% of the methane produced at large municipal solid waste landfills. This regulation effectively drives the design, installation and operation of landfill gas management systems that results in the reduction of a significant amount of GHGs from many landfills in the Province.

VANCOUVER LANDFILL GAS CAPTURE PROJECT

In 2012 the City of Vancouver completed a project to upgrade the landfill gas collection system at its landfill in Delta. This was one of the largest individual GHG reduction projects in the Metro Vancouver region. The project resulted in over 430,000 tonnes of carbon offset credits that were allocated amongst member municipalities. These credits helped Metro Vancouver and its member municipalities balance most of the emissions from their operations between 2012 and 2014, and achieve carbon neutrality in 2015.

OTHER LANDFILL GAS CAPTURE PROJECTS

There are a number of closed landfills in the region that are owned by member municipalities and private companies. Some of these landfills have implemented gas collection systems that either flare or directly use the methane-containing gas as a source of clean energy (e.g., to heat greenhouses), which helps reduce GHG emissions in the community.

Industry

The region's relatively small but diverse manufacturing sector (e.g., cement production, food processing, metal fabrication, chemical manufacturing, forest products, and petroleum refining) and construction industry combine to contribute approximately 25% of the region's total greenhouse gas (GHG) emissions. These emissions are generated from burning fossil fuels and industrial processes (17%), non-road engines such as generators and construction equipment (8%), and other smaller sources. GHG emissions from commercial transportation (light and heavy duty vehicles, air, rail and marine vessels) are included under the Transportation Issue Area.

In the Metro Vancouver region, industrial facilities primarily generate GHG emissions from burning natural gas, propane and fuel oil to produce heat for industrial processes, and to a lesser extent, to heat buildings. In addition to burning fuel, cement production processes are a major source of industrial carbon dioxide emissions. The region's two cement plants are the largest industrial point sources in Metro Vancouver and account for more than 10% of the region's GHG emissions (approximately 1.6 million tonnes).

Since 2000, GHG emissions from the industrial sector have fallen by 43%. This reduction is largely due to the closure of BC Hydro's Burrard Thermal Generating Plant. Aside from this major electricity generation facility, GHG emissions from other industrial sectors have remained relatively stable over the last two decades. The challenge in reducing industrial emissions will be in identifying and supporting solutions that are cost- effective while minimizing impacts on industry competitiveness.

Metro Vancouver can look to a variety of strategies to achieve industrial GHG emissions reductions such as: targeted incentive and education programs, green procurement, advocacy, pilot projects/ demonstrations, regulations that encourage process emissions reduction, improvement in energy efficiency, energy recovery, and moving to less carbon-intensive sources of energy. These activities would increase the production and use of low carbon, renewable energy alternatives and stimulate product and process innovations. A key consideration in the design of these approaches will be how to best activate and leverage industry's own innovation, resources and expertise that can address specific technological and economic constraints. Metropolitan areas in Europe, like Rotterdam and Helsinki, offer interesting examples of how the application of circular economy principles coupled with greater collaboration of governments, businesses and academic/research institutions can generate new economic opportunities while achieving reductions in greenhouse gas emissions and/or increasing community resiliency in the face of climate change.

With consideration of the location of industrial facilities, there are opportunities for targeted GHG emissions reduction projects that are coordinated with Metro Vancouver's own operations and assets (e.g., waste heat recovery or increasing the use of biosolids residuals from wastewater treatment as a renewable fuel). In some cases, this could mean development of specific partnerships and agreements with industrial firms (see also the Energy Issue Area).

Metro Vancouver's Authority and Role

B.C.'s *Environmental Management Act* gives the Metro Vancouver Regional District the authority to "provide the service of air pollution control and air quality management and, for that purpose, the board of the regional district may, by bylaw, prohibit, regulate and otherwise control and prevent the discharge of air contaminants". Under this authority, Metro Vancouver develops and implements plans, policies, regulations and projects that improve air quality and reduce greenhouse gas emissions.

Under the authority delegated within EMA, Metro Vancouver establishes air quality regulations and administers a system of permits to manage the nature and quantity of air emissions from large industrial and commercial emitters of air contaminants, under *Air Quality Management Bylaw No. 1082*. There are more than 150 industrial facilities that operate under the requirements of a Metro Vancouver air emissions permit in the region, and thousands of other sources authorized under emission regulations.

Metro Vancouver is also responsible for reducing emissions from its own industrial facilities, such as its wastewater treatment plants and waste to energy facility. Metro Vancouver works closely with partners to increase the reuse of its residuals (waste products) and generate energy resources like biogas and waste heat by other industrial facilities (also see Energy Issue Area).

Metro Vancouver's *Integrated Air Quality and Greenhouse Gas Management Plan* includes strategies and actions to reduce GHG emissions from various industry sectors.

Examples of Metro Vancouver's current climate actions

NATIONAL INDUSTRIAL SYMBIOSIS PROGRAM (NISP)

Metro Vancouver is funding a National Industrial Symbiosis Program (NISP) pilot in the region, which facilitates business-to-business opportunities for unused or under-utilized resources of one business to be connected to another business. This process, referred to as "industrial symbiosis", can reduce both solid waste and GHG emissions. One example is a greenhouse business co-locating with rendering facility so that it can use its waste heat to reduce its use of natural gas for heating and reusing carbon dioxide to promote vegetative growth. The NISP pilot has received funding under the Sustainability Innovation Fund, which was created by the Metro Vancouver Board to provide financial support for innovative projects that contribute to the region's sustainability.

SMALL BUSINESS ENERGY ASSESSMENTS

With funding from the LiveSmart BC: Small Business Program, Metro Vancouver facilitated 300 small businesses to improve their energy efficiency and reduce their energy costs. Metro Vancouver hired a company to provide businesses with free energy advisor services and better access to efficient technologies and incentives. Business energy assessments were delivered in 15 Metro Vancouver municipalities to 14 business sectors. Of the 300 businesses that participated more than 30 completed upgrades leading to energy savings and GHG emission reductions.

CORPORATE ENERGY MANAGEMENT

In 2014, the Metro Vancouver Board approved a Corporate Energy Management Policy that commits the organization to continuously improving energy performance in its operations including its own large industry-like facilities, and to continuously improving the efficiency with which it produces, generates, and recovers energy. Projects and initiatives that emanate from this policy result in the reduction of corporate GHG emissions related to energy use.

Examples of climate actions of others

BC GOVERNMENT GREENHOUSE GAS INDUSTRIAL REPORTING AND CONTROL (GGIR&C) ACT (2015)

Under the GGIR&C Act, the B.C. government introduced the Greenhouse Gas Emission Reporting Regulation, the Greenhouse Gas Emission Control Regulation, and the Greenhouse Gas Emission Administrative Penalties and Appeals Regulation.

BC AND FEDERAL GOVERNMENT INNOVATIVE CLEAN ENERGY (ICE) FUND

The B.C. government's ICE Fund is designed to support the Province's energy, economic, environmental and GHG emissions reduction priorities, and to advance B.C.'s clean energy sector. The Fund helps develop solutions to make B.C.'s major industries cleaner, more efficient

and more competitive in global markets. In 2017, the Province expanded this program, announcing a $40 million partnership with the Government of Canada, under the Pan-Canadian Framework on Clean Growth and Climate Change, to support the development of pre-commercial clean energy projects and technologies over a three year period. The funding comes from the ICE Fund and the SD Tech Fund, managed by Sustainable Development Technology Canada.

FEDERAL LOW CARBON ECONOMY (LCE) FUND

The Government of Canada's $2 billion Low Carbon Economy Fund was established to support greenhouse gas and clean energy projects. The LCE Fund is expected to support the implementation of the Pan-Canadian Framework on Clean Growth and Climate Change by leveraging investments in projects that will generate clean growth and reduce GHG emissions. The Fund is split into two parts. The Low Carbon Economy Leadership Fund provides $1.4 billion to provinces and territories that have adopted the Pan-Canadian Framework, to help them deliver on commitments to reduce greenhouse gas emissions. Over $500 million is available for the Low Carbon Economy Challenge, which will fund projects that will leverage ingenuity to reduce emissions and generate clean growth.

CAP AND TRADE (ONTARIO, QUEBEC, CALIFORNIA)

A Cap and Trade system is an economic tool that aims to reduce GHG emissions from the highest emitting sectors such as cement plants, electricity producers, oil and gas industry, etc. It is a flexible market mechanism that encourages the implementation of the most cost-effective GHG reduction projects and allows for trading of GHG credits among facilities covered under the cap and trade system. Ontario and Quebec are participating in the Western Climate Initiative's cap and trade regime that also includes California.

LOWER CARBON CEMENT

In 2011, the cement industry introduced a new lower carbon Contempra cement which reduces CO_2 emissions by 10%, while producing concrete with equivalent strength and durability as concrete produced with regular Portland cement. The lower carbon cement is prepared by intergrinding regular clinker (the main ingredient in cement) with up to 15% limestone, which is 10% more than in regular Portland cement.

Energy

Energy is essential to provide the services the region depends upon. Currently, much of this energy comes from fossil fuel sources that emit greenhouse gases (GHGs) when burned. There are numerous opportunities to generate renewable and low carbon energy in our communities, and to pursue energy efficiency measures wherever possible.

Residents and businesses use energy to heat buildings and water, fuel vehicles, and power industrial processes. Metro Vancouver uses energy to provide essential services to the region: electricity is used to treat and pump drinking water and wastewater; natural gas is used to heat its buildings; and gasoline and diesel are the most common fuels for most vehicles used across the region. Using fossil fuel energy such as gasoline, diesel, propane, and natural gas results in GHG emissions.

Fortunately, grid electricity in British Columbia has very low GHG emissions because it is primarily generated by hydroelectric dams. Switching from fossil fuel-based energy sources to electricity and low carbon fuels provides a significant opportunity to decarbonize our region's energy system. Investing in local low carbon energy systems such as renewable natural gas, waste heat recovery, solar, and heat pumps can support business development, job creation and energy self-sufficiency while reducing GHG emissions. Eliminating sources of energy waste (e.g., heated/cooled air leakage from buildings) and improving energy efficiency (e.g., through equipment upgrades and process improvements) should be an integral part of reducing energy-related GHG emissions.

Recovering energy from waste streams produces a renewable and clean energy that can replace fossil fuel use or electricity. Metro Vancouver has a number of opportunities to capture waste heat from its utility processes, solid waste management facilities, and liquid waste collection system. Recovered heat can be used to generate electricity or in district energy systems that provide energy to buildings for space heating and water heating. Metro Vancouver currently produces renewable natural gas at several of its wastewater treatment plants, which displaces the use of fossil fuels for operation of these facilities. There is potential to produce additional renewable natural gas or other biofuels at its facilities. Through its policies and programs, Metro Vancouver can also support other projects in the region that generate renewable, low carbon energy.

Metro Vancouver's Authority and Role

Metro Vancouver provides utility services – drinking water, wastewater treatment and solid waste management – through two legal entities, the Greater Vancouver Water District and Greater Vancouver Sewerage & Drainage District. The Greater Vancouver Water District Act gives Metro Vancouver the authority to generate, transmit and sell clean, renewable hydroelectricity from water flowing in its drinking water system. Some of Metro Vancouver's facilities provide renewable electricity to the grid through agreements with BC Hydro. The wastewater treatment process produces biogas – a clean renewable fuel – that is in turn used to provide heat and electricity to the wastewater treatment plant, displacing natural gas and grid electricity that would otherwise have to be purchased.

To support the development of low-carbon district energy systems in the region, Metro Vancouver enables its member jurisdictions to access waste heat from raw sewage and treated effluent through the Liquid Waste Heat Recovery Policy.

Metro Vancouver's *Corporate Energy Management Policy* commits the organization to continuously improving energy performance in its operations, and to continuously improving the efficiency with which it produces, generates, and recovers energy.

Examples of Metro Vancouver's current climate actions

CORPORATE ENERGY MANAGEMENT

In 2014, the Metro Vancouver Board approved a Corporate Energy Management Policy that commits the organization to continuously improving energy performance in its operations including its own large industry-like facilities, and to continuously improving the efficiency with which it produces, generates, and recovers energy. Projects and initiatives that emanate from this policy result in the reduction of corporate GHG emissions related to energy use.

BIOGAS RECOVERY (LULU ISLAND WASTEWATER TREATMENT PLANT)

Metro Vancouver has approved a project to build a facility at its Lulu Island Wastewater Treatment Plant that will capture biogas and upgrade it to pipeline quality renewable natural gas for sale to FortisBC. This renewable natural gas will be used in the region to replace natural gas from fossil fuel sources.

EFFLUENT HEAT RECOVERY (NORTH SHORE WASTEWATER TREATMENT PLANT)

At Metro Vancouver's new North Shore Wastewater Treatment Plant, heat will be extracted from treated effluent and transferred to a hot water loop that will distribute the energy to buildings served by Lonsdale Energy Corporation, a district energy provider in the City of North Vancouver. The effluent heat recovery facility will achieve GHG emissions reductions by displacing the use of natural gas in boilers. The system will be operational in 2021.

WASTE-TO-ENERGY FACILITY

Metro Vancouver's Waste-to-Energy Facility, located in Burnaby, processes approximately 260,000 tonnes of the region's solid waste each year, generating 170,000 MWh of electricity and recovering 7,000 tonnes of ferrous metals annually. Metro Vancouver is also exploring opportunities to use heat from the Waste-to-Energy Facility in nearby district energy systems.

CARBON PRICE POLICY FOR USE IN DECISION-MAKING

Metro Vancouver has adopted a price of $150 per tonne of CO_2-equivalent to account for GHG emissions in its decision-making, in particular when choosing between different options during the early stages of a project. The policy is expected to enable some additional clean energy projects because their lower GHG emissions are valued financially.

CAPILANO ENERGY RECOVERY FACILITY

Metro Vancouver's Capilano Energy Recovery Facility uses a turbine to generate electricity from the treated drinking water that is returning from the higher elevation Seymour Capilano Filtration Plant to the lower elevation Capilano distribution system. The electricity generated is used to offset a portion of the power requirements for the Capilano Raw Water Pump Station.

SUSTAINABILITY INNOVATION FUNDS

The Metro Vancouver Board created the Sustainability Innovation Funds to provide financial support for innovative projects that contribute to the region's sustainability. Three separate funds exist, for projects in the areas of liquid waste, water, and under the broader umbrella of the MVRD mandate. The funding criteria includes partnerships with member jurisdictions, academia, and community groups. Since 2014, a number of energy-related projects have received funding, including: Barnston/Maple Ridge Pump Station Energy Recovery, Genomics Approach to Anaerobic Digestion Optimization, Microwave-enhanced Advanced Oxidation Process Sludge Destruction Project, and the Regional Park Solar Powered Conversion Project.

Examples of climate actions of others

ORGANIC WASTE BIOFUEL FACILITY (SURREY)

The City of Surrey is implementing a facility that will process organic waste from households and other sources into renewable natural gas, which will fuel the City's natural gas-powered waste collection vehicles and its growing fleet of natural gas-powered operations service vehicles. It will also provide a renewable fuel source for the new District Energy System that will heat and cool Surrey's City Centre. Taking this step will significantly reduce the City's corporate carbon footprint. The facility will also produce a high-end compost product for use in agricultural and landscaping applications.

SEWAGE HEAT RECOVERY (SOUTHEAST FALSE CREEK NEIGHBOURHOOD ENERGY UTILITY)

The City of Vancouver's Southeast False Creek Neighbourhood Energy Utility uses waste thermal energy captured from sewage to provide space heating and hot water to buildings in the area. This recovered energy reduces GHG emissions associated with heating those buildings by more than 60 percent. The utility began operation in 2010 and now serves 395,000 square metres of residential, commercial, and institutional space, with further expansions planned over time to serve new developments.

Land-Use and Growth Management

The Metro Vancouver region is growing rapidly. Over a million more residents and over 500,000 additional jobs are anticipated over the next 30 years. The location of new homes, businesses and institutions strongly influences both greenhouse gas (GHG) emissions and exposure to risks associated with climate change.

Land use decisions determine where residents live, work, shop and play. Sprawling urban development increases GHGs as residents are likely to be mostly or entirely dependent on automobiles to get around. These car trips, which tend to have single occupants, increase vehicle use and greenhouse gas emissions. Metro Vancouver and its member municipalities are working to reduce GHGs by focusing growth in a network of transit-oriented urban centres and building compact, complete communities that offer amenities close to home. Focused growth reduces emissions by supporting low carbon transportation such as walking, cycling and public transit. Actions in this Issue Area are complementary to those contained in the *Transportation* Issue Area.

Where and how the region accommodates growth also determines how much residents, businesses and infrastructure are exposed to physical risks associated with climate change, such as flood risk from rising seas and rivers. Land use planning is an important tool for directing growth away from higher risk areas and enabling communities to adapt to changing conditions. For buildings and other infrastructure that remain in flood-prone areas, protection such as dikes may need to be built or upgraded to mitigate increasing climate risk (see *Infrastructure* Issue Area), and additional resources may need to be allocated to emergency response planning (see *Health, Safety and Emergency Management* Issue Area).

Metro Vancouver's Authority and Role

Metro Vancouver develops and stewards the regional growth strategy, *Metro Vancouver 2040: Shaping our Future (Metro 2040)*, which is the collective vision for how our region will accommodate growth into the future. Changes to the regional growth strategy require approval from the MVRD Board. Through *Metro 2040,* Metro Vancouver strives to contain growth within the Urban Containment Boundary, which has the benefits of reducing development in some flood prone areas, protecting conservation and recreation, agricultural and rural lands, and managing infrastructure costs. *Metro 2040* also encourages land use and transportation infrastructure that improves the region's ability to withstand climate change impacts and natural hazard risks.

Metro Vancouver plays a key role as a regional forum for regional land use planning issues and challenges. As local government climate adaptation plans advance, the region will play a role in sharing information and lessons learned across member jurisdictions.

Metro Vancouver is the local government for Electoral Area A. In this role, it provides key services – including land-use planning, emergency planning and assessing natural hazard risks – for residents of Barnston Island and communities along Howe Sound, Indian Arm and the west side of Pitt Lake. The area has approximately 500 properties and includes over 250 permanent residents.

LAND-USE AND GROWTH MANAGEMENT

Examples of Metro Vancouver's current climate actions

REGIONAL LONG RANGE GROWTH SCENARIOS

In collaboration with member jurisdictions, TransLink and other stakeholders, Metro Vancouver is using a scenario planning approach to consider key drivers and disruptors that will impact the region into the future. The project will consider the region's land use planning framework in the context of a changing climate and consider policy responses.

MANAGING FLOOD RISK IN ELECTORAL AREA A

Metro Vancouver establishes flood construction levels and adaptive construction approaches to flooding for Barnston Island, communicates flood preparedness information to residents and plans for major flood events. Also see the Health, Safety and Emergency Management Issue Area

FREQUENT TRANSIT CORRIDOR STUDIES

To support the planning and implementation of transit infrastructure on the North Shore, in 2016-17, Metro Vancouver worked with TransLink, the City of North Vancouver, the District of North Vancouver, the District of West Vancouver, Squamish First Nation and the Province of BC on a frequent transit corridor study. The study advanced ongoing efforts to direct growth and integrate land use and transportation planning on the North Shore and provided partners with information on planning and designing transportation corridors across municipal boundaries to support future transit investments.

Examples of climate actions of others

LAND USE AND TRANSPORTATION PLANNING ON THE EVERGREEN LINE

The Evergreen Line extension to the SkyTrain system, connecting Coquitlam City Centre through Port Moody to Lougheed Town Centre, opened in late 2016. The City of Coquitlam and Port Moody are both planning around transit stations along the Evergreen Line to provide supportive densities and a mix of land uses that will allow more people to live and work near high quality transit service, leveraging a major public transportation investment and reducing greenhouse gas emissions relative to alternative forms of development.

BC FLOOD HAZARD AREA LAND USE MANAGEMENT GUIDELINES

The Province of BC recently updated its Flood Hazard Area Land Use Management Guidelines. The updated guidelines incorporate sea level rise into the determination of building setbacks and flood construction levels in coastal areas.

DISTRICT OF NORTH VANCOUVER CLIMATE CHANGE ADAPTATION STRATEGY

Through its Climate Change Adaptation Strategy, the District of North Vancouver has identified a need to create and implement a Coastal Hazard Development Permit Area to protect people, property, and foreshore ecosystems from coastal flood impacts.

CITY OF VANCOUVER COASTAL FLOOD RISK ASSESSMENT

In 2014 the City of Vancouver commissioned a Coastal Flood Risk Assessment to better understand flooding risk and subsequently updated their Building Bylaw to include floodplain standards and requirements for floodplain areas.

Agriculture

Similar to other regions of the world, climate change is having an impact on agriculture in the Metro Vancouver region. The combination of mild climate, fertile soils and a robust agricultural industry can keep this region food secure even as agricultural productivity declines in other food growing parts of the world due to a changing climate and limited access to fresh water. Protecting agricultural land and enhancing local food production are important elements of the resilience strategy for the region.

Climate models predict there will be both positive and negative consequences for agriculture. Rising average temperatures shifts the types of crops that can be grown and decreases heating costs for greenhouses. At the same time, rising temperature may introduce and exacerbate pest and disease problems. Changes in the seasonal precipitation patterns could limit water supply during the growing season putting increased stress on crops and livestock.

Less certain is the increased frequency and impact of extreme events such as heat waves and flooding on crop damage and productivity. Heat waves may also increase demand and costs for cooling livestock barns and for refrigerated crop storage. Rising sea levels can compromise access to irrigation water from the Fraser River, and storm surges may require dikes and other coastal flood protection measures to prevent agricultural land from flooding.

Agriculture both contributes greenhouse gases (GHG) and creates opportunities to build resilience and help communities adapt to climate change. Around 3% of the regional GHG emissions come from agriculture, primarily methane from livestock and manure, nitrous oxide (N_2O) from the application of fertilizer and soil management, and carbon dioxide from burning fossil fuels to heat the greenhouses and operate farm equipment.

Federal and Provincial governments are leading research and helping farmers transition to farm practices that reduce GHG emissions. Improvements in livestock feed and manure handling can reduce methane, while changes in soil management practices can reduce the release of N_2O. Alternative fuels, such as biofuels, can be used to run farm equipment, heat greenhouses and lower carbon emissions.

Less well understood is the contribution agricultural land makes to climate resiliency. Securing local food production can ensure that at least some of the food consumed by residents is accessible year round and during emergency situations. Equally important is the role agricultural land plays in providing ecosystem services. Nutrient and organic matter recycling on agricultural land supports regional efforts to compost organic waste. Agricultural land also provides habitat to wildlife; both resident species and migratory birds use the Fraser delta as a major stopover on the Pacific Flyway. Other examples are helping communities manage river water levels and extreme precipitation events through groundwater infiltration and flood management. Agricultural soils may play a substantial role in carbon sequestration, which can maintain soil productivity over the long term.

Metro Vancouver's Authority and Role

Metro Vancouver develops and stewards the regional growth strategy *Metro Vancouver 2040: Shaping our Future (Metro 2040)*, which is the collective vision for how our region is going to accommodate growth into the future. Through *Metro 2040* Metro Vancouver strives to contain growth within the Urban Containment Boundary. *Metro 2040* policies support provincial policies to protect agricultural lands.

Metro Vancouver adopted a Regional Food System Strategy (RFSS) in 2011 and a Regional Food System

Action Plan in 2016 to show what actions at the municipal and regional district level can support a sustainable, resilient and healthy food system. An important feature of the Action Plan is the identification of new ways for local governments to collaborate on food security, emergency planning and adaptation to climate change.

Examples of Metro Vancouver's current climate actions

AGRICULTURAL LAND USE INVENTORY

Metro Vancouver partnered with the BC Ministry of Agriculture to complete the Agricultural Land Use Inventory 2016 Update, which will identify changes to the region's agricultural landscape over the last five years. The data collected on land use and crop cover can inform decisions on promoting the viability of the agriculture industry, understanding agricultural water demand and the role agricultural land plays in providing essential ecosystem services.

AGRICULTURE AWARENESS GRANTS

Metro Vancouver provides agriculture awareness grants each year to non-profit organizations to assist communities educate school-aged children and public about the importance of local food and agricultural production in the region.

AGRICULTURAL LAND PROTECTION

Metro Vancouver established a memorandum of understanding with the Agricultural Land Commission to strengthen ongoing collaboration and support for common goals including a defensible Agricultural Land Reserve and an Urban Containment Boundary as defined by *Metro 2040*. Protecting agricultural land and containing urban growth and development are important for both reducing GHG emissions and adapting to a changing climate.

Examples of climate actions of others

BC AGRICULTURE & FOOD CLIMATE ACTION INITIATIVE

Funded by the Governments of Canada and British Columbia, the Climate Action Initiative is delivering industry led climate adaption programs throughout BC. This collaborative approach has led to a suite of regional adaption strategies (including the Delta Agricultural Adaptation Strategy below) and guidance on farm practices and climate change adaption for producers. The focus of the work is on adapting to agriculture's water future, preparing for extreme weather events, addressing emerging pest challenges and managing for farm-level resilience

DELTA AGRICULTURAL ADAPTATION STRATEGY

In 2013 the City of Delta participated in a Delta Adaptation Strategy that identified potential impacts on agricultural production in four priority impact areas: 1) increasing coastal flood risk; 2) changing hydrology (effects on water supply & salinity levels); 3) increasing amount & variability of precipitation (excess winter & spring moisture); and 4) increasing variability & extreme conditions. Several actions resulted from the Delta Adaptation Strategy including a study on the economic impacts of a storm surge flood event, on-farm emergency planning and a communication strategy to promote farming in Delta.

RENEWABLE NATURAL GAS FROM AGRICULTURE

Through its purchase of renewable natural gas, Fortis BC is supporting agricultural operations to develop renewable natural gas projects. For example, Seabreeze Dairy Farm in Delta combines anaerobic digestion and a biogas upgrading plant to produce high-quality biomethane, or Renewable Natural Gas, from the manure of the farm's dairy cows along with organic waste from the Metro Vancouver area. FortisBC operates the interconnection facility at this project, monitoring gas quality and connecting this source of Renewable Natural Gas to customers. The byproducts created as a result of this process includes hygienic bedding for the cows and a nutrient rich digestate which becomes fertilizer for growing crops to feed the cows, creating a sustainable loop of food, waste and energy. This project creates 45,000 gigajoules (GJ) of Renewable Natural Gas, which is enough to heat about 500 homes for a year.

APPENDIX 2: Climate Change Data and Trends

Increasing levels of greenhouse gas emissions are warming our planet and driving climate change. How do scientists know this? This appendix provides a snapshot of some of the key data points and observed trends related to global climate change. References and links are provided to key sources of information, which provide more in-depth data, trends, and scientific analysis.

Global Average Temperature

The planet's average surface temperature has risen about 1.1°C since 1880, based on measurements made on land and at sea (Figure 1).[1] Most of that warming has occurred in the past 35 years, with polar regions experiencing greater warming than the more temperate regions.[2] Sixteen of the seventeen warmest years on record have occurred since 2001. Scientific research has shown this change is driven primarily by increased carbon dioxide and other human-made greenhouse gas emissions into the atmosphere.[3,4] Although the global atmospheric concentrations of carbon dioxide have varied over the millennia, since the industrial revolution in the mid-1700s it has increased to unprecedented levels (Figure 2).[5]

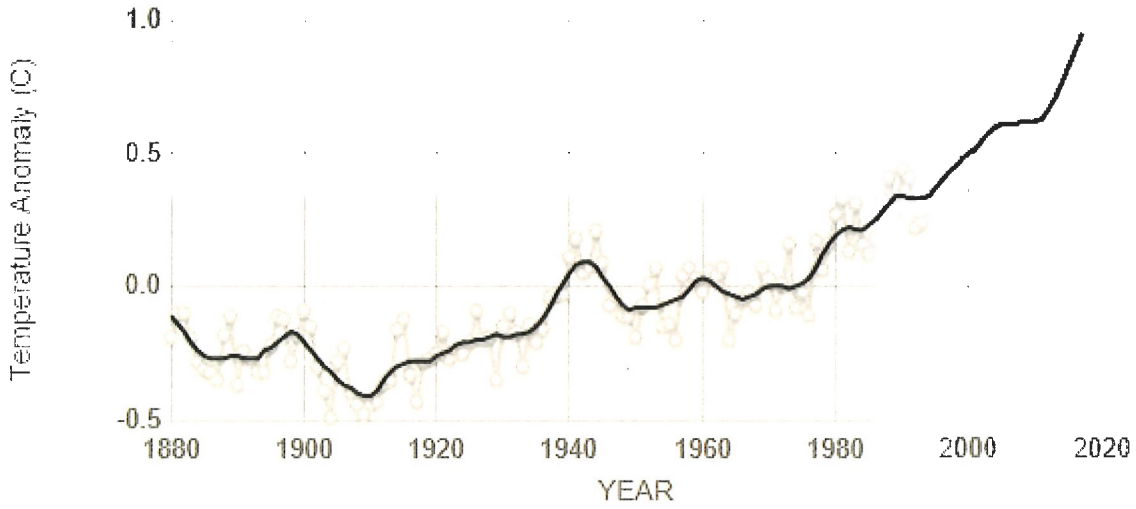


Figure 1. Global surface temperature change (land and ocean, compared to 1951-1980 average)
SOURCE: CLIMATE.NASA.GOV

1 https://climate.nasa.gov/vital-signs/global-temperature/
2 https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature
3 https://climate.nasa.gov/evidence/
4 http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf
5 https://climate.nasa.gov/evidence/

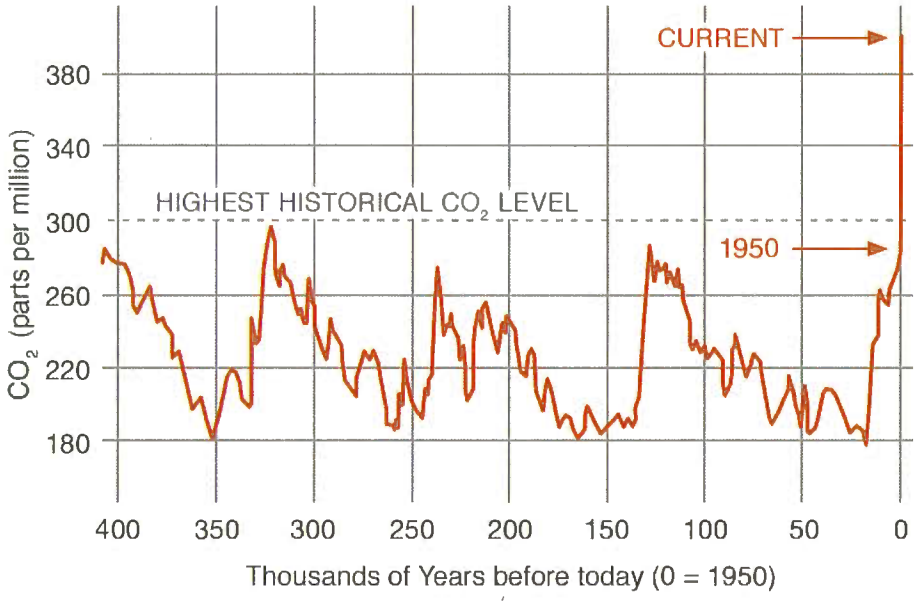


Figure 2. Global atmospheric concentrations of carbon dioxide over the past 400,000 years

(CREDIT: VOSTOK ICE CORE DATA/J.R. PETIT ET AL.; NOAA MAUNA LOA CO2 RECORD.)

Changing Global Climate System

Scientists have projected that increasing global temperatures would cause a number of significant changes to the global climate system. Some of these changes, such as declining global snow and ice cover and rising sea levels, are happening gradually as temperatures rise. Other changes are a consequence of amplified climate instability, for example the increasing frequency and intensity of extreme weather events such as heat waves, heavy precipitation, and storms. Below is a description of three of the expected changes to earth systems caused by rising global temperatures: sea level rise, decreased snow and ice cover, and extreme weather events.

SEA-LEVEL RISE

As the climate warms, sea levels are rising worldwide (Figure 3).[6] Higher global temperatures contribute to sea-level rise in two ways. First, as ocean temperatures increase, seawater expands and the overall volume of oceans increases. Second, higher temperatures accelerate the melting of glaciers and ice caps, also increasing the volume of the oceans.

Globally, sea levels have risen at an average rate of 1.8 mm per year from 1961 to 2003 and approximately 20 cm since 1880. Sea levels are expected to rise by an additional 30 to 120 cm by the year 2100.[7]

Coastal regions face several risks from rising seas. Higher sea levels will flood unprotected low lying areas such as islands and coastal river deltas. Wave action combined with higher sea levels will make more land vulnerable to coastal erosion.[8] Moreover, in the next several decades, storm surges and high tides combined with sea level rise will further increase flooding risk. In some coastal areas, groundwater and/or surface water will be contaminated with sea water as sea levels rise. This could impact the water available for irrigation and drinking water.

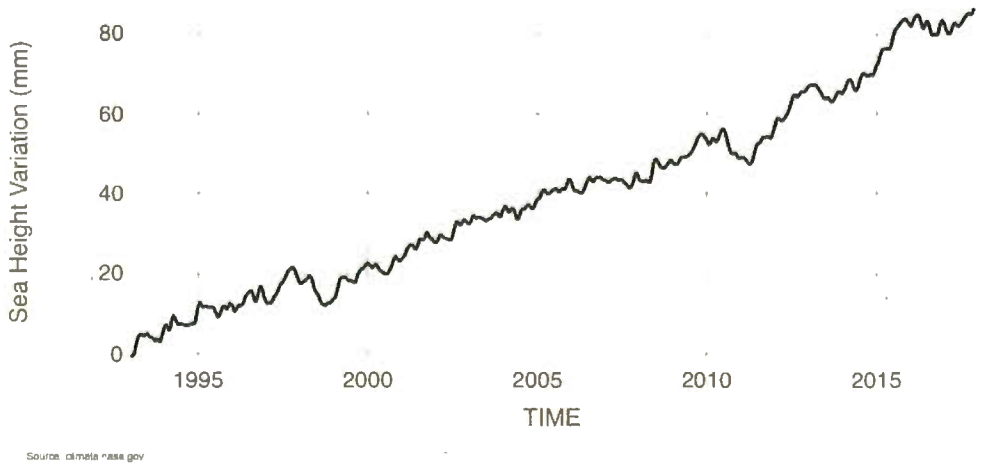


Figure 3. Sea Level Rise from 1993 to Present

6 https://climate.nasa.gov/vital-signs/sea-level/
7 https://climate.nasa.gov/evidence/
8 https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf

DECREASED SNOWPACK/SNOW COVER

Snow and ice cover helps regulate the climate by reflecting incoming solar energy back into space. Over the next century, water contained in glaciers, ice caps and annual snowpack are expected to continue to decline. With less snow cover and a decrease in the amount of reflected sunlight, the ground absorbs four to six times as much heat.

Monitored snowpack levels in western North America are decreasing, with record lows observed throughout the United States (Figure 4).[9] Since 1955, average snowpack has declined on average by 14 percent including areas in California, Oregon, and Washington, with some sites recently experiencing snow-free periods for the first time ever.[10] Glaciers have been retreating at least since the 1960s and mountain snow cover has declined on average in both the Northern and Southern hemispheres.[11]

The decline of glaciers and annual snowpack will reduce freshwater availability in regions supplied by meltwater, where more than one sixth of the world population currently lives. Rapid melting snowpack can also lead to springtime flooding and lower river and reservoir levels in the late summer. Changes in melting patterns and reduced stream flow will also affect hydro-electric power generation that is reliant on the water that is supplied through melting snowpack.

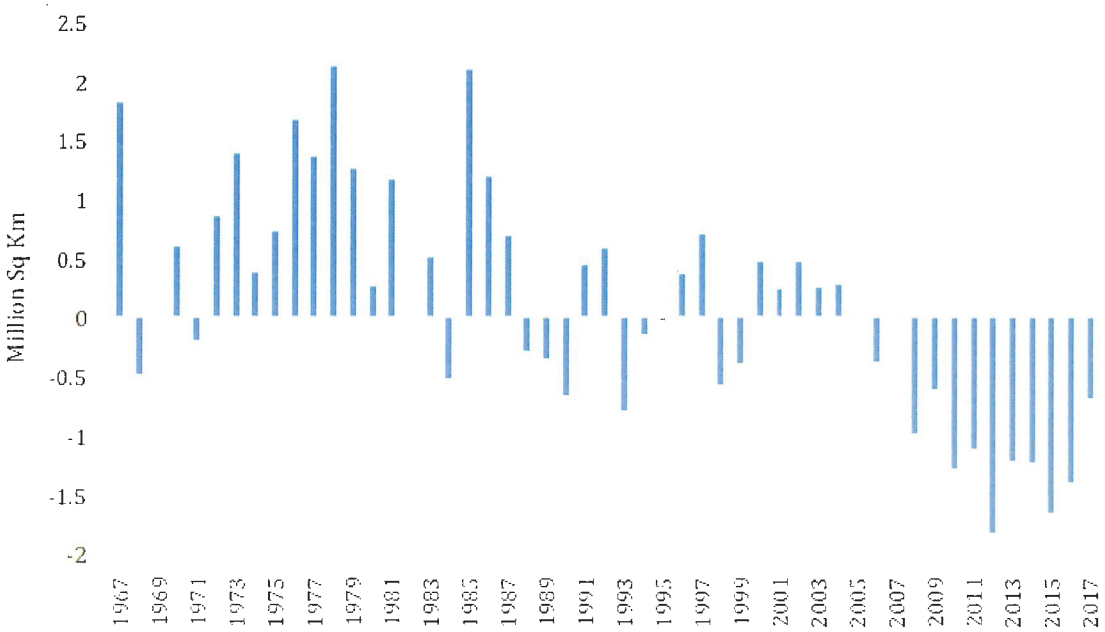


Figure 4 North American snow cover compared to 1981-2010 average

SOURCE: RUTGERS UNIVERSITY GLOBAL SNOW LAB12

9 https://climate.rutgers.edu/snowcover/chart_anom.php?ui_set=1&ui_region=namgnld&ui_month=6
10 https://blog.epa.gov/blog/2015/06/the-importance-of-snowpack/
11 http://nsidc.org/cryosphere/sotc/snow_extent.html
12 https://climate.rutgers.edu/snowcover/chart_anom.php?ui_set=1&ui_region=namgnld&ui_month=6

EXTREME WEATHER EVENTS

Climate change is increasing the frequency and intensity of extreme weather events. Climate-change-related risks from extreme weather events are already considered moderate to high with 1°C of warming and those risks are expected to increase as temperatures continue to rise.[13] International agencies that are tracking extreme events are already observing an increase (Figure 5).[14] Scientists are increasingly able to evaluate the contribution of climate change to specific extreme events.[15]

Although there has been a slight increase in the frequency or duration of droughts over the last 50 years, scientists expect climate change to increase the intensity and duration of droughts to increase after 2050, especially if global GHG emissions do not decline.[16] [17] Less snow and a lack of moisture in the ground increases the likelihood and prevalence of wildfires and dry spells. Longer dry spells and drought in the summer months also increase wildfire risk.

Scientists are studying how the frequency and severity for floods will change due to climate change.[18] Globally, the amount of damage caused by extreme weather events, including flooding, is increasing dramatically – both from the number of events and the increasing value of the built environment.[19] In BC, flood risk is exacerbated by sea level rise, particularly during events such as king tides and storm surges.

Climate-related weather extremes and shifting temperature patterns can put stress on ecosystems, disrupt food production and water supply, damage infrastructure and urban settlements, lead to loss of life, and have consequences for population health.[20] These interrelated challenges pose a particular threat to cities with aging infrastructure such as water and sewage systems, roads, bridges, and energy grids. Governments, including municipalities, are spending more on climate change adaptation to protect essential services, with costs rising from $4 billion globally in 2010 to $25 billion in 2014.[21]

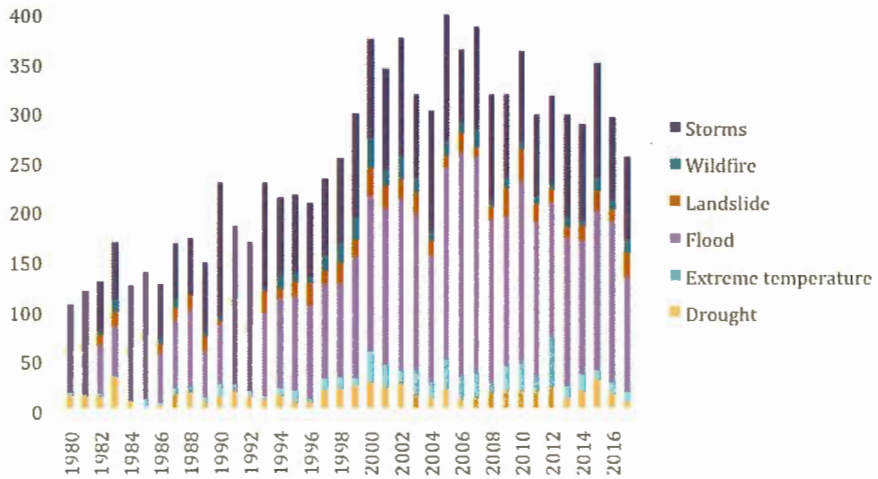


Figure 5. Reported Extreme Weather-related natural disaster events 1980-2017[22]

13 http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf
14 https://ourworldindata.org/natural-catastrophes
15 https://e360.yale.edu/features/pinning-wild-weather-on-climate-change-scientists-are-upping-their-game Yale Environment 360
16 https://rmets.onlinelibrary.wiley.com/doi/pdf/10.1002/joc.3875
17 https://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=4270
18 https://www.earth-syst-dynam-discuss.net/esd-2017-59/esd-2017-59.pdf
19 http://www.iisd.org/sites/default/files/publications/adaptation_can_infrastructure.pdf
20 http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf
21 https://nca2014.globalchange.gov/report/sectors/urban
22 Data Source: EMDAT (2017): OFDA/CRED International Disaster Database https://ourworldindata.org/natural-catastrophes