

AGRICULTURE ROADMAP



Climate 2050 Roadmap Draft: Agriculture

Metro Vancouver acknowledges that the region's residents live, work and learn on the shared territories of many Indigenous peoples, including 10 local First Nations: Katzie, Kwantlen, Kwikwetlem, Matsqui, Musqueam, Qayqayt, Semiahmoo, Squamish, Tsawwassen, and Tsleil-Waututh.

Metro Vancouver respects the diverse and distinct histories, languages, and cultures of First Nations, Métis, and Inuit, which collectively enrich our lives and the region.

FRONT COVER: FARMING IN METRO VANCOUVER

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October 13, 2021

Your Input is Valued.

We heard you loud and clear.

This Roadmap was drafted in Summer/Fall 2021 based on feedback received from the farming community as well as a broad range of individuals, organizations and stakeholder groups.



Public feedback is valued and the project teams will continue to seek input on this draft Roadmap through much of 2022, which recognizing the intense and ongoing disruptions experienced by many in the agricultural sector due to the drought, heat and flooding events that all took place during the 2021 growing season.

Goals and targets in Metro Vancouver's climate-related plans are science-based and remain a priority. The interim target of a 45% reduction in greenhouse gas emissions below 2010 levels by 2030 has a time horizon of less than ten years. Pursuing a carbon neutral region by 2050 requires taking bold action now.

The actions in this Roadmap reflect both current policies and new directions that reflect the best ideas, approaches and available technologies. As with all good planning, this Roadmap must be viewed as an iterative, dynamic path forward. The goals remain clear, but the Roadmap will reflect and be updated to match new and changes in policies, ideas, approaches and technologies.

Metro Vancouver

Metro Vancouver is a federation of 21 municipalities, one Electoral Area and one Treaty First Nation that collaboratively plan for and deliver regional-scale services. Its core services are drinking water, wastewater treatment and solid waste management. Metro Vancouver also regulates air quality, plans for urban growth, manages a regional parks system and provides affordable housing. The regional district is governed by a Board of Directors of elected officials from each local authority.

Mission

Metro Vancouver's mission is framed around three broad roles.

1. Serve as a Regional Federation

Serve as the main political forum for discussion of significant community issues at the regional level, and facilitate the collaboration of members in delivering the services best provided at the regional level.

2. Deliver Core Services

Provide regional utility services related to drinking water, liquid waste and solid waste to members. Provide regional services, including parks and affordable housing, directly to residents and act as the local government for Electoral Area A.

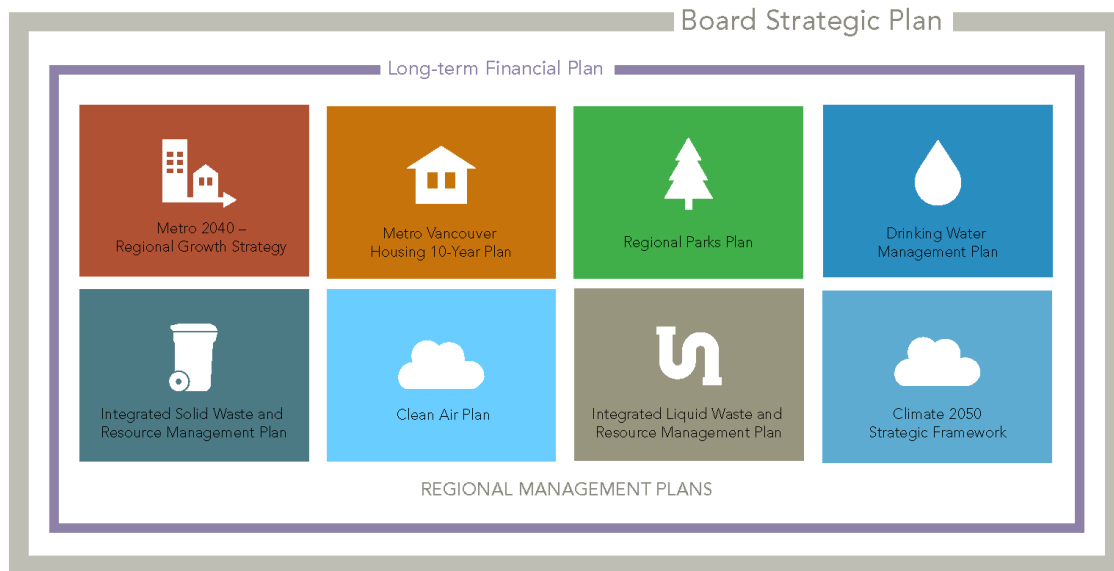
3. Plan for the Region

Carry out planning and regulatory responsibilities related to the three utility services as well as air quality, regional planning, regional parks, Electoral Area A, affordable housing, labour relations, regional economic prosperity, and regional emergency management.



Building a Resilient Region

Building the resilience of the region is at the heart of Metro Vancouver’s work. Each of Metro Vancouver’s regional plans and strategies adopts a vision, guiding principles, goals, strategies, actions and key performance measures that will support a more resilient, low carbon and equitable future. Metro Vancouver’s interconnected plans and strategies are guided by the Board Strategic Plan, which provides strategic direction for each of Metro Vancouver’s legislated areas of responsibility and the Long-Term Financial Plan which projects total expenditures for capital projects and operations that sustain important regional services and infrastructure. Together these documents outline Metro Vancouver’s policy commitments and specific contributions to achieving a resilient region.



Metro Vancouver’s Roles and Responsibilities for Climate Action

The three broad roles outlined in Metro Vancouver’s mission, each demonstrate responsibilities related to climate change. More specifically, 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, including greenhouse gas emissions. Through the regional growth strategy, Metro Vancouver, with its members, plans for compact, complete communities that are foundational to enabling a carbon neutral, resilient region. As part of delivering its core services, Metro Vancouver also generates and uses clean, renewable energy from its facilities and is working to ensure core regional services and infrastructure are prepared for and resilient to climate change.

In its role as a regional forum, Metro Vancouver builds and facilitates collaborative processes which engage the public and build partnerships to address significant regional issues like climate change. As part of this role, Metro Vancouver coordinates with and advocates on behalf of its member jurisdictions to other governments and regional partners on greenhouse gas management and climate change adaptation initiatives. We will be looking to many other regional partners to lead the implementation of key actions in the *Climate 2050 Roadmaps*, highlighting the importance of ongoing collaboration with other governments and partners.



The Roadmap at a Glance

Humans rely on agriculture to provide healthy, delicious food. Agriculture relies on healthy ecosystems, balanced soils and predictable growing conditions to produce crops for our enjoyment and consumption. Increasingly however, agricultural producers have been facing difficult challenges in managing their operations due to the effects of climate change and have been identified as also needing to adjust their business practices to reduce their contribution to that changing climate.

Like many industries, agriculture will be affected by higher temperatures, shifting precipitation patterns, severe weather events and sea level rise. In response to these complicated and challenging climate change impacts, this Roadmap focuses on supporting new technologies, using renewable energy sources, supporting and conserving ecosystem services and healthy soils relied upon by farms, and using adaptation as a method to support a resilient agricultural community that will survive, thrive and help to reduce the effects of climate change.

The *Climate 2050 Agricultural Roadmap* is about taking the necessary steps to ensure the agricultural sector is supported in the journey to resiliency and ensuring the long-term production of the food humans rely on. This Roadmap lays out four key strategies and 26 actions that will reduce the region's greenhouse gas emissions and create a strong, adaptive agricultural community in Metro Vancouver by 2050.



The Agricultural Roadmap lays out 26 actions for reducing emissions and increasing resiliency, organized under the following 4 strategic areas:

Strategy 1: Protect Agricultural Land

Strategy 2: Support Farmers as Climate Action Leaders

Strategy 3: Support Long-Term Farm Health and Resiliency

Strategy 4: Leverage Economic Opportunities, Innovation and Leadership

To achieve a carbon neutral agricultural community in this region, we are going to have to support farmers - financially and through information sharing - to transition their operations to using new sustainable technologies (e.g., solar power) and to incorporating regenerative agriculture and nature-based solutions into their daily operations. Farmers should not be left to manage this transition on their own, and the food available to this region, both today and well into the future, relies on making these adjustments as a collective whole, with each stakeholder playing a vital and unique part:

- For Farmers – it means using climate smart, ecological and regenerative agriculture and investing in new available technologies to take advantage of digital systems and processes;
- For Industry – it means funding new research and embracing digital innovations or information sharing to create new low-carbon options (e.g., electric farm equipment);
- For Consumers – it means increasing their awareness (e.g., the connection between agriculture and our resilience to climate change), adjusting their personal choices (e.g., eating more local food and reducing food waste), and becoming stronger advocates (e.g., supporting structural and regulatory change that protects agricultural land and the longevity of farming in the region); and
- For Government – it means establishing policies, creating programs and providing financial assistance to bring all these elements together to support the changes needed in the agricultural sector in order for it to become fully adaptive and resilient to the climate challenges ahead.



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Visioning Net-Zero Carbon, Resilient Agriculture in 2050

In 2050....agriculture is a key contributor to a low-carbon future having embraced clean and renewable energy sources, switched to regenerative farming practices, and transitioned farm land for both carbon capture and local food production.

Agriculture continues to significantly contribute to the Metro Vancouver regional economy, provides fresh, healthy food for local use and export markets, and operates in a sustainable and resilient capacity. Agricultural land is protected for future farming needs, and it helps to manage floods, captures carbon and provides habitat for pollinators and other wildlife while also benefitting from these ecosystem services.

Agricultural production practices have evolved and continue to adapt to the vulnerabilities of climate change. Farmers are able to pivot operations to manage changes in temperature and rainfall and are able to adjust farming practices and adapt to extreme weather events by using technological innovations and by taking advantage of new or expanded capacity and financial support systems. The agricultural community has seen noticeable improvement and maintenance of soil health and overall has increased and expanded its agricultural viability ensuring a long-term succession of farming and sustainable local food production for future generations.

PLACEHOLDER FOR IMAGE

Climate 2050 Agriculture Roadmap

A pathway to net-zero carbon, resilient Agriculture in Metro Vancouver

The Challenge

Agriculture in the Metro Vancouver Region contributes to the regional economy and provides fresh, healthy food for residents, visitors, businesses and export markets. In addition, agricultural land provides an aesthetic landscape, and other public benefits called ecosystem services, including wildlife habitat, carbon sequestration, water infiltration and flood management. At the same time, agricultural activities cause greenhouse gas and common air contaminant emissions. These come from livestock production, farm equipment, excess fertilizer applications, burning of organic residues, and the heating of greenhouses with natural gas and other fuels.

Compared to the biggest contributors of greenhouse gas emissions in the region, agriculture contributes approximately 4% to the total mostly from three main sources: 1. carbon dioxide produced from fuel combustion to heat greenhouses and to run farm equipment; 2. methane from livestock and manure storage; and 3. nitrous oxide from fertilizer and manure soil treatments. While the agricultural community is not a large contributor overall, all sectors will need to lower their emissions contributions in order for Metro Vancouver to hit carbon neutrality by 2050.

Agricultural activity is also vulnerable to the impacts of climate change. Farmers are dealing with changes in temperature and rainfall, and extreme weather events, all of which affect local food production. To increase our resilience, we need to support farming practices that improve soil health, strengthen agricultural viability and sustain local food production for future generations.

We are creating a roadmap to help us reach a low-carbon, resilient future while also improving air quality. By 2050, we can make agriculture carbon neutral and power it with clean, renewable energy. Farmers can use regenerative farm practices to capture carbon and build the soil for long-term productivity. And we can protect and invest in agricultural land to enable food production and provide secure tenure to farmers, and sustain the agricultural community over the long term.

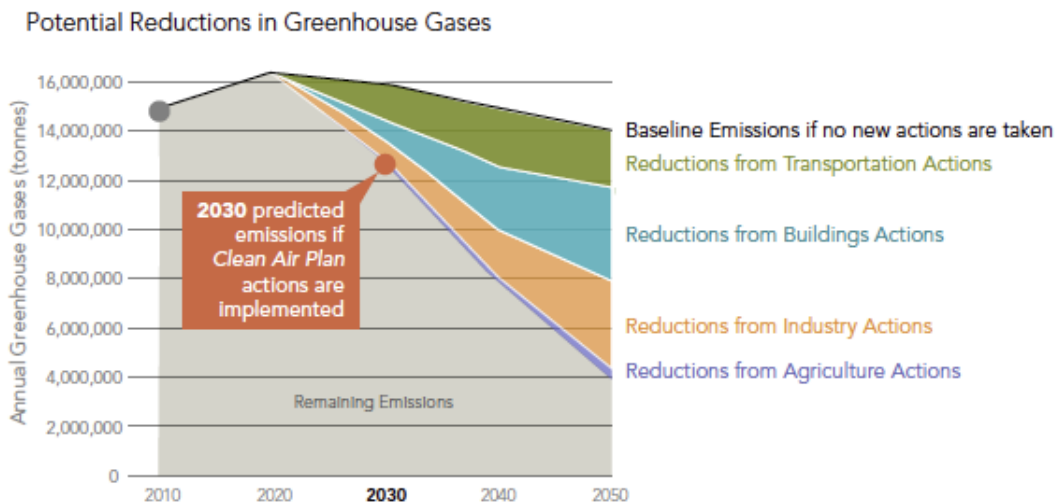
Call Out Box: What is a Carbon Neutral Region?

A carbon neutral region generates no net greenhouse gas emissions. This is achieved through the deepest greenhouse gas emission reductions possible across all economic sectors, and any remaining emissions are balanced out by the carbon dioxide that the plants, trees, and soil in the region remove from the atmosphere, or potentially through technological means.

A carbon neutral region is the best option for future generations to maintain a good quality of life, beyond 2050. We have to make some difficult decisions and investments today or pass them onto our children and grandchildren at higher costs and consequences. Metro Vancouver and many of its member municipalities have committed to ambitious targets and bold leadership to respond to the climate crisis. This plan responds to the global challenge to come together, think big, and act now.

Goals

GOALS	TARGETS AND MEASURABLE OUTCOMES
GOAL: The agricultural sector is carbon neutral and maximizes carbon sequestration.	TARGET: 35% reduction in greenhouse gas emissions by 2030, relative to 2010 levels.
GOAL: All agricultural operations minimize greenhouse gas emissions using best available management practices and technologies, and are powered by clean, renewable energy.	
GOALS: The Agriculture community consistently applies its knowledge of the benefits of ecosystem services to support the resiliency of local farming operations.	MEASURABLE OUTCOMES: To Be Determined: measurable climate-resilient outcomes are currently unknown for the agricultural community. Additional review and consultation will be required to determine what outcomes are attainable and available to measure on how well the region's agricultural producers are adapting to climate change impacts.
GOAL: Metro Vancouver complete food system is adaptable and resilient.	
GOAL: Long-term investment in the Agriculture community is coordinated and successful.	



The Connection Between Climate and Air Quality

The *Clean Air Plan* is Metro Vancouver's air quality and greenhouse gas management plan. Actions in the *Plan* will reduce air contaminant emissions and impacts, including greenhouse gases, in our region over the next 10 years, and in doing so, support the 2030 target of reducing regional greenhouse gas emissions by 45% compared to 2010 levels, and establish the foundation for the 30-year commitment of a carbon neutral region by 2050. This management plan also addresses air quality targets for the region.

Agricultural activities including fuel combustion in greenhouses and farm equipment, manure management, livestock and fertilizer use, generate both greenhouse gases and air contaminants with direct health impacts, such as fine particulate matter, ammonia and nitrogen oxides. Residents in the region generally experience good air quality; however, health researchers have demonstrated that there are no known safe levels for some health-harming air contaminants.

Actions in the *Roadmap* and the *Clean Air Plan* will help reduce all of these emissions to protect human health and the environment.

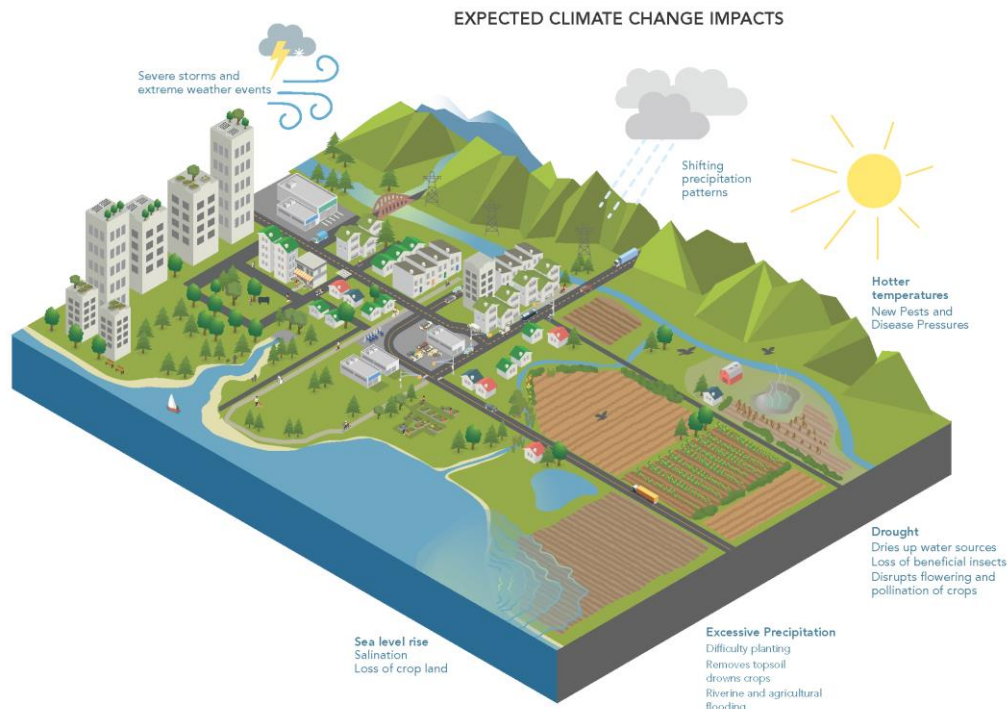


Climate Impacts on Agriculture

The agricultural sector is one of the most vulnerable sectors to the impacts of climate change. Farmers will continue to deal with changes in temperature and rainfall, shifting pests and diseases, and extreme weather events that significantly affect local food production. These impacts are not unique to the region, and have been and will continue to affect those agricultural areas in other parts of the world that supply food to this region. Climate change will lead to an overall increase in temperature, which may benefit agriculture by expanding the growing season, enabling a wider variety of crops that can be produced locally; however, there is also uncertainty and significant climate risks to agriculture such as the increased frequency and severity of extreme weather events - droughts, heat waves, heavy rainfall and flooding.

Extreme conditions will have immediate impacts on food production in the Metro Vancouver area as well as other parts of North America and internationally that supply food in this region.

Adverse impacts on agricultural crops are expected from higher temperatures, increased frequency and/or severity of droughts and storm, severe precipitation events, and salinization of soil and groundwater due to sea-level rise. The potential impacts to agriculture will increase costs of crop and livestock production and reduce economic viability.



PLACEHOLDER GRAPHIC

Based on climate projections to the 2050s, we can expect the following changes and impacts:

Climate Changes



Higher Temperatures overall, with higher daytime and nighttime temperatures, and more hot summer days. This will lead to increased frequency and severity of heatwaves, wildfires and droughts.



Shifting Precipitation Patterns, including more rainfall in every season except the summer, and less precipitation falling as snow.



Severe Storms and Extreme Weather Events, including high winds and heavy rainfall.



Sea Level Rise, with 0.5 m expected by 2050, which will impact coastal communities in our region. While sea level rise is an important aspect of climate change with significant regional impacts, it is not directly addressed in this report because it is being addressed through other Metro Vancouver initiatives.

Impacts Felt



Adjustments in temperature disrupt expected seasonal temperature changes affecting fisheries, livestock and crop mortality and the increase in the prevalence of new parasites and diseases. A longer growing season does lead to earlier harvests, a greater range of crop suitability and a decrease in heating costs for greenhouses in cooler months; however, warmer temperatures lead to an increase in demand for water for irrigation during the growing season and exacerbates pest and disease problems that are controlled by cooler temperatures.



Variations in temperature increase the variability in growing conditions which can impact crop quality, pollination and the life-cycle of pests and disease. These changes create challenges in aligning production with processing schedules. Hotter summers and heat waves also decrease productivity and crop quality and increase crop losses. Heat stress may require more heat-tolerant plants which may not currently be in use and may increase stress on limited water resources placing additional demands for irrigation. Energy use increases for the cooling and ventilation of greenhouses, crop storage and livestock.



Changes in precipitation increases the demand for supplementary irrigation that could put pressure on local water supplies and on adjacent ecosystems and riparian areas. Unreliable rainfall during the growing season increases irrigation requirements that didn't previously exist and waterlogged soils lead to delayed planting, soil compaction and nutrient leaching. Crop damage, crop loss, livestock relocation and soil erosion are all additional challenges agricultural producers are faced with due to the experienced changes in precipitation experienced within this region.



Riverine and field flooding from periods of extreme rainfall and increased runoff from adjacent urban development reduces ground permeability and causes long-term inundation of water into agricultural lands. This water intrusion reduces and limits land-use potential and causes root rot damage to year-round crop varieties.



More incidences of coastal flooding from higher tides and more severe storm surges causes immediate and long-term damage to agricultural land and operations including increased salinization of soils from brackish water, increased coastal erosion, loss of livestock and crops, reduced fish passage and a decrease in water quality used for irrigation and ecosystems. Coastal flooding also places additional pressures on ensuring flood prevention mechanisms, such as dykes, spillways and pumps, are all adequately maintained.



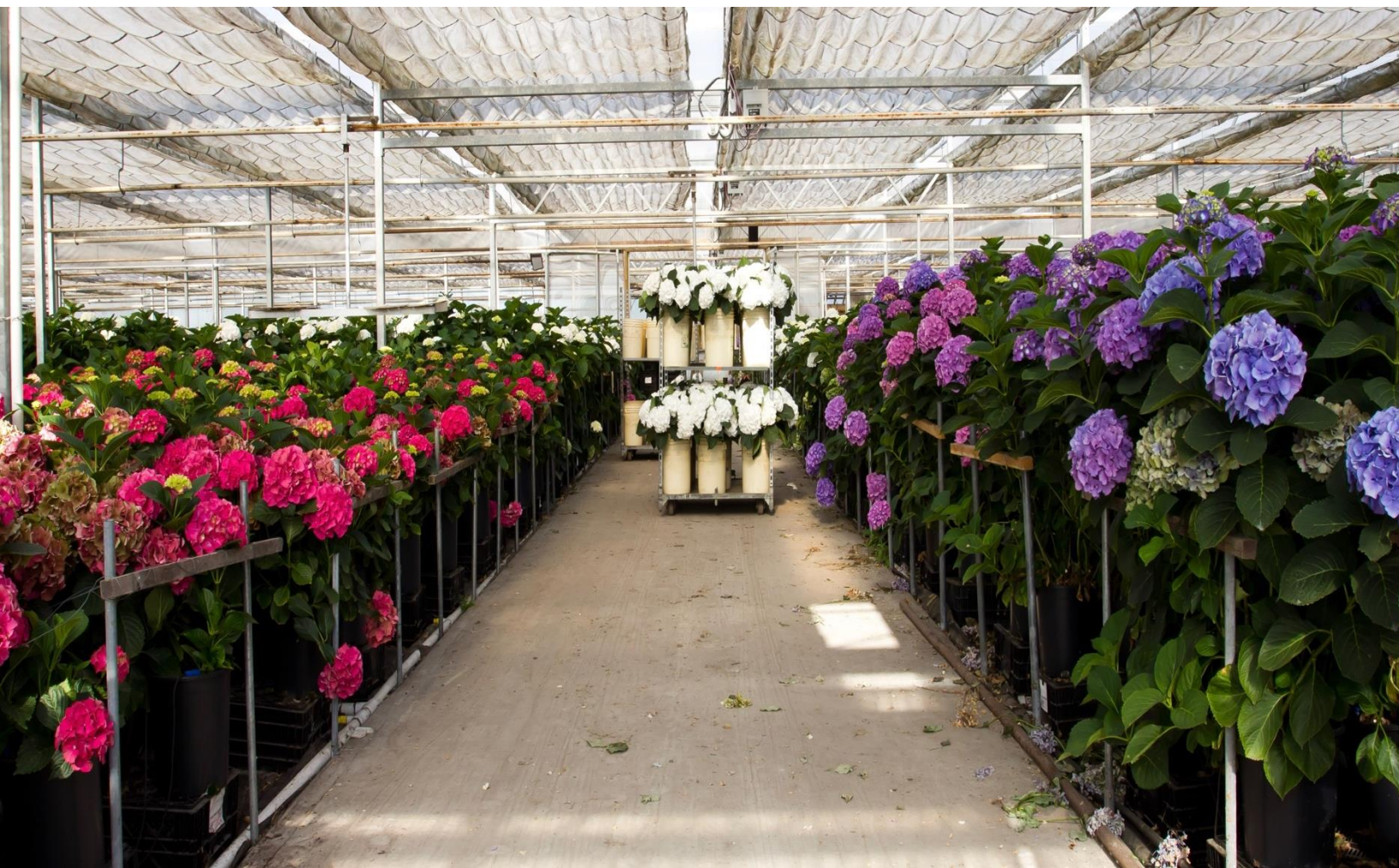
Food loss from climate change impacts affects the availability and pricing of local food producers, as well as international food markets, to produce enough food for human consumption. Local food systems impacted by climate change also experience disruptions to regional infrastructure, supply and delivery lines, a skilled agricultural labour force, and trade markets. This may lead to food price increases, food shortages of some agricultural products, distribution disruptions and an overall increase in food insecurity for an area.

Emissions from Agriculture in Metro Vancouver

Metro Vancouver's 2015 regional emissions inventory estimates that agricultural activities generate 4% of total greenhouse gas emissions in the region. The major sources of agriculture-related greenhouse gas emissions in this region are: carbon dioxide from fuel combustion in greenhouses and farm equipment; methane from livestock and manure storage; and nitrous oxide from fertilized and manured soils.

Agriculture emits 10% of the total greenhouse gases in Canada, with similar estimates for agriculture globally. This figure only measures emissions from agriculture production (including for food and non-food products) and does not reflect the full spectrum agricultural system emissions caused by upstream fertilizer and farm equipment manufacturing nor downstream from food transportation, refrigeration, processing and food waste disposal.

Opportunities to reduce greenhouse gas emissions from agriculture in Metro Vancouver include using cleaner, more renewable fuels, reducing energy demands and improving the energy efficiency of greenhouses, improving fertilizer and manure management, and altering livestock diets. Agriculture can also contribute to carbon sequestration by maintaining existing natural vegetation and woodlots, planting trees and hedgerows, and using regenerative farm practices that add carbon to soil. Protecting agricultural land for farming also prevents land conversion and development that generally emit more greenhouse gases.



Net-Zero Emissions, Resilient Agriculture

Reaching net-zero emissions and resilience in the agriculture sector involves considering and balancing, wherever possible, necessary elements of climate change action:

- **Reducing Greenhouse Gas Emissions** that accelerate climate change.
- **Increasing resilience** and the agriculture sector's ability to prepare, respond and recover from the effects of climate change that cannot be avoided.

A "net-zero emissions and resilient" agricultural sector is one that emits almost no greenhouse gas emissions and is able to withstand the negative effects of a changing climate, ensuring farm yield and business livelihoods are maintained. Looking to 2050, the *Roadmap* seeks to support the continued transition of agriculture toward a net-zero emissions future where renewable energy systems, innovative farm practices, and grazing and crop techniques support a sustainable and thriving future. By aiming for all of these desired outcomes simultaneously, we can identify ways to reduce emissions and vulnerability to climate change impacts at the same time.

In order for meaningful change to take place within the agriculture community, it is helpful to examine how it is connected to the three pillars of sustainability: economic, environmental and socio-cultural. These three pillars can also be used to structure and support necessary solutions and actions for change.

1. ECONOMIC - agricultural operations are businesses that need to make profits in order to survive and continue to function; these businesses can be difficult to adjust and may rely on expensive innovations and new technologies that still need to be developed in other sectors. For example, farmers cannot stop using diesel tractors until alternative fuel source (e.g., electric) tractors have been developed and commercialized. When appropriate funding, incentives and technologies are offered to the agricultural sector, farmers can begin to implement these new innovations while still maintaining a profitable business.

2. ENVIRONMENTAL - farming relies on and is affected by the environment. Affecting change, including using new fertilizer types and application methods, incorporating new irrigation systems and adjusting soil quality to increase carbon sequestration are all adjustments to farming practices that may take multiple growing seasons to determine if they were successful or not. Using nature-based solutions to solve problems is likely the best case scenario; however, outcomes are hard to determine in the short term.

3. SOCIO-CULTURAL - many farms are family-run businesses with generational ties to farming practices and many farms operate within a region where most residents have limited experience with the challenges and realities of running a farm. While these can both be challenging to overcome as farming is faced with the necessity to adjust its practices, generational knowledge and the desire for residents to have a closer connection to their food can also be used as positives for change.

What is the difference between "Zero Carbon", "Zero Emissions", "Net-Zero" and "Carbon Neutral" and what is "Carbon Sequestration"?

"**Zero Carbon**" also known as Zero Carbon Emissions, is reached when no greenhouse gas emissions exist at the point of use. A zero carbon fuel source either produces no greenhouse gas emissions, or the greenhouse gas emissions that are produced are offset by renewable energy (either generated onsite or purchased).

"**Zero Emissions**" are reached when no greenhouse gases or other air contaminants are generated at the point of use. Zero emissions include zero carbon and the elimination of or non-existence of health-harming air contaminants (e.g., fine particulate matter and nitrogen oxides).

"**Net-Zero**" is reached when there is a balance between the whole amount of greenhouse gases that are released into the atmosphere and the amount that is taken out.

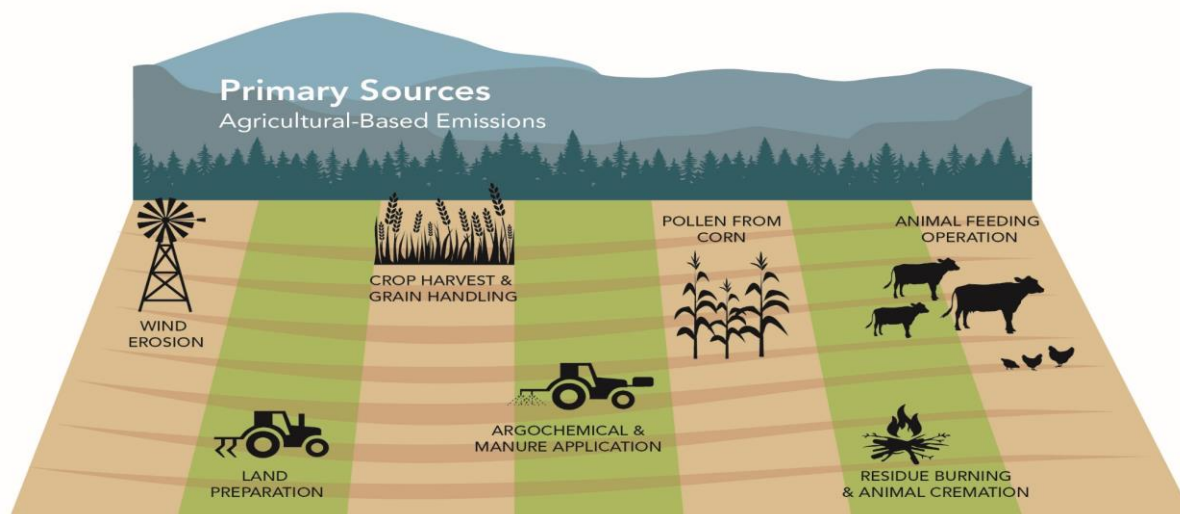
"**Carbon Neutral**" is reached when a company achieves a balance between the carbon dioxide it releases into the atmosphere and the amount it takes out.

"**Carbon Sequestration**" is a process of capturing and storing atmospheric carbon dioxide. In the agricultural context, carbon sequestration includes carbon storage in soils in conjunction with sound land management practices, and is one component in creating a resilient agricultural sector.

Lowering Emissions Through Renewable Energy and New Technology

Agricultural operations emit air contaminants that can impact human health and the environment. These contaminants are sourced from a variety of farming practices including: the use of poultry and cattle manure; by-products from heating greenhouses; feed types provided to livestock; fertilizer application; and pesticide application.

Each of these contributors to air contaminants can be mitigated and addressed using a combination of renewable energy sources, new technologies, new management practices, and new input application methods.



1. Renewable Energy Sources

Renewable energy sources such as biogas and wind and solar have been around for decades and, when applied as alternative energy sources, their use helps to significantly reduce greenhouse gas emissions. Trucks, tractors and other non-road equipment, as well as greenhouses and agricultural buildings, all represent opportunities for the agricultural sector to transition to the use of clean, renewable energy sources. Most agricultural vehicles and equipment are extremely expensive (each range from \$15,000 - \$700,000 when purchased new) and are built to be durable and used for decades. Farmers need help to turn these vehicles over and take them out of production and they need technologies to advance making the option to purchase, for example an electric tractor with the same operating costs and life span as the current diesel version, actually possible.

2. New Technologies

New technologies across all industries are being invented, tested and applied to mainstream uses on a regular basis. Within the agricultural sector, new energy sources such as renewable natural gas (RNG) hydrogen energy, and re-using captured carbon dioxide are all options that have potential to transform farming operations into carbon neutral producers. Greenhouses have the most to gain from these new technologies; however, more research is required to fully understand how fuel is used and released and how different technologies and fuel types can be applied to existing buildings and production systems. These new technologies can be used in conjunction with improving the energy efficiency of greenhouses (for example, making them more air tight and improving thermal performance) to increase the overall sustainability of the agriculture sector. Businesses involved in the Agritech Grant Program in British Columbia are providing insight into how farming can evolve.

3. New Management Practices

Adjusting production management practices at the farm level is an area where the agricultural community has more individual control. Enhancing grazing practices and optimizing grass and forage quality has shown to reduce methane emissions from cattle and retaining, expanding and adding freshwater wetlands and riparian zones directly onto farms can increase a farm's resiliency, and using regenerative agricultural practices within production fields can increase the ability for soils to store carbon, thereby releasing less carbon emissions into the atmosphere. Additional data collection in this area is vital to understanding the degree to which the agricultural community can, contribute to a reduction in greenhouse gas emissions in the region, and determine how these management practices can contribute to the long-term resiliency of agricultural producers.

4. New Input Application Methods

In farming, field crops use nutrients, or inputs, (e.g., potassium, phosphorous and nitrogen) to grow. These nutrients are replaced back into the soil for each growing cycle through the use of mineral fertilizers. As these fertilizers are applied to crops, ammonia and greenhouse gas emissions, such as nitrous oxide, are released into the atmosphere. A convenient and standardized approach to fertilizer use involves an even application across entire fields regardless of plant need. Research has been conducted that shows that slow-release fertilizers and precision applications (for example, using field mapping to determine which specific parts of the crop need the fertilizer) can reduce emissions produced from using this input.



Understanding and Benefitting from Ecosystem Services

The agriculture sector within Metro Vancouver, British Columbia, Canada and across the globe is at a turning point of needing to adapt to the increasingly extreme effects of climate change. Every season, floods, rainfall events, heat waves, and droughts last longer or are more severe. Crop losses are more extensive, pest management is more difficult, and production costs are more expensive. Through all of this, farmers are relied upon to continue to produce the same quality and higher quantities of food even while it becomes harder and more challenging to do so. In order to continue to fill this economic and social need, farms must become as healthy and resilient as possible. This is achieved by understanding and benefitting from the ecosystem services provided by nature and working with those systems to ensure the long-term viability of agricultural producers.

6 Core Principles of Regenerative Agriculture



1. Support Regenerative Agriculture

The agricultural sector is affected by and relies upon the natural environment. As the negative effects of climate change continue to increase and take their toll on farming operations, the natural environment increasingly is being identified as something farmers can turn to, not only to help them adjust to the changing conditions, but to also work to actually counteract climate change. Regenerative agriculture focuses on building high-quality soil, increasing biodiversity, and retaining rainwater with a focus on working in sync with nature. Land management practices such as agroecology and agroforestry are increasingly being applied by farmers globally and show promising signs of success.

2. Support and Expand Ecosystem Services

Regenerative agriculture and maximizing ecosystem services on farmland will help farmers manage against the uncertainty of the timing, extent and frequency of extreme weather conditions. Programs such as Farmland Advantage, work directly with farmers, helping to not only conserve critical riparian streams and habitats but making farms more resilient to climate concerns. Farmland Advantage targets high risk and high opportunity (e.g., where support by a farmer already exists) areas throughout British Columbia and focuses on providing assessments and working collaboratively with farmers. Identifying the best ways to enhance ecosystem services on farmland largely depends on understanding the regional specialization and differences in landscapes, for example, rain, wind and sun microclimates, ocean and riverine environments, species at risk locations, soil composition, etc. One way to identify these differences is to conduct natural asset mapping, an evaluative process that compiles an inventory of a community's existing natural assets (e.g., aquifers, forests and wetlands), within Metro Vancouver's agricultural areas, to determine how these areas can currently work to collectively create a resilient agricultural sector.

3. Payment and Programs for Ecosystem Services

In order for the agricultural sector to be resilient in the wake of a significantly changing climate, adaptation will need to take place at the farm level. This requires that individual farmers take their land out of production; and although this results in the farmer losing the ability to expand their business, these set-aside areas also provide benefits to the farmer in the form of ecosystem services that provide habitat for pollinators and well as natural

flood and erosion control. In order to make establishing set-asides financially viable for the farming community, they need appropriate compensation, directly or indirectly, for these set-asides. Delta Farmland and Wildlife Trust and Farmland Advantage provide programs that specifically support ecosystem services in farmland in Metro Vancouver but there are other indirect tools (e.g., land acquisition programs) that can be used to share the burden throughout the entire population of Metro Vancouver as all residents, businesses and visitors benefit from supporting measures that help farmers maintain a sustainable business and that help farms adapt and increase their resiliency.

Other programs and policies that have been used throughout British Columbia and Canada to support the expansion of ecosystem services in agricultural areas include: Land Acquisition Fund Property Levy (Capital Regional District); Natural Asset Reserve Fund (Edmonton); reverse auctions (Ducks Unlimited); Species at Risk Farm Incentive Program (Ontario); Land Stewardship and Habitat Restoration Program (Ontario); Natural Area Protection Tax Exemption Program (Vancouver Island); Riparian Tax Credit (Manitoba); Stewardship Portal (Ontario). Funding sources for the lower mainland would need to be examined and reviewed to determine the most appropriate and effective option for supporting ecosystem services within Metro Vancouver's agricultural areas.

4. Focus on Soil Health

Good soil health is the backbone to a sustainable, resilient farm operation. Healthy soils help with water retention and infiltration, help reduce the effects of drought and the need to use fertilizers, help improve soil nutrients and can help roots grow deeper and sustain cover crops which helps sequester carbon and reduce carbon dioxide release into the atmosphere. Beneficial Management Practices (BMP) for maintaining soil health, as used in regenerative agriculture, include reducing or eliminating tillage, reducing and minimizing soil disturbance and keeping plants growing year-round through the use of cover crops during the off-season. Work and research is currently on-going in Metro Vancouver to determine the benefits of healthy soils, which is imperative to help farmers understand how they can adjust their business practices to get the inherent benefit of the soil they depend on so much.



Developing Adaptable and Resilient Food Systems

The Metro Vancouver region is one of the most important food producing areas in British Columbia. The system that supports food production in the Lower Mainland is comprised of a myriad of players engaged in farming, processing, transporting, distributing, celebrating and food waste recovery. These players function as individual units yet are simultaneously part of a larger natural, social, economic and political system that is incredibly complex, layered and multi-jurisdictional. Food systems that are sustainable and able to adapt to changing climate, economic and societal conditions must be energy efficient, protect ecosystems as part of their operations, build and bind a local community, and provide for sustained and attainable economic development opportunities.

In the context of this Roadmap, sustainable food systems are not just about providing local, healthy food, they are about ensuring the resiliency of the farm system in the context of significant major driving forces such as development pressures, climate change impacts, greenhouse gas emissions reductions, increasing transportation costs, pandemics and global health crises, and droughts, floods and an increased incidence of severe weather events to name a few. A transition to a sustainable, adaptable and resilient food system will require a multitude of interventions, decisions and changes in business and consumer practices both at the community and individual level.



1. Update Food System Strategy

A key step in examining the resiliency of Metro Vancouver's food system is to update the existing Regional Food System Strategy. This would allow for a separate process to answer tough questions about sustainability, adaptability and resiliency solely from the perspective of food. New experiences such as a global pandemic and exacerbated experiences such as extended heat waves and droughts can be examined cohesively with other issues such as vulnerabilities in the food chain, Indigenous access to traditional foods, inefficiencies in the transportation system, expansion of agricultural waste reduction; and Agritech and the role of technology and innovation.

2. Plan for Systemic Agricultural Changes

Large portions of the most productive agricultural land occupy low-lying, reclaimed coastal regions are susceptible to coastal flooding and are at risk from increased soil salinization and widespread farmland inundation and crop losses. A significant amount of work has already been done examining how communities are going to manage sea level rise and increased coastal flooding but there has not been a singular, regional examination of what that means specifically to the agricultural community, how it can be addressed and what systemic changes are needed in order to ensure the long-term viability of the region's farms. Focusing on cover crops, improving soil structure, switching to salt-tolerant crops are all elements that need to be examined in more detail and applied under a regional scale.

REGIONAL FOOD SYSTEM STRATEGY

In 2011, the Metro Vancouver Board endorsed the Regional Food System Strategy to create a collaborative approach to a sustainable, resilient and healthy food system. Since that time, the region has experienced a significant amount of urban growth, has seen increased and unprecedented pressure for agricultural lands to accommodate non-farm uses, has experienced increased food insecurity among vulnerable populations and among new demographic sectors as a result of a global pandemic, has experienced increasing changes to climate such as heat waves and droughts and has not addressed gaps in the previous Strategy including managing for hazards such as floods and earthquakes and engaging with the Indigenous community to help them expand access to traditional food sources.

In order for these issues to be explored from a purely food-centric perspective, they will be included in a review of Metro Vancouver's Regional Food System Strategy separate from this Roadmap. Of particular note, the following items should also be explored from a food system point of view:

- i. examine the Milan Urban Food Policy Pact to determine what regional monitoring frameworks can be implemented to evaluate gaps in policy and resource mobilization and reveal overall food system improvements;
- ii. examine the entire food system chain from a regional level to determine where emissions can be reduced and what efficiencies can be achieved;
- iii. examine the Food and Agriculture Organization of the UN to determine what sustainability indicators can be applied regionally to Metro Vancouver;
- iv. identify partnerships with industry, for example, Cleanfarms.ca, to determine ways to reduce packaging waste in the agriculture and food industries;
- v. work with the Indigenous Advisory Council on Agriculture and Food, as well as other Indigenous partners, to identify opportunities to strengthen Indigenous food systems and increase Indigenous participation in the agriculture and food sectors;
- vi. establish partnerships and programs to support and increase information sharing with farmers about the sustainability challenges faced by the agricultural sector;
- vii. establish partnerships and programs to support and increase information sharing with the consumer about how food is produced, sustainability challenges faced by the food sector, and the benefits of supporting local farmers;
- viii. examine how the local agriculture community can diversify including: new, more resilient crop species; appropriate locations for crops based on soil type and hazard vulnerabilities (e.g., coastal flooding); and new adaptive agricultural management and production models;
- ix. gain a complete and comprehensive understanding of a farmer's realities regarding regulations, jurisdictional requirements, food safety needs, access to labour, profit margins, machine and equipment purchasing and maintenance costs and how that relates to the price of food to the local consumer; intended to bridge the gap between the realities of the farming community and expectations of the consumer;
- x. establish inter-municipal learning opportunities for staff, administration and council to learn from each other and understand how municipal interests and activities intersect with food systems planning and decision-making;
- xi. determine the content for a toolkit to be used by new or young farmers interested in starting a farm operation within Metro Vancouver, including step-by-step instructions to follow, Beneficial Management Practices to follow, and financial sources to seek;
- xii. address the tension that exists between food safety (health protection) and food security (health promotion) activities.

Enable Long-Term Investment in Agriculture

Agricultural producers understand and largely support the need to adapt and adjust their processes to remain viable as a sector; however, they have experienced gaps in the knowledge, financial support, policy structure or understanding of what these adjustments should be, how to go about making them happen on their farms, and how they can be applied to their business practices.



1. Support Champions and Provide Strong Leadership

In order for the agricultural sector to make the necessary adjustment to manage for climate change and keep their farming operations running and viable, long-term investment in agriculture and farming operations is necessary at all levels and through multiple streams: financial, support services, leadership, innovation, education, policy and regulation. While climate adaptation requires changes to individual behaviour as well as business practices, these changes are often unsuccessful without the necessary champions and leaders (e.g., BC Climate and Agricultural Initiative).

2. Ensure Policy, Regulatory and Financial Support

In order for the agricultural sector to remain viable and to continue to adapt to changing climate conditions, all levels of government in Canada will need to ensure there are adequate policies and regulations established to support innovation and create opportunities for businesses to be flexible to adjust to changing international, national, local and sector needs. Regulators will also need to show leadership in understanding and supporting that conventional farming models will likely not be applicable in the future and that alternative models with new and multiple objectives should be pursued. Tax reform, incentive programs, learning opportunities, research funding, and an overall recognition and understanding of the importance of supporting the agricultural sector as it adjusts and adapts to the new climate realities will go a long way. Coupled with the policy and regulatory support needed by the agricultural sector is the financial support farmers need to make this transition. Financial support doesn't just have to show up through complicated adjustments to tax structures or finding ways to reduce the impact of the high cost of land in the Metro Vancouver region, it can also take place through offering programs that provide specialized agricultural advisement to primary producers, supporting extension services that help understand supply chain, packaging, food safety, human resources, and marketing and distribution commitments.

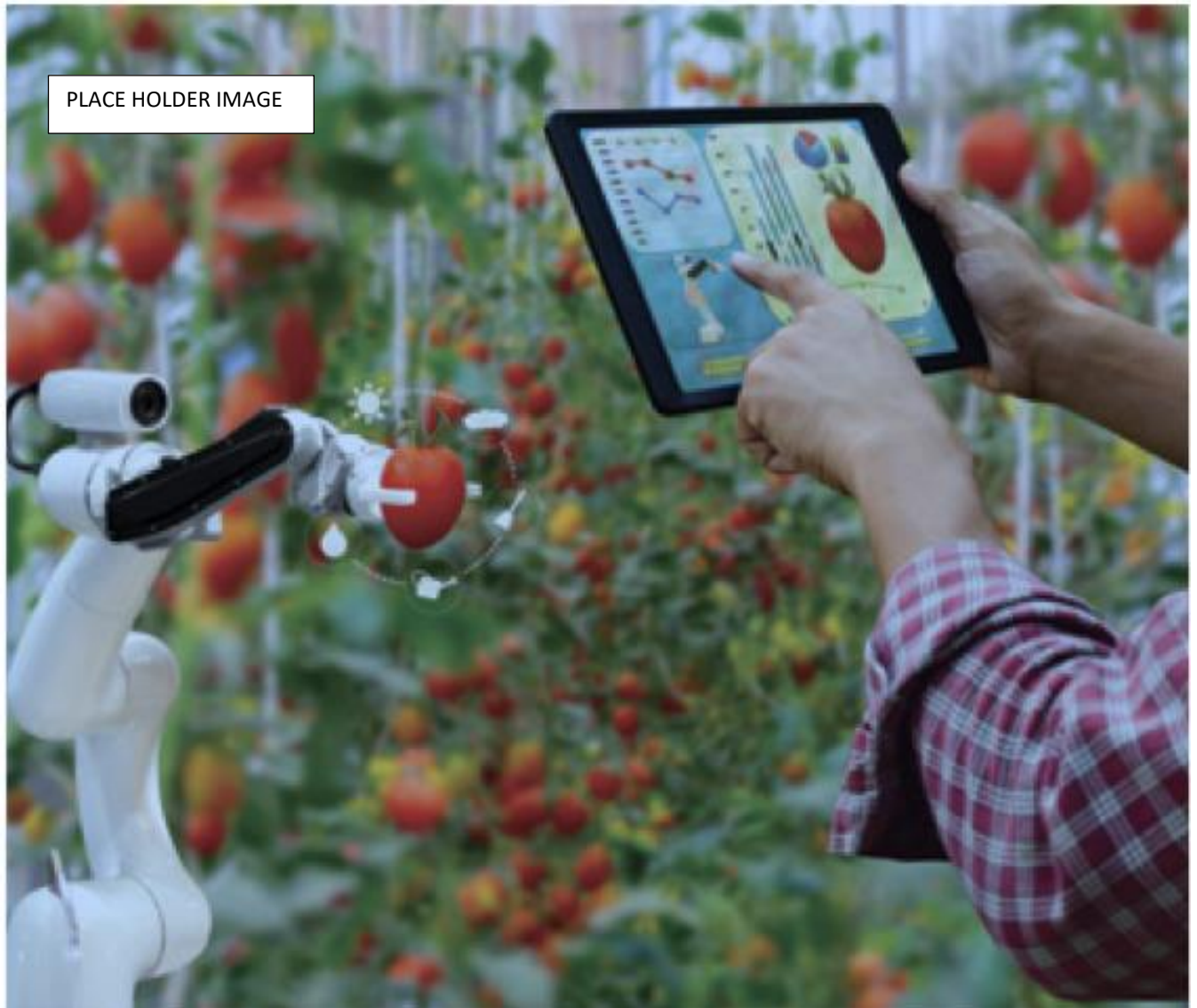
3. Create Opportunities to Increase Self-Sufficiencies

Many farmers rely on others to provide them information on how they can adjust their operational practices to become more resilient. Production improvements are often suggested to farmers, for example, to incorporate new growing practices, add new building technologies, or participate in educational opportunities that may require expensive testing to implement (e.g., soil for carbon sequestration), may not be readily available (e.g., solar powered equipment) or that may be offered during the most productive part of a farmer's day. Part of the leadership gap that exists in the agricultural sector is the lack of resources that could help farmers increase their existing self-sufficiencies by relying less on outside sources to determine if a new farming method is successful or not. Programs such as COMET (US Department of Agriculture) allow farmers to use an online evaluation tool to determine a generalized estimate of the greenhouse gas impacts of a conservation or adaptive principle implemented by the farming operation. Tools like these provide more knowledge and information to the farmer to make better decisions and allow for more adaptive and innovations on their own farms. Online programs like AgPal (Government of Canada) allow farmers and agri-businesses to find relevant resources and information (for example, funding and grants, licensing and regulations, business practices, science, environment and sustainability) in an easy to access platform that they can use at a time that is suitable to them. Expanding and supporting these types of

resources go a long way in increasing a farmer's ability to be self-sufficient and able to adjust and pivot to outside changes and pressures.

4. Integrate the Use of Technological Solutions

While the agricultural sector is making great strides in using regenerative agricultural practices and ecosystem services to create sustainable farming operations, technology is also playing a vital part in helping farmers adjust to climate change and increase their overall operational resiliency. Supporting technology to optimize fertilizer application, generate renewable energy from agricultural residues, and assist with pest, water and soil management are great examples of how farming is benefiting from high-tech innovations. Continuing to innovation and technology, as well as Provincial programs such as Agritech (supports agriculture and food and seafood processing) will help the agriculture sector in Metro Vancouver, and throughout the province, remain competitive, diverse, resilient and adaptive.



Barriers and Opportunities

Most barriers are also chances for opportunities....

International Pressures

Barrier	Opportunity
Farm businesses are expected to accommodate all climate-related policy and regulatory changes while working with global commodity prices and also competing with cheaper imports.	Climate change is experienced locally but it is being experienced globally and throughout the world people are experimenting and researching solutions that may be applicable in a local setting; solutions can be shared.

Sea-level Rise and Extreme Weather Events

Barrier	Opportunity
Salt water intrusion is an on-going issue and drainage problems and flooding pose great risks; the extreme land shortage in the Lower Mainland doesn't provide opportunities to 'move' farmland to somewhere else.	Pushing the sector and all levels of government to collaboratively develop solutions by developing salt-resistant crops and by supporting crop diversification within the region thereby establishing a more resilient agricultural sector.
Lack of knowledge and understanding by the consumer on how extreme weather events, for example an on-going heat wave, affect their own food security. Crop damages due to extended droughts and high temperatures not only affect crop production, they affect a farmer's livelihood, decrease the amount of food available for consumption and increase food costs.	Communication with surrounding urban communities is an opportunity to connect them with their local food and strengthen the urban population's understanding of agriculture and how their personal decisions and choices toward managing climate change can be connected to the cost of the food they consume.
Ongoing insufficient access to water for irrigation for agricultural purposes.	Determine how using practices such as regenerative agriculture can directly impact the amount of water needed by the agricultural sector to reduce the effects of climate change; test and implement alternative water storage and recycling methods and strategies to overall increase the resiliency of the farming community within Metro Vancouver.

Local Decision Making

Barrier	Opportunity
Financial costs from the effects of climate change hinder the agricultural sector's ability to produce food.	Adjust policies, regulations, and financial structures to shift toward supporting the agricultural sector in becoming more resilient and finding ways to best adapt to the climate challenges ahead.
Urban development impacts and the effects of climate change have not been factored into managing and protecting local agricultural land and managing and dealing with water shortages.	Local governments can apply local solutions to ensuring the resiliency of the agricultural resiliency; not all of their decisions are reliant on other levels of government to approve.
The agricultural community is marginalized and produce food for consumers who do not understand the challenges and risks that go into local farming.	Communication with surrounding urban communities is an opportunity to connect them with their local food and strengthen the urban population's understanding of agriculture and how their personal decisions and choices toward managing climate change can be connected to the cost of the food they consume.
Lack of access to irrigation for agricultural purposes including: water licences that are over prescribed;	Determine how using practices such as regenerative agriculture can directly impact the amount of water

Climate 2050 Roadmap Draft: Agriculture

water taken without a licence; marginal ground water quality; and difficulty accessing ground water sources.	needed by the agricultural sector to reduce the effects of climate change; test and implement alternative water storage and recycling methods and strategies to overall increase the resiliency of the farming community within Metro Vancouver.
Standing in the way of farmers to fully integrate adaptability and sustainability into their farm operations includes no capacity to do so and the processes, applications and permitting being too onerous, costly and time consuming.	Support and expand programs such as Farmland Advantage that directly provide support services to assess a farmer's land, determine remediation needs (if any), follow-up with additional inspections and provide payment for ecosystem services.
There are more non-farm landowners in ALR than farmers in Metro Vancouver making it difficult to comprehensively use agricultural land to manage for climate change; high absentee landlords in the ALR make it difficult to access underused agricultural land; agricultural land is held idle by non-farm land owners while at the same time there are operators who cannot find land to use for farming purposes.	Adjust policies, regulations and financial structures to make non-farm uses that do not support agricultural operations harder to support for the long-term and that make it less financially viable to use agricultural land for uses other than agriculture.
Metro Vancouver farmland is very desirable for estate and non-farm use development and activities that generate higher financial gains compared to food production and agricultural uses, makes it difficult to comprehensively use agricultural land to manage for climate change.	Adjust policies, regulations and financial structures to make non-farm uses that do not support agricultural operations harder to support for the long-term and that make it less financially viable to use agricultural land for uses other than agriculture.
Ongoing tension and pressure from industrial sector to expand into and convert agricultural land to ease regional industrial land shortages.	Adjust policies to re-affirm using Agricultural land for agricultural purposes; specifically examine how agriculture and ag-industrial uses can co-benefit and co-exist within a region that experiences pressures for both use types.

Ongoing Research and Support

Barrier	Opportunity
Switching to high-value crops may be challenged by exposure to pests, soil salinization etc.	The integrated pest management approach inherent in regenerative agriculture provides an opportunity to address increased pest exposure; research and technology can determine ways to adapt crops and farmland to better manage sea water inundation and the increased salinization of soil as a result.

Journey to Net-Zero Emissions, Resilient Agriculture

Agriculture contributes to the regional economy and provides fresh, healthy food for local consumption and export. Protecting agricultural land supports regional food security and provides ecosystem services, which are public benefits that include flood management, carbon sequestration and wildlife habitat. Agricultural activities also generate emissions of greenhouse gases and other air contaminants.

Linkage to Other Issue Areas

There are several linkages between agriculture and other issue areas and Metro Vancouver is exploring which linkages must be considered when developing policies and actions. This *Roadmap* primarily addresses agriculture within our region and impacts and actions related to climate change or air contaminants. Some of the related issue areas for agriculture are:

Land Use and Growth Management – Containing urban growth protects agricultural land for farming. Agriculture is vulnerable to impacts from adjacent land uses and new housing developments and transportation infrastructure.

Human Health and Well-Being – Fresh local and imported food, especially fruits and vegetables, support healthy communities; food choices affect health as well as emissions and agriculture viability.

Transportation – Transporting imported and exported foods and food distribution within the region, are sources of emissions.

Waste – Food loss and food waste increase air contaminant emissions, including greenhouse gases.

Industry and Energy - Production of renewable natural gas from agricultural organic residues has the potential to supply energy to the agriculture sector as well as other industries thereby reducing greenhouse gas emissions from manure and from industrial energy use.

Nature and Ecosystems – Protecting, restoring and connecting natural areas, and enhancing ecosystem services on agricultural land support a climate resilient agriculture sector. The significant connection the *Nature and Ecosystems Roadmap* has to the agricultural sector is explored in more detail below.

As these other Roadmaps are developed, they will be made available on the Metro Vancouver website.

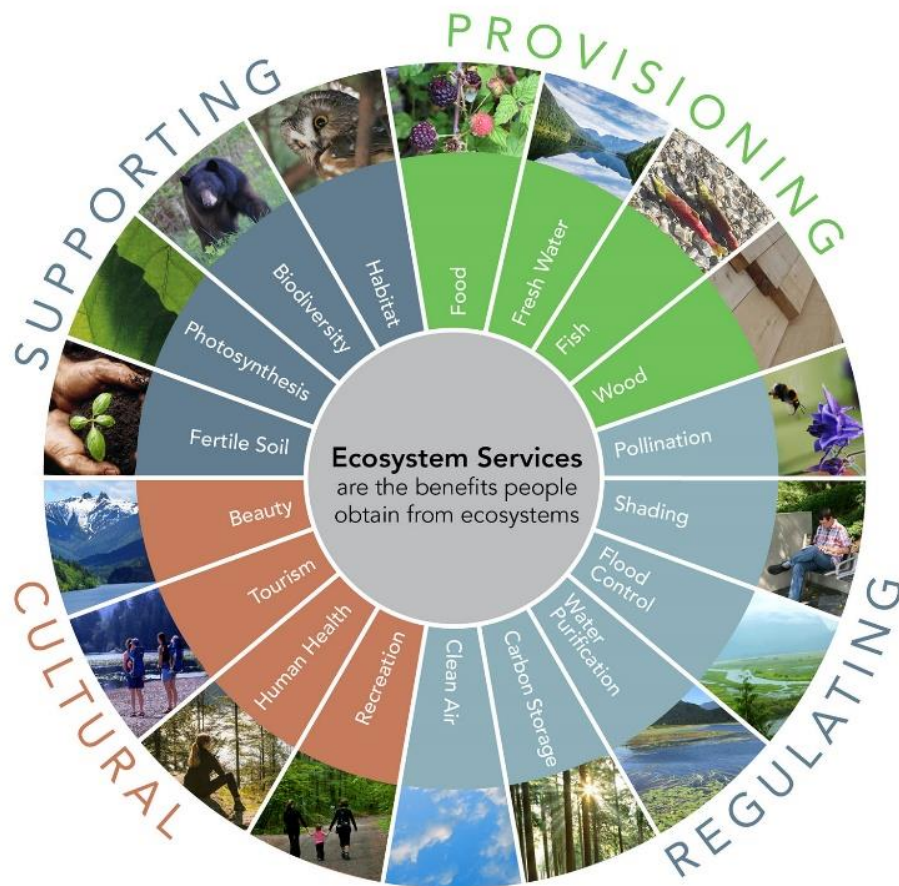


CLIMATE 2050 NATURE AND ECOSYSTEMS - ROADMAP CONNECTION TO AGRICULTURE

While there are several linkages between the *Agriculture Roadmap* and the other issue areas of *Climate 2050*, more than any of the others, the *Nature and Ecosystems Roadmap* is the most inter-connected and related to the *Agriculture Roadmap*.

The *Nature and Ecosystems Roadmap* and *Agricultural Roadmap* largely connect through the co-benefits each provides the other:

- NATURAL SPACES provide agricultural lands pollinator habitat, flood and erosion control and natural pest management; and
- AGRICULTURAL LANDS provide the opportunity for wildlife and bird habitat, natural asset management, connections and linkages to Metro Vancouver’s Green Infrastructure Network, regional park space and habitat for sensitive ecosystems and species at risk.



Source: Metro Vancouver Regional Planning 2018

Strategies and Actions

ROLES AND RESPONSIBILITIES

Under authority delegated by the BC Government in the *Environmental Management Act*, Metro Vancouver is responsible for managing and regulating air quality and greenhouse gases in the region, including air contaminants from agricultural sources. Metro Vancouver is also responsible for developing, implementing and stewarding *Metro Vancouver 2040: Shaping our Future (Metro 2040)*, the regional growth strategy, and for preparing an update to that strategy, *Metro 2050* (draft). Both *Metro 2040* and *Metro 2050* contain Metro Vancouver’s greenhouse gas reduction targets and include strategies to protect agricultural land and promote agricultural viability through policies such as the Urban Containment Boundary.

While Metro Vancouver plays a pivotal role in advancing climate strategies and actions for the agricultural community in response to climate change issues, air quality management and climate action require close coordination among all governments, as well as private businesses, utilities, institutions and residents. The government and agency organizations that fill key roles in reducing agricultural emissions and helping increase resiliency of Metro Vancouver’s agricultural community are outlined below:

ENTITY	ROLE
BC Ministry of Agriculture, Food and Fisheries (AFF)	Supports the production, marketing, processing and merchandising of agricultural products, provides guidance for agricultural operations and secures agricultural production through the mandate of the Agricultural Land Commission.
Agricultural Land Commission (ALC)	Preserves agricultural land, encourages farming in British Columbia and encourages local governments to enable and accommodate farm use of agricultural land.
BC Ministry of Environment and Climate Change Strategy (MOECCS)	Responsible for the protection, management and conservation of BC’s water, land and air and living resources and leads climate action through various policies, legislation, regulation and programs.
Government of Canada	Establishes standards for agricultural operations and agricultural equipment as well as supports agricultural research.
Member Jurisdictions	Have authority over local land use decisions and support agriculture through zoning, environmental policies and engaging with residents. Some member jurisdictions can manage agriculture through Farm Bylaws approved by the BC Ministry of Agriculture.
Energy Utilities	Provide rebates, infrastructure and energy for agricultural operations as well as access to market for energy sources such as renewable natural gas (RNG) (e.g., BC Hydro, FortisBC)
Farm Industry Review Board	An independent administrative tribunal that is responsible for hearing complaints from person aggrieved by odour, noise, dust or other disturbances arising from agriculture and may also study and report on farm practices.
Industry Associations	Support agricultural producers with the latest information on technologies, policies and regulations.
Academic Institutions	Conduct research and provide education and training as well as advocate and inform others about ways to transition to a low-carbon and resilient future.
Non-Profits	
Other Organizations	
Local Residents	Make food choices that can support agriculture by buying local food.

STRATEGY 1: Protect Agricultural Land

Above all else, farming cannot take place, food cannot be produced, and ecosystem services cannot be gained if farmland does not exist. Agricultural land in Metro Vancouver is increasingly threatened from non-farm land uses. Currently, there are more non-farm landowners in the Agricultural Land Reserve (ALR) than there are farm owners which is a significant barrier to not only turning unused or non-productive land into operating farms and to ensuring the ALR is cohesively used to protect farming operations from climate change, but it is also a substantial barrier that prevents new or young farmers from gaining access to land to farm, whether it be through leasing or purchasing. This imbalance in land ownership and use of the ALR represents lost economic development opportunity for the region and places strains on the local food system when the demand for local food is constrained by the availability of land for farming. The agricultural sector stimulates links with restaurants, retail, food manufacturing and tourism making its protection a regional priority.

1.1 Continue to Protect Agricultural Land From the Impacts of Land Development

Advocate to member jurisdictions to use the powers provided to them through the *Local Government Act* and *Agricultural Land Commission Act* and Regulations to: 1. adopt policies, regulations and Development Permit Guidelines requiring agricultural impact assessments for development taking place adjacent to the ALR; and 2. limit the extend of urban development and commercial uses that seek to extend utility services into the ALR.

1.2 Provide Secure Tenure for Farmers.

Work with member jurisdictions to protect the supply of agricultural land and promote agricultural viability with emphasis on food production by actively monitoring the status of agricultural land, including the amount of actively farmed land and other indicators to be able to promote agricultural viability and food production. Metro Vancouver will continue to work with its Agricultural Advisory Committee to protect the region's agricultural land base and will continue to work with the Agricultural Land Commission to protect and optimize the use of agricultural land in order to preserve farmland capability well into the future.

METRO
2040

1.3 Enable Long-term Investment in Agricultural Lands.

Metro Vancouver will update its Regional Food System Strategy to determine appropriate, effective and measurable actions that will enable investment in agricultural lands for the long-term, including how to support local food production that will contribute to food security and regional resilience.

1.4 Encourage Adjustment of Agricultural Practices to Ensure Long-Term Local Food Sources.

Work with the BC Government, Government of Canada, industry and other regional partners to determine the changing conditions for farming in the region and what farming practices can be adjusted to ensure food production can successfully continue here well into the future. This should include examining irrigation infrastructure and water use, adjustments to farming techniques to account for climate change and incorporating regenerative agriculture and nature-based solutions into farming daily practices.

BIG
MOVE

1.5 Increase Entry and Reduce Barriers to Local Farming.

Advocate to the BC Government for changes to the tax structure for agricultural properties to reduce incentives for non-farm use development in the ALR. Work with member jurisdictions to support existing land matching initiatives or to create their own programs (e.g., municipal-owned agricultural land trust provided for long-term leasing for incubator farms) that would help eliminate the barriers to local farming experienced by young or new farmers.

1.6 Protect Agricultural Land for Ecosystem Services

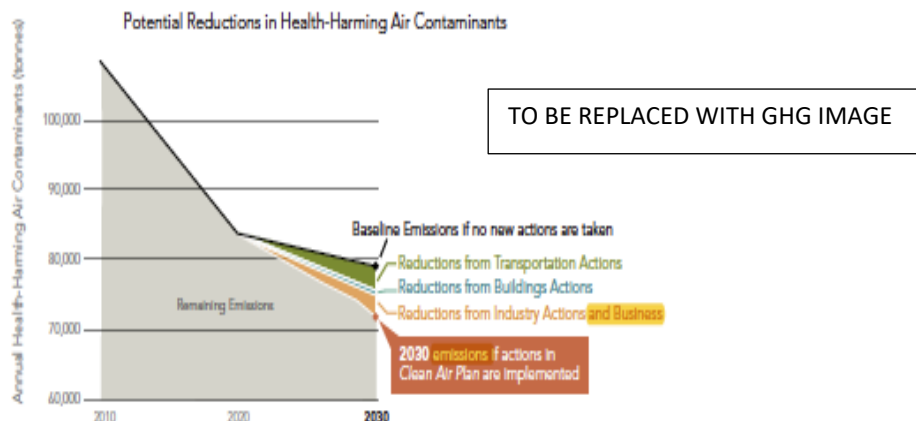
Metro Vancouver will examine the use of ecosystem services as a benefit to the regional agricultural sector including what programs are most beneficial to farmers financially and what methods are most effective in securing land for ecosystem services and for ensuring the long-term health and resiliency of farming operations.

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STRATEGY 2:

Support Farmers as Climate Action Leaders

Agricultural activities generate 4% of regional greenhouse gas emissions, primarily from heaters and boilers in greenhouses, agricultural equipment, and livestock. Improving energy efficiency and switching to clean, renewable energy for greenhouses and agricultural equipment and using enhanced Beneficial Management Practices (BMP) will help achieve 2030 agriculture emission targets for greenhouse gases. Increasing the production of renewable natural gas through anaerobic digestion of agricultural and other waste will help to displace natural gas from fossil fuels in sectors where zero emission solutions are more challenging.



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The agricultural sector has demonstrated its leadership in continually looking at ways to adjust production methods to reduce costs and increase efficiencies and has demonstrated its willingness to continue to innovate and make adjustments in order to remain competitive and viable and be a positive, contributing factor to a healthy future. Supporting farmers and the agricultural sector in continuing this tradition of leadership is an essential step in leading to a net-zero greenhouse gas emissions future.

Potential Impacts of Strategy 2	Key Partners
Reduce annual greenhouse gases by up to 100,000 tonnes Reduce annual health-harming air contaminants by up to 50 tonnes	Government of Canada
	BC Government
	Agriculture Community
	Member Jurisdictions

2.1 Reduce Emissions from Greenhouses

BIG MOVE

Work with the BC Government, BC Agricultural Council, BC Greenhouse Growers Association and member jurisdictions to explore opportunities to reduce emissions from greenhouses. Opportunities could include improving energy performance and transitioning to using cleaner, renewable energy, while considering the need for supplemental carbon dioxide in greenhouses to support plant growth. This can be supported by preparing passive design standards specific to greenhouse operations and providing an on-line decision support tool for how to best upgrade greenhouses. Metro Vancouver will update the regional emissions inventory with data specific to greenhouses to increase the understanding of their level of greenhouse gas emissions and will work with industry to determine how much carbon dioxide is used for their processes.

2.2 Improve Soil Health to Help Address Carbon Emissions

BIG MOVE

Work with the BC Government, member jurisdictions, industry and other regional partners to expand the knowledge and understanding the role of soil health in ensuring long-term agricultural viability and resilience against climate change and as a local source able to reduce carbon emissions within the Lower Mainland.

Examine ways to financially support expansion of data collection in soil carbon measuring and establish actionable programs specific to soil carbon storage and sequestration.

2.3 Outreach Program on Reducing Agricultural Emissions

Develop and implement an awareness and outreach program on reducing agricultural emissions. The program would be developed with the agriculture community, member jurisdictions and BC Government, and would supplement existing agricultural outreach and support programs. The program would include examining all sources of agricultural emissions to determine how agricultural practices could be adjusted (for example, adjusting cattle feed to reduce methane, using field mapping to apply fertilizer more efficiently, and using crops and soil on farms to capture and sequester carbon) to not only reduce agricultural emissions, but include farmers in an effort to reverse the effects of climate change in the region.

2.4 Enhance Funding for Environmental Farm Plans

Advocate to the Government of Canada and BC Government to enhance the funding for developing and implementing Environmental Farm Plans. This program helps agricultural operations reduce emissions of nitrous oxide, methane and other air contaminants. This should include continued development and promotional Beneficial Management Practices (BMP), as well as providing reliable incentives and technical guidance to farms to support adoption of low emission practices and technologies.

2.5 Incentives for Farmers to Transition to Lower Emission Equipment

Advocate to the BC Government and Government of Canada to enhance or develop funding supports for cleaner agricultural equipment (e.g., incentives, tax credits, loans, etc.). This would help accelerate the transition to lower emission equipment (e.g., a harvester with better emission controls) or encourage the installation of improved emission controls on existing equipment (e.g., diesel particulate filters). **Higher incentives should be available if old equipment is scrapped and for zero emission equipment to increase their adoption.**

2.6 Pilot Study with Zero Emission Agricultural Equipment

Work with the BC Government, industry, and the agriculture community to develop a pilot study for zero emission agriculture equipment such as an electric tractor. The study could identify the long-term pathways for wider adoption of zero emission agricultural equipment, including charging and related infrastructure, and could focus on emerging alternative fuels such as hydrogen.

2.7 Streamline Emission Requirements for Anaerobic Digestion Facilities

Develop an emission regulation for anaerobic digestion of manure, other agricultural waste and commercial food waste. The updated regulation would maintain equivalent protections for regional air quality and human health as the existing permit process, and would provide a simpler path to regulatory compliance.

2.8 Expand Anaerobic Digestion of Agricultural Waste

Advocate to the BC Government, Government of Canada, energy utilities and member jurisdictions to expand development of anaerobic digestion facilities to process manure, other agricultural waste and commercial food waste. This could include financial incentives (and tax credits) and removal of barriers in existing regulations. Any expansion should avoid the loss of agricultural land in the Metro Vancouver region.

2.9 Encourage Local Agriculture

Metro Vancouver will update the Regional Food System Strategy and will continue to advocate to member jurisdictions and other regional partners to address regional food security issue, to encourage more local food production, and to prioritize agricultural practices that reduce emissions or help maintain or sequester carbon.

STRATEGY 3: Support Long-Term Farm Health and Resiliency

Farmers and agricultural operations have adapted and evolved over time accommodating changes in economics, consumers, weather, technology, transportation, and markets. Resiliency and adaptation are not new concepts and have been requirements for the long-term success of the agricultural sector in general for centuries. While facing adversity is not a new concept, the degree to which farmers need to adapt to continue to succeed in the face of a rapidly changing climate is.

Farmers and their businesses will not be able to continue to withstand the effects of climate change, feed present and future populations or provide ecosystem services to adjacent urban areas without adjusting their practices to ensure the health of their farm is a top priority. These adjustments will need to incorporate and connect to the ecosystem, natural biological applications and regenerative techniques more than ever before. This involves first understanding a farm's specific vulnerabilities and then second, pursuing actions so that they can directly benefit from the ecosystem services (e.g., soil nutrient and organic matter, habitat for wildlife, food for pollinators, carbon sequestration and flood management) provided by their agricultural land.

3.1 Expand the Use of Regenerative Agriculture

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MOVE**

Work with the BC Government to normalize regenerative agricultural practices for farming operations within the lower mainland by offering additional extension services, financial support and information sharing opportunities. Metro Vancouver will examine the feasibility of establishing a regional network for farmers (for example, Texas' Soil for Water Network) that provides access to peer-to-peer knowledge sharing from research, pilot projects and operational adjustments to increase the support for local farmers to increase their resiliency to climate change.

3.2 Support and Expand Ecosystem Services

**BIG
MOVE**

Work with the BC Government, member jurisdictions, the farming community and other regional partners such as Farmland Advantage to determine how much agricultural land is available and appropriate to be used for ecosystem services, how individual farms can benefit from the restoration and protection of these lands (including riparian areas) on their farms, and how farmers and land owners can be compensated for keeping these lands set aside for ecosystem services. Metro Vancouver will provide regionally-appropriate guidance on the valuation methodologies, tools and decision-making frameworks needed to identify, preserve, restore, and, where necessary, expand natural ecosystems on agricultural land and will examine the benefits of connecting these areas within a regional Green Infrastructure Network, as a way to increase agriculture's role in contributing to a resilient region, both on and off the farm.

3.3 Support Innovations in Agricultural Operations

**BIG
MOVE**

Work with the BC Government, Federal Government, industry and regional partners to expand digital and high-tech agricultural systems to improve production operations that will increase the resiliency and longevity of agricultural operations, including GPS-guided machinery, sensor and data-driven analytics, quantification platforms and technology hubs, precision farming, drone monitoring and data collection, and using cognitive systems to help address labour shortages.

3.4 Ensure Long-term, Reliable Access to Water

**BIG
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Work with the BC Government to provide viable and tangible solutions to ensuring water resources needed by the farming community are provided in a sustainable, consistent and reliable manner including: exploring innovative sources and new technologies for water re-use (e.g., municipal waste water, sea water, brackish water, meat and dairy processing wastewater, and agricultural drainage water) and water conservation (e.g., applying mulches to field crops); and developing a new reservoir or storage systems that takes advantage of rainfall collection when it is abundant to be used during periods of low or no rainfall during the growing season. Metro Vancouver will update the agricultural water demand model to incorporate current climate conditions, crop irrigation systems and soil information data to contribute to the discussion of water availability for the agricultural community and will develop a toolkit on how a circular water economy can be supported within the Metro Vancouver farming community.

STRATEGY 4: Leverage Economic Opportunities, Innovation and Leadership

Agriculture requires long-term investment, financial support and leadership from all levels of government (federal, provincial, regional and local), from private industry (transportation, finance, support services, logistics, retail, and research), and from society (consumers, education, non-profits, places of worship). Farming is the corner stone to the agricultural sector providing healthy food to every individual and as every human being needs to eat, every human being should be invested in ensuring the longevity and resilience of farming.

4.1 Prioritize Agriculture Via Strategic Action

Metro Vancouver will illustrate leadership in the importance of prioritizing agriculture within the region by committing to provincial, federal or international programs that establish bench-line policies, measurable targets and achievable actions. Metro Vancouver will also encourage member jurisdiction engagement and participation in the programs aimed at the municipal level, for example, the Mexico City Pact and Milan Food Policy Pact, as they can help communities commit to addressing the effects of climate change on agriculture and provide reporting frameworks by which to monitor the effectiveness of policies and the progress of actions.

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4.2 Continue Long-term Financial Investment in the Agricultural Sector

Work with the Federal and BC Governments to support the agricultural sector through direct and indirect financial investment that: provide incentive programs to help farmers adjust their operations to become more sustainable; expand funding sources for long-term, consistent and reliable funding to agricultural producers to pay for agricultural land to be used for ecosystem services and advance the resiliency of farming operations in the lower mainland; and designate resources for testing practices and technology to help farmers effectively use soil as a means to store carbon for a greater societal benefit.

4.3 Increase Access to Information for Local Farmers and Agricultural Producers

Work with member jurisdictions and the BC Government to provide information to the farming community in formats that are compatible with the specific needs of farmers, including providing on-field workshops, supporting Farmer-to-Farmer information sharing, and providing existing and new educational materials, guidelines, regulations and toolkits in different languages and as audio books to expand outreach and ease of accessing information.

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4.4 Reduce Confusion with Provincial Legislative Overlaps

Prepare a joint and coordinated toolkit that brings together all legislation applicable to agriculture and farming from the Ministry of Agricultural, Food and Fisheries, Agricultural Land Commission, Ministry of Environment and Ministry of Municipal Affairs to collectively address legislation that can be contradictory (e.g., riparian protection within the Agricultural Land Reserve) to make it transparent, clear and concise about the expectation from farmers for managing these areas on their farms.

4.5 Support Long-term Local Food Production

Metro Vancouver will update the Regional Food System Strategy to ensure food-specific challenges, gaps and opportunities are identified for the region to specifically include climate change issues and will include examining impacts and considerations specific to food production vulnerability and longevity within the region.

4.6 Bridge the Gap Between the Agriculture Community and the Consumer

Metro Vancouver will develop engaging and approachable educational campaigns aimed toward the public about agriculture and how it is affected by climate change, what costs and processes go into producing food (e.g., the farm to food cost spectrum), what actions farmers are taking to adapt to significant regional climate issues and how consumers can be a positive contributor to agricultural resiliency through their actions and decision making. These campaigns will specifically work to bridge the gap between the public and the realities of what climate change is, helping to increase understanding and awareness of it broadly and as it relates specifically to food costs and availability.

4.7 Help Farmers Build Capacity to Adapt to Climate Change

Work with the BC Government, member jurisdictions, industry and other regional partners to increase the agricultural community's capacity to integrate climate change considerations into their ongoing business decisions and operations. This will include a wide spectrum of support mechanisms, including: encouraging and aiding farm-level preparation of emergency plans; working at the farm level to help producers implement water back-up plans or determine appropriate methods to recycle or store water; increasing producer access to programs, tools, practices, equipment and finances to help them self-monitor and manage soil (e.g., US Department of Agriculture on-line COMET carbon sequestration evaluation tool); and help prepare farm-level business continuation plans for prolonged extreme weather events and disruptions to water and energy supplies.

BIG
MOVE

Setting the Path Ahead

The "Setting the Path Ahead" section will eventually be found on Metro Vancouver's Climate 2050 webpages under "Agriculture" and will serve as a companion to the Agriculture Roadmap. This will allow Metro Vancouver to track progress towards targets and add and adjust strategies and actions in response to performance measurements.

The timeline below includes all of the actions included in this Roadmap. There is much work to be done; however, there are some critical actions that, if started over the next two years, will make a major difference to accelerating the region's drive to zero emission and resilient agriculture.

CLIMATE 2050 AGRICULTURE ROADMAP ACTION TIMELINE

STRATEGY	2021-2024	2025-2029	2030-BEYOND
STRATEGY 1 Protect Agricultural Land	<ul style="list-style-type: none"> Continue to Protect Agricultural Land From the Impacts of Land Development Provide Secure Tenure for Farmers Enable Long-term Investment in Agricultural Lands Encourage Adjustment of Agricultural Practices to Ensure Long-Term Local Food Sources Increase Entry Into and Reduce Barriers to Local Farming Protect Agricultural Land for Ecosystem Services 		
STRATEGY 2 Support farms as leaders in Climate Change mitigation.	<ul style="list-style-type: none"> Support Improving Soil Health to Help Reduce Carbon Emissions Enhance Funding for Environmental Farm Plans Provide Incentives for Farmers to Transition to Lower Emission Equipment 	<ul style="list-style-type: none"> Reduce Emissions from Greenhouses Pilot Study with Zero Emission Agricultural Equipment and Heating Sources 	<ul style="list-style-type: none"> Streamline Emission Requirements for Anaerobic Digestion Facilities Expand Anaerobic Digestion of Agricultural Waste Encourage Local Agriculture
STRATEGY 3 Support Long-Term Farm Health and Resiliency	<ul style="list-style-type: none"> Expand the Use of Regenerative Agriculture Support and Expand Ecosystem Services Support Innovations in Agricultural Operations 	<ul style="list-style-type: none"> Ensure Long-term, Reliable Access to Water 	
STRATEGY 4 Enable Long-Term Investment in Agriculture	<ul style="list-style-type: none"> Prioritize the Agriculture Sector Via Strategic Action Increase Access to Information for Local Farmers and Agricultural Producers Support Long-term Local Food Production 	<ul style="list-style-type: none"> Continue Long-term Financial Investment in the Agricultural Sector Reduce Confusion with Provincial Legislative Overlaps 	<ul style="list-style-type: none"> Bridge the Gap Between the Agriculture Community and the Consumer Help Farmers Build Capacity to Adapt to Climate Change

Measuring Our Progress

The table below lists examples of some of the performance indicators that could be used to help Metro Vancouver measure regional progress towards meeting the targets set out for this purpose. The performance indicators used will depend on the availability of this information from other organizations. Because the Agriculture Roadmap is calling for actions from many different partners and stakeholders, and because, in some instances, it is suggesting using technology that either does not currently exist or that is not readily available at a consumer level, data availability may be limited until technologies advance and industry markets further advance toward full operational sustainability. Additionally, data sharing from partner organizations will be foundational to understanding the pace of progress toward s our common goals and will help governments to continue to shape equitable and cost-effective pathways to a zero emission and resilient future.

ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Resilient Agriculture	% ALR used for long-term set aside ecosystem services	ALUI	no
Protected Agricultural Land	% ALR actively farmed	ALUI	yes
Regional GHG Impact	The agricultural sector is carbon neutral by 2050.	various	yes
Regional GHG Impact	% greenhouse gas emissions from greenhouses	various	yes
	The agricultural sector produces clean, renewable energy to meet all its production needs by 2050.	various	yes
	The agricultural sector provides clean, renewable energy to other energy users by 2050.	various	no

Feedback and Engagement Process

This Roadmap was generated with input from many organizations, including other levels of government, and residents across the region. The project team is continuously assessing that input, and many of the recommendations are reflected in the structure and content of this Roadmap.

This Roadmap reflects current policies and the best ideas, approaches and technologies available at time of writing. As with all climate planning, it must be viewed as an iterative, dynamic path forward. The goals remain clear, and new policies, ideas, approaches and technologies must be anticipated and reflected in the Roadmap.

The project team continues to be open to feedback, at any time, in this Agricultural Roadmap and any other aspect of the climate action initiatives led or coordinated through Metro Vancouver. Send any comments direct to the Project Team through Climate2050@metrovancover.org or phone 604-432-6200.

Glossary

Adaptation means anticipating, planning for and responding to the adverse effects of climate change and taking appropriate action to prevent or minimize the damage it can cause, or taking advantage of opportunities that may arise. It has been shown that well planned, early adaptation action saves money and lives later.

Adaptive capacity means the ability of ecosystems, economies, infrastructure and communities to adjust to climate change (including climate variability and extremes) by moderating potential damages, taking advantage of potential opportunities, or coping with consequences.

Agroecology applies ecological principles to agriculture ensuring a regenerative use of natural resources and ecosystem services while addressing the need for food sovereignty. While the practices can be wide-ranging, agroecology is characterized by diversifying farms and farming landscapes, replacing chemical inputs with organic materials and processes, optimizing biodiversity and stimulating interactions between different species.

Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence.

Air contaminants are any substances emitted into the air that do or could a) harm public health (including material physical discomfort) and property, b) damage the environment, including the climate, c) impede normal business operations, or d) impair visual air quality.

Carbon dioxide (CO₂) is the primary driver of climate change, and is produced primarily by burning fossil fuels. In agriculture, carbon dioxide is primarily generated by fuel combustion by greenhouses and agricultural equipment. Carbon dioxide is also released from farm fields during soil cultivation as organic materials undergo biological decomposition. Plants, trees and soils can sequester carbon in stable organic matter.

Carbon neutral region is a region that has achieved the deepest greenhouse gas emissions reductions possible across all economic sectors, and removes or captures sufficient carbon dioxide to balance any remaining regional greenhouse gas emissions.

Carbon sequestration is the removal of carbon dioxide from the air and the long-term storage of carbon to mitigate climate change. Carbon enriched soils are healthier, have better resilience to extreme weather, better water permeability, microbial diversity, higher yields and reduced input requirements.

Carbon sinks are natural systems that absorb more carbon dioxide than they release. The main natural carbon sinks are plants, the ocean and soil.

Clean, renewable energy is low or zero emissions energy that is replenished over days or years. In Metro Vancouver, clean, renewable energy is primarily electricity from renewable sources such as hydro or solar.

Climate change adaptation means anticipating, planning for and responding to the adverse effects of climate change and taking appropriate action to prevent or minimize the damage it can cause, or taking advantage of opportunities that may arise. It has been shown that well planned, early adaptation action saves money and lives later.

Common air contaminants are air contaminants that can harm public health and reduce residents' quality of life and life expectancy by causing heart and lung diseases, cancer, asthma, and other impacts. Some air

contaminants have odorous characteristics. Common air contaminants include fine and coarse particulate matter, diesel particulate matter, ground-level ozone, nitrogen dioxide, sulphur dioxide and volatile organic compounds.

Ecosystem services are the benefits people obtain from ecosystems. Ecosystem services provided by farmland include nutrient and organic matter recycling (from food waste), food for pollinators, wildlife habitat, flood control, and carbon sequestration.

Greenhouse gases are air contaminants that trap heat and are the cause of climate change. Greenhouse gases include carbon dioxide and nitrous oxide, as well as short-lived climate forcers such as methane, halocarbons, black carbon and ozone. Limiting or preventing greenhouse gas emissions and removing these gases from the atmosphere is critical to avoiding catastrophic climate change (generally referred to as climate change mitigation).

Green Infrastructure "Natural and human made elements that provide ecological and hydrological functions and processes. Green infrastructure can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs. - Green Infrastructure Ontario

Hazard refers to a dangerous phenomenon, substance, human activity, or condition. In this context, hazards are caused or made worse by climate change. Examples include rainstorms, extreme weather, wildfires, storm surges, and landslides.

Impacts refers to the consequences of realized risks on ecosystems, economies, infrastructure and communities. Impacts may be referred to as consequences or outcomes, and can be adverse or beneficial.

Methane (CH₄) is a short-lived greenhouse gas and is 25 times more effective than carbon dioxide at trapping heat in the atmosphere. Methane emissions from agriculture are produced by ruminant animals such as cattle and sheep through a bacterial process called enteric fermentation, as well as being released from manure storage sites, especially when wet because of the lack of oxygen during decay. Natural gas is mostly composed of methane.

Natural assets are the stock of natural resources and ecosystems (including geology, soil, air, water and all living things) that provide benefits to people. Examples include forests, wetlands, and streams. It is from these natural assets that humans derive a wide range of services, often called ecosystem services, which make human life possible.

Natural infrastructure can be considered an *active* form of nature likely focused on the most important of these benefits. Natural infrastructure comprises an *active management component* aimed at providing (or conserving) the key advantages—such as climate resilience, clean water and biodiversity. It differs from traditional "grey" infrastructure, such as pipes, tunnels and factories, which are completely constructed by humans. Natural infrastructure is a form of "green" infrastructure, a term that also includes systems with positive environmental outcomes, such as renewable energy or electric vehicles.

Nature-based solutions (NBS) refers to the [sustainable management](#) and use of nature for tackling socio-environmental challenges. The challenges include issues such as [climate change](#), [water security](#), [water pollution](#), [food security](#), [human health](#), and [disaster risk](#) management.

A definition by the [European Union](#) states that these solutions are "inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build [resilience](#). The [Nature-based Solutions Initiative](#) meanwhile defines them as "actions that work with and enhance nature so as to help people adapt to change and disasters". Such solutions bring more, and more diverse, nature and

natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions".^[1] With NBS, healthy, resilient and diverse [ecosystems](#) (whether natural, managed or newly created) can provide solutions for the benefit of societies and overall [biodiversity](#). Nature-based Solutions (NbS) are defined by IUCN as “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits”.

Promoting nature-based solutions to enhance ecosystem functions, expand green infrastructure and increase resilience.

Nitrous oxide (N₂O) is a long-lived greenhouse gas, and is 298 times more effective than carbon dioxide at trapping heat in the atmosphere. Nitrous oxide emissions from agriculture is primarily produced by microbes as they process nitrogen in soils from fertilizers, manures and other inputs.

Regenerative agriculture can rebuild soil organic matter, restore degraded land and improve the water cycle by utilizing natural nutrient cycles, restoring soils, raising carbon levels, protecting water, and enhancing biodiversity and ecosystem services. OR/AND: is a holistic land management practice that holds the potential of reversing climate change by rebuilding soil organic matter and restoring degraded soil biodiversity resulting in carbon drawdown and improvement of the water cycle (Regeneration International, 2017). This farming method that regenerates soil fertility, improves water retention, fosters biodiversity, and sequesters carbon.

Resilient/Resilience capacity to withstand and/or recover from hazards, risks and challenges associated with a changing climate. Also referred to as adaptive capacity which is the capacity of ecosystems, economies, infrastructure and communities to absorb the impacts of climate change while maintaining essential services and functions needed to support health and well-being. In some cases, resilience involves changing services and functions so they are more sustainable.

Sensitivity is the degree to which a community or system is affected (positively or negatively) by climate variability or change. The effect may be direct or indirect.

Vulnerability is the degree to which ecosystems, economies, infrastructure and communities are susceptible to, or unable to cope with, the adverse effects of climate change. Vulnerability varies based on exposure, sensitivity and adaptive capacity. Geographic location, socio-economic conditions, and other factors can impact