

CLIMATE **2050 Roadmap**

Agriculture

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

July 2023

FRONT COVER: FARMING IN METRO VANCOUVER

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July 2023

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: ɬicəy̓ (Katzie), q̓ʷɑːn̓ƛəń (Kwantlen), kʷikʷəƛ̓əm (Kwikwetlem), máthxwi (Matsqui), xʷməθkʷəy̓əm (Musqueam), qiqéyt (Qayqayt), se'mya'me (Semiahmoo), Sḵwx̱wú7mesh Úxwumixw (Squamish), scəẃaθən məsteyəxʷ (Tsawwassen), and sə́lílwətaʔɬ (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.



CRANBERRY PRODUCTION IN PITT MEADOWS

Metro Vancouver

Metro Vancouver is a federation of 21 municipalities, one electoral area, and one treaty First Nation that collaboratively plans for and delivers regional-scale services. Metro Vancouver's core utility services include drinking water, sewage treatment, and solid waste management, along with regional services like regional parks, affordable housing, regional land use planning, and air quality and climate action that help keep the region one of the most livable in the world.

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.

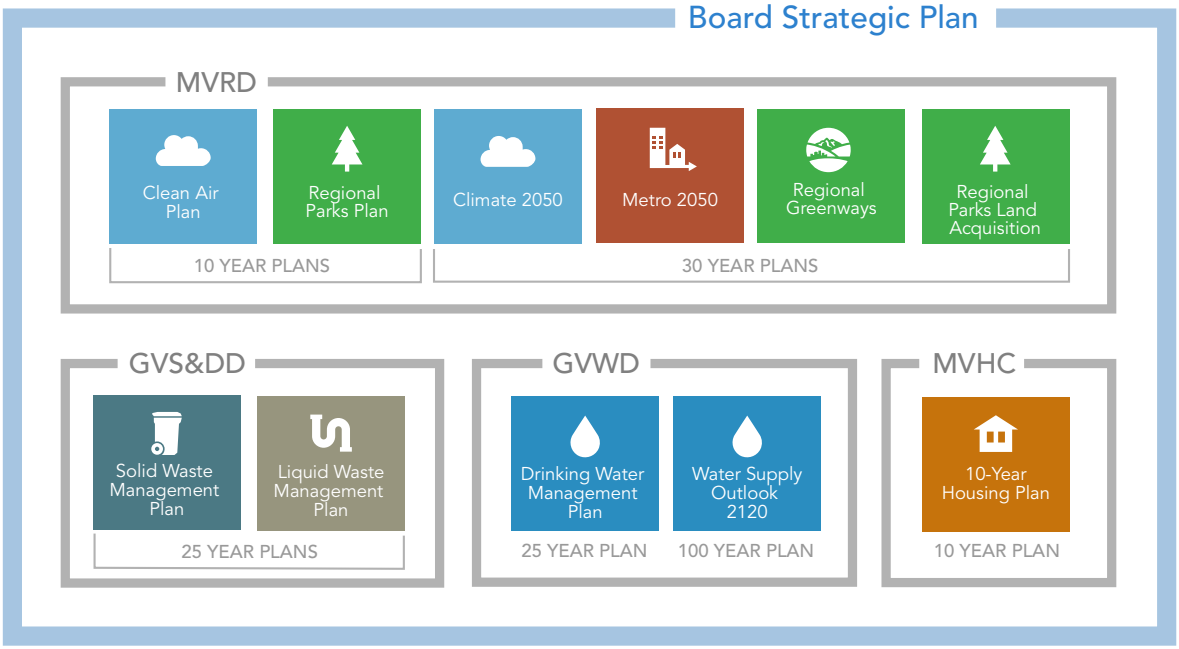
3. **Plan for the Region**

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.





AGRICULTURAL LANDS IN SURREY

Metro Vancouver's Roles and Responsibilities for Climate Action

The three broad roles outlined in Metro Vancouver's mission 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 *Metro 2050*, the Regional Growth Strategy, Metro Vancouver and its members, plan 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.

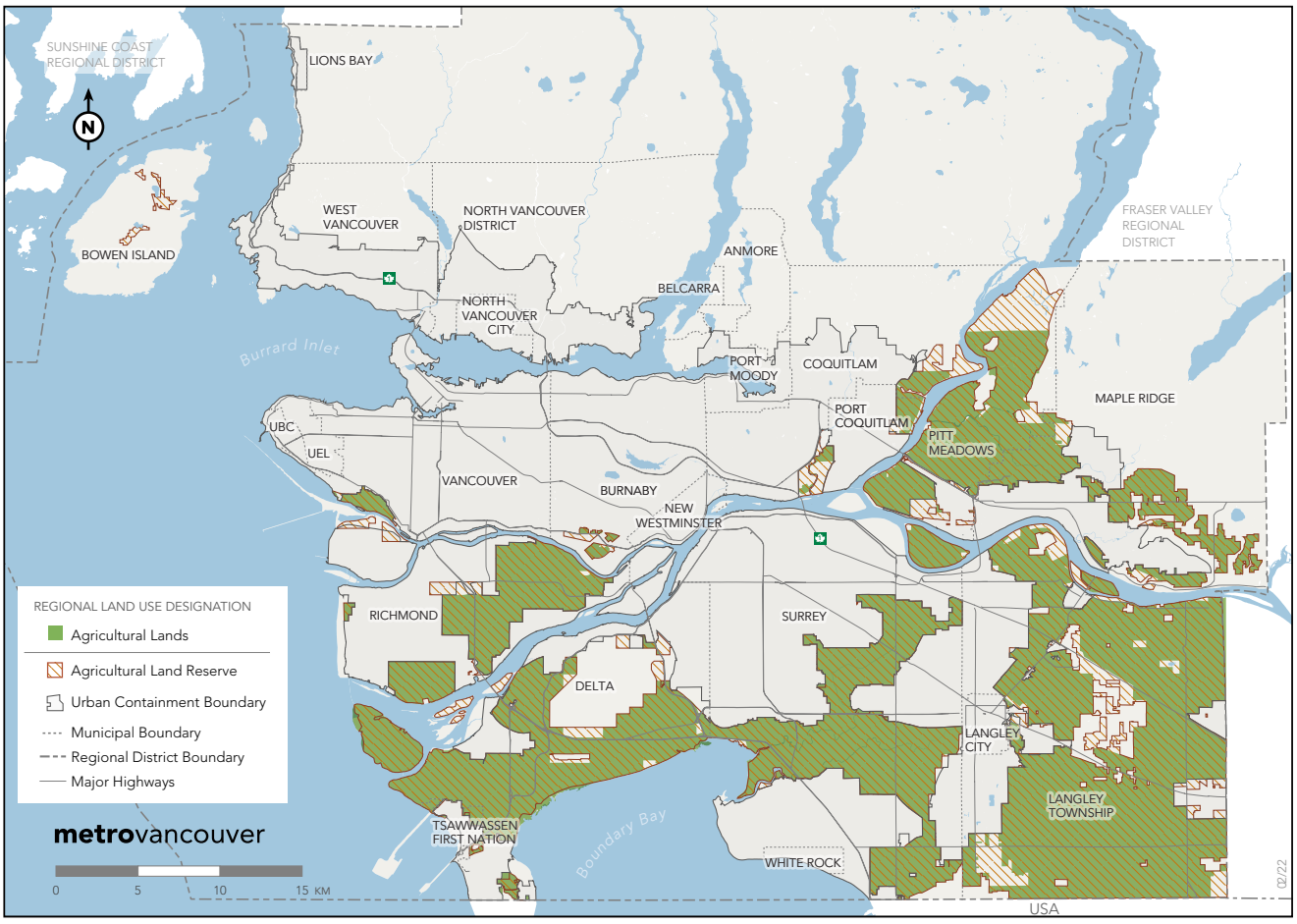
In its role as a regional forum, Metro Vancouver builds and facilitates collaborative processes which engage the public and build partnerships to address significant regional issues like climate change. As part of this role, Metro Vancouver coordinates with and advocates to other governments and regional partners on behalf of its member jurisdictions on greenhouse gas management and climate change adaptation initiatives. Many regional partners will be looked toward 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

Supporting the viability and long-term productivity of agricultural land in Metro Vancouver is incredibly important to the region's urban population. Comprising approximately 20% of the land base in the region, agricultural land supports the local economy (12,148 direct farm jobs (2020, Census Canada)), supplies residents with healthy, fresh food ($1.3 billion annual operating revenues (2020, Census Canada)), and provides valuable ecosystem services such as flood control, wildlife habitat, and clean air. Additionally, agricultural producers rely on healthy ecosystems, balanced soils, and predictable growing conditions in order to manage and support a healthy and complete food system. The agricultural sector, however, has increasingly been facing difficult challenges due to the effects of climate change.

Like many sectors, agriculture is affected by higher temperatures, shifting precipitation patterns, severe weather events, and ongoing 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 healthy soils, conserving ecosystem services, and encouraging adaptation as a method to support a resilient agricultural community that will survive, thrive, and also contribute to reducing the effects of climate change.

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



METRO VANCOUVER'S DESIGNATED AGRICULTURAL LANDS



BLUEBERRY FIELD

The *Agriculture Roadmap* sets out actions reducing emissions and increasing resilience, organized under the following 4 strategic areas:

1. Protect Agricultural Land
2. Support Farmers as Climate Action Leaders
3. Support Long-Term Farm Health and Resilience
4. Support a Viable, Profitable and Stable Agricultural Sector

To achieve a carbon neutral agricultural sector in this region, farmers will need support to transition their operations to use sustainable technologies (e.g., solar power) and to incorporate regenerative agriculture and nature-based solutions into their daily practices. Farmers should not be left to manage this transition on their own, as the food availability in 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** – this includes using climate smart, ecologically-minded regenerative agriculture to increase resilience and investing in new available technologies to take advantage of digital systems and processes;
- **For Industry** – this includes funding new research and embracing digital innovations or supporting information sharing to create new low-carbon options (e.g., electric farm equipment);
- **For Consumers** – this includes increasing awareness (e.g., connection between agriculture and climate change resilience), adjusting 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** – this includes collectively establishing policies, creating programs, and providing financial assistance to support needed changes in the agricultural sector in order for it to become resilient to the climate challenges ahead.

FARM MACHINERY IN METRO VANCOUVER





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AGRICULTURAL LAND IN LANGLEY TOWNSHIP



The Vision: Net-Zero, Resilient Agriculture by 2050

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

Agriculture continues to significantly contribute to Metro Vancouver's 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 adapt operations to manage changes in temperature and rainfall and modify farming practices 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 has increased and expanded its agricultural viability overall, ensuring a long-term succession of farming and sustainable local food production for future generations.

The Challenge

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

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 referred to as ecosystem services, including wildlife habitat, carbon sequestration, water infiltration, and flood management. At the same time, some agricultural activities cause greenhouse gas (GHG) and health-harming air contaminant emissions. These typically come from livestock production, farm equipment, excess fertilizer applications, burning of organic residues, and the heating of greenhouses with fossil natural gas and other fossil fuels.

From an emissions perspective, compared to other, more significant contributors of greenhouse gases (GHG) in the region, agriculture sources make up approximately 4% of the total, largely from three main areas: 1. carbon dioxide produced from fossil 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 significant contributor to the region's overall GHG emissions, for Metro Vancouver to achieve carbon neutrality by 2050, all sectors will need to do their part to lower emissions or eliminate them entirely.

From a climate change perspective, agricultural activity is vulnerable to and continuously impacted by the worsening effects of extreme weather events including atmospheric rivers and extended droughts. Farmers are subjected to such things as flooding, salt intrusion into soils, and an increase in new pests and plant diseases - all of which affect local food production. To increase agricultural resilience, we need to support farming practices that embrace nature-based solutions, improve soil health, including reducing contamination and the spread of invasive species, strengthen agricultural viability, and sustain local food production for future generations.

This Roadmap is being created to help the region reach a low-carbon, resilient future while also improving air quality. By 2050, the agricultural sector can become carbon neutral and be powered with clean, renewable energy. Farmers can use regenerative farming practices to capture carbon and build the soil for long-term productivity. Agricultural land can be protected and invested in to enable food production and provide secure tenure to farmers to sustain the agricultural community over the long term.

What is a Carbon Neutral Region?

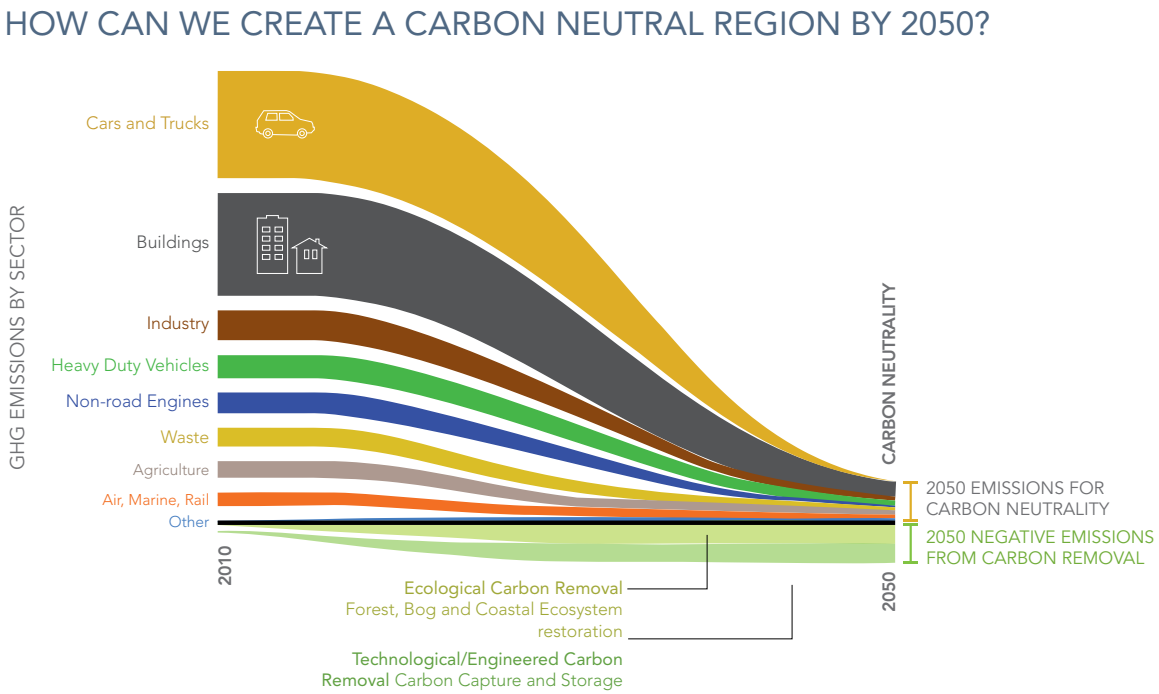
A carbon neutral region generates no net greenhouse gas emissions. This is achieved through the deepest greenhouse gas emission reductions possible across all economic sectors. Any remaining emissions are balanced out by the carbon dioxide that the plants, trees, and soil in the region remove and capture 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. Some difficult decisions and investments have to be made today to not pass these challenges onto upcoming generations at higher costs and consequences. Metro Vancouver, and many of its member jurisdictions, has committed to ambitious targets and bold leadership to respond to the climate crisis. This Roadmap responds to the specific issues and ideas raised by the region's agricultural sector and responds to the global challenge to come together, think big, and act now.

The Goals

GOALS	TARGETS AND MEASURABLE OUTCOMES
GOAL: The agricultural sector is carbon neutral and maximizes carbon sequestration.	**TARGET:** 35% reduction in greenhouse gas emissions from the agricultural sector 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.	
GOAL: The agriculture community consistently applies its knowledge of the benefits of ecosystem services to support the resilience 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 measurable on how well the region's agricultural producers are adapting to climate change impacts.
GOAL: Metro Vancouver's complete food system is adaptable and resilient.	
GOAL: Long-term investment in the agriculture community is coordinated and successful.	

While the agriculture sector is one of the lowest GHG emission sources in the region, efforts to reduce these emissions are required from all sectors in order to reach the 2050 carbon neutrality goal.



DAIRY FARM

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, to 2030. Implementing these actions also supports the 2030 target of reducing total regional greenhouse gas emissions by 45%, including a 35% reduction within the agricultural sector, compared to 2010 levels, and establishes the foundation for the 30-year commitment of a carbon neutral region by 2050. The *Clean Air Plan* also includes air quality targets for the region.

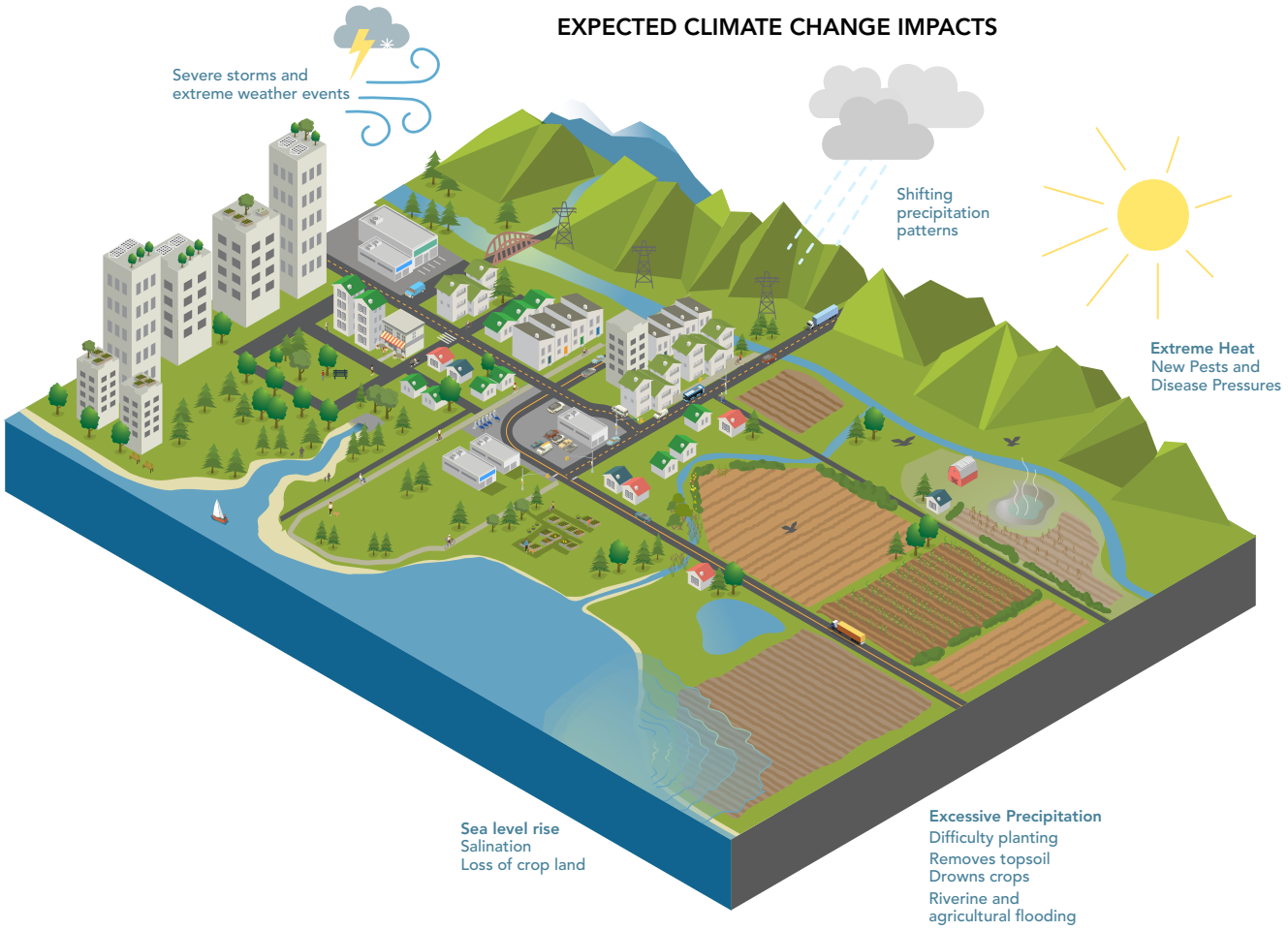
Agricultural activities, such as fuel combustion, manure management, and fertilizer use, generate greenhouse gases and air contaminants with direct health impacts. Actions in this Roadmap and the *Clean Air Plan*, combined with policy in *Metro 2050*, the Regional Growth Strategy, which also supports carbon neutrality by 2050, will help reduce these emissions to protect human health and the environment.



The Impacts: Climate and Agriculture

The agricultural sector is one of the most vulnerable sectors to the impacts of climate change. Farmers manage their operations and grow high quality local food while continually dealing with significant changes in temperature and rainfall, extended droughts, shifting pests and diseases, and extreme weather events that can drastically affect their businesses and production yields. These impacts are not unique to this region; all parts of the world, including areas that grow food that residents of Metro Vancouver rely on, have been and will continue to be affected by changes in climate.

While climate change-caused temperature increases may benefit agriculture by expanding the growing season and enabling a wider variety of crops that can be produced locally, overall, there is more uncertainty about how these significant climate risks will negatively affect agriculture. Ultimately, regardless of what the exact impacts are, the ripple effects result in an increase in the costs of crop and livestock production, a reduction of the economic viability of the agricultural sector, and an increase in food insecurity for the region as a whole.



Based on climate projections to the 2050s we can expect the following climate changes and the resulting impacts felt on the agricultural sector in the Metro Vancouver region:

Climate Changes



Hotter 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. Sea level rise is an important aspect of climate change with significant regional impacts.



Drought, increasing in length during summer months, is exacerbated with an increase in hotter temperatures.

Impacts Felt



Adjustments in temperature disrupt expected seasonal temperature changes affecting livestock and crop mortality and the increase in the prevalence of new parasites and diseases. A longer growing season can lead to earlier harvests, a greater range of crop suitability, and a decrease in heating costs for greenhouses in cooler months; however, warmer temperatures will lead to an increase in demand for water for irrigation during the growing season and exacerbate pest and disease problems that are often 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 crop productivity and quality and increase 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 facing due to the changes in precipitation experienced within this region.

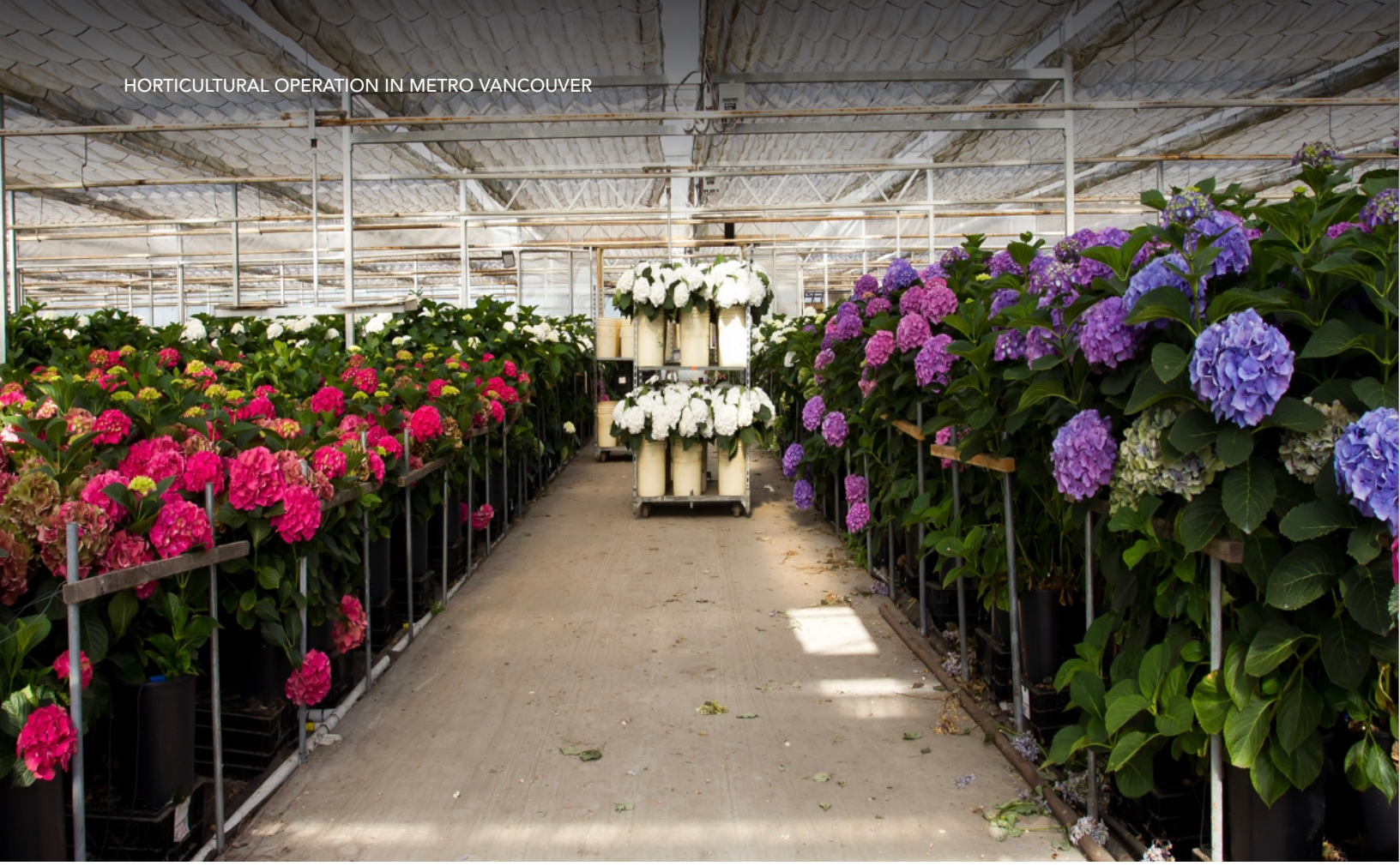
Riverine and field flooding from periods of extreme rainfall and increased runoff from adjacent urban development reduces ground permeability and causes long-term inundation of water into agricultural lands. This water intrusion reduces and limits agricultural production potential and causes root rot 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 and 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.



SMALL LOT FARMING IN METRO VANCOUVER



HORTICULTURAL OPERATION IN METRO VANCOUVER

The Emissions: Agriculture in Metro Vancouver

Metro Vancouver's 2015 regional emissions inventory estimates that agricultural activities generate 4% of total GHG emissions in the region. Sources of agriculture-related GHG emissions in this region include: carbon dioxide from fuel combustion in greenhouses and farm equipment; methane from livestock and manure storage; and nitrous oxide from fertilized and manured soils (Note: Greenhouses referenced in this Roadmap also include licensed cannabis greenhouses).

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

Opportunities to reduce GHG 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 supporting ecosystem services through natural vegetation and forests, 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 emits more GHGs.

An Overview: 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; and
- **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 low-to-no GHG emissions and is able to withstand the negative effects of a changing climate, ensuring farm yield and business livelihoods are maintained. Looking to 2050, this 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.

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 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, commercialized, and made widely available. When appropriate funding, incentives and technologies are offered to the agricultural sector, farmers can begin to implement these new innovations while still maintaining profitable businesses.

2. Environmental – farming relies on and is affected by the environment. Producers can transition to new fertilizer types and application methods, incorporate new irrigation systems, and adjust soil quality to increase carbon sequestration, but such adjustments to farming practices may take multiple growing seasons before success can be determined. 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 be difficult to overcome, farming is faced with the need to adjust its practices and generational knowledge as well as recognize that residents want to have a closer connection to their food.



POTATO FIELD

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

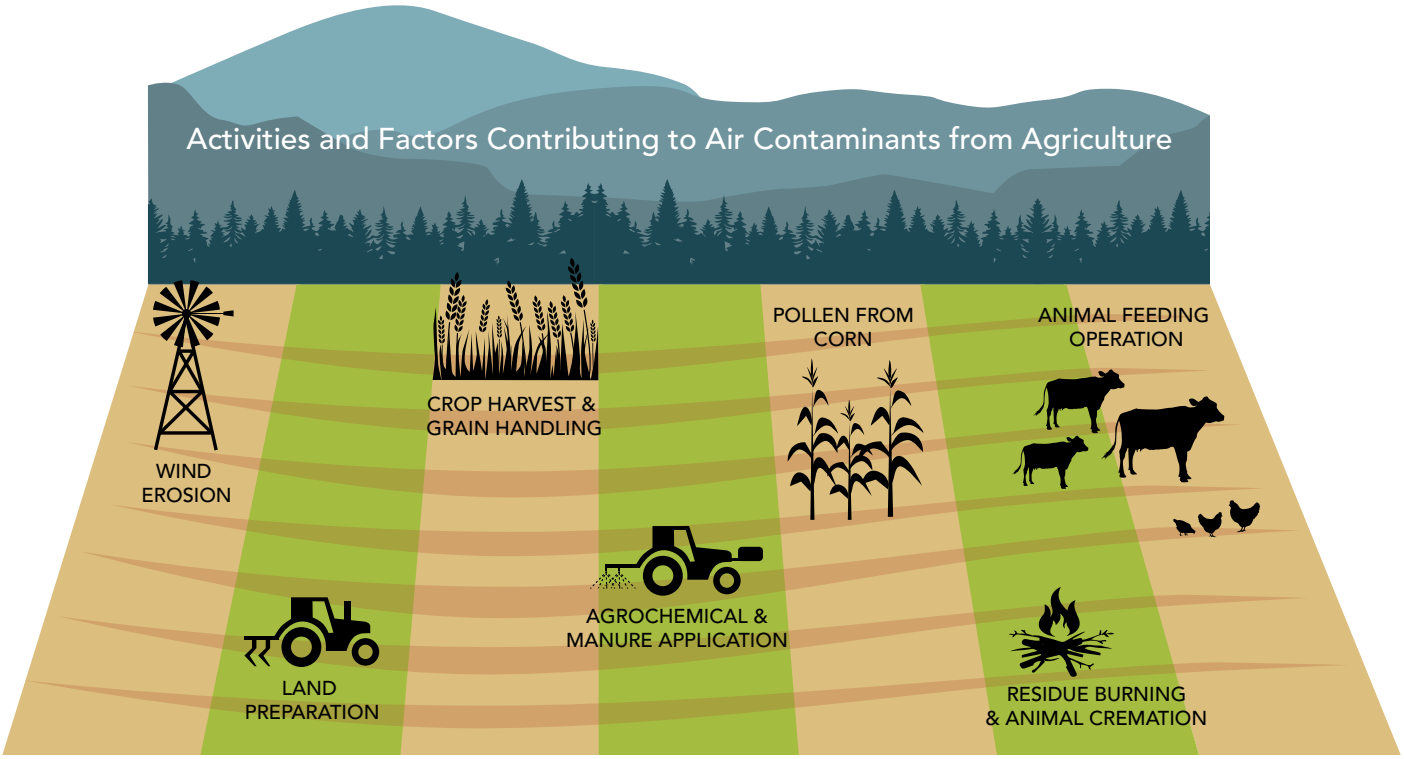
"Zero Carbon" also known as Zero Carbon Emissions, is reached when no greenhouse gas emissions exist at the point of use. A zero carbon fuel source either produces no GHG emissions, or the emissions produced are offset by renewable energy (either generated onsite or purchased).

"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.

Lower Emissions: Clean, Renewable Energy and New Technology

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



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

1. Renewable Energy Sources

Adjusting fuel sources used by trucks, tractors, greenhouses, and agricultural buildings and equipment represent opportunities for the agricultural sector to transition to the use of clean, renewable energy sources. This transition, however, comes with significant challenges that cannot be managed or funded solely by agricultural producers. For example, while farmers do need to replace vehicles or equipment and modify buildings with clean or renewable fuel sources, much of the required technology to do so is not currently available, let alone within reach financially.

2. New Technologies

New technologies across all components of the agricultural sector are being invented, tested and applied to mainstream uses on a regular basis (e.g., through support from the BC Agri-tech Grant Program). New energy sources such as renewable natural gas, hydrogen energy, biogas from manure digesters, and re-using captured carbon dioxide are all options that have potential to transform agricultural operations into carbon neutral producers. Greenhouses have the most to gain from these new technologies; however, more

work is required to fully understand how fuel is used and released, how different technologies and fuel types can be applied to existing buildings and production systems, and how the costs and financial feasibility of retrofitting existing structures can be managed. These new technologies can be used in conjunction with improving the energy efficiency of greenhouses (e.g., improving thermal performance) to increase the overall sustainability of the agriculture sector.

3. New Management Practices

Adjusting farm management practices to support lowering agriculture-based air emissions is an area where the agricultural community has more direct control, including:

- enhancing grazing practices and optimizing grass and forage to reduce methane emissions from cattle;
- expanding the practice of on-farm crop and food waste composting solutions; and
- using regenerative agricultural practices to increase carbon storage in soils.

Additional data collection to support these practices is vital to understanding the degree to which the agricultural community can contribute to a reduction in GHG emissions in the region and also contribute to the long-term resilience of agricultural operations.

4. New Input Application Methods

In farming, field crops use nutrients, or inputs, such as potassium, phosphorous, and nitrogen to increase yields. 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, often through a standardized application process regardless of plant need, GHG emissions (e.g., nitrous oxide) are released into the atmosphere. Research, and the application of agri-tech solutions, has shown that slow-release fertilizers and precision applications (e.g., field mapping captured from drones) can more specifically determine which parts of the crop need the fertilizer resulting in an overall reduction of emissions from this input type.



FIELD MAPPING CAPTURED BY DRONES

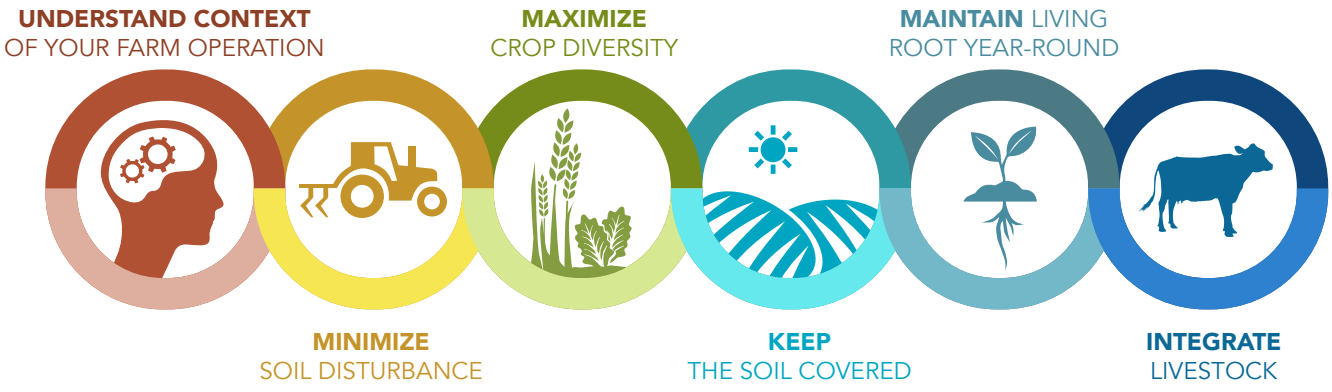
Ecosystem Services: Understand, Benefit From, and Support

The agriculture sector within the Metro Vancouver region, British Columbia, Canada and across the globe is at a turning point of needing to adapt to the increasingly extreme effects of climate change. When they occur, floods, rainfall events, heat waves, and droughts are lasting longer or are more severe. Crop losses are becoming more extensive, pest management is more difficult, and production costs are more expensive. Through all of this, farmers are relied upon and expected to increase production yields while maintaining crop quality even though it becomes harder and more challenging to do so. In order to continue to fill this economic and social demand, farms must become as healthy and resilient as possible. This is best achieved by understanding and benefiting from the ecosystem services provided by nature and working with those systems to ensure the long-term viability of agricultural producers (see page 34).

1. 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, natural systems are increasingly being identified as something farmers can turn to, not only to help them adjust to the changing conditions, but to also counteract the impacts of climate change. Regenerative agriculture focuses on restoring high-quality soils and the biodiversity and water resources on land focusing on working in sync with nature. Regenerative land management practices such as agroecology and agroforestry are increasingly being applied by farmers globally and show promising signs of success.

6 Core Principles of Regenerative Agriculture



2. Ecosystem Services

On farmland throughout the region, existing healthy ecosystems and their natural processes provide benefits to humans known as "ecosystem services".These services help farmers manage against the uncertainty of extreme weather conditions (e.g., wetlands can store excess water during a flood event), help combat against invasive species, provide habitat for pollinators, create shade areas for livestock, beneficial insects and animals, reduce wildlife conflicts with field crops, and provide an opportunity to increase the overall resilience of agricultural operations. Identifying the best ways to enhance ecosystem services on farmland, as well as natural areas adjacent to farmland in Metro Vancouver, depends on understanding the unique landscapes that exist here (e.g., rain, wind and sun microclimates, ocean and riverine environments, species-at-risk locations, and soil composition) so they can be collectively leveraged to create a resilient agricultural sector.



SOIL-BASED AGRICULTURE

3. Payment and Programs for Ecosystem Services

To increase the resilience of the region's agricultural sector, adaptation will need to take place at the farm level. A viable and increasingly common adaptation strategy is the retention and restoration of natural areas such as forests, wetlands, streams, hedgerows, and fallow or "old fields", which provide important ecosystem services that benefit producers, biodiversity, and regional resiliency. Accommodating ecosystem services at the farm level requires individual farmers to take some land out of production and place them in "set-asides" which can result in the loss of production and loss of income. Organizations such as Delta Farmland & Wildlife Trust and Farmland Advantage provide payment for ecosystem services on farmland in Metro Vancouver but these programs rely on short-term payment programs and are not guaranteed from year-to-year. For long-term resilience to be achieved, a stable region-wide program with payment options is required.

4. Soil Health

Healthy soil is the backbone to a sustainable, resilient agricultural sector. Healthy soil helps to:

- retain water and increase infiltration;
- reduce the effects of drought;
- reduce fertilizer application needed for crops;
- reduce the proliferation of invasive species;
- improve soil nutrients; and
- support deeper plant root growth which helps sequester carbon and reduce carbon dioxide release into the atmosphere.

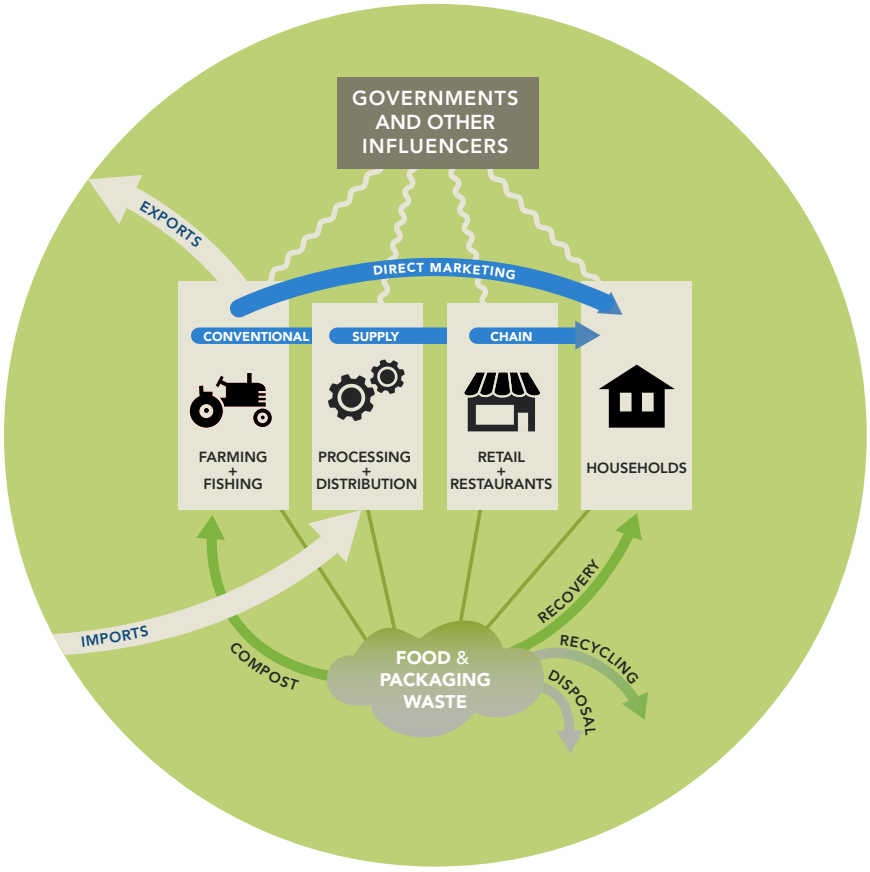
Research is ongoing at all levels, including at local universities, to determine the benefits of healthy soils, which is imperative to help all aspects of the agricultural sector understand how it can benefit from the soil it depends on. Addressing soil degradation, including hydrological changes, contamination, and an increasing prevalence of invasive species, is also important to address to ensure overall optimum soil health for agricultural production is achieved.

Food Systems: Adaptation and Resilience

The Metro Vancouver region is one of the most important food producing areas in British Columbia. The systems that support food production in this region are comprised of a myriad of players engaged in farming, processing, transporting, distributing, and consuming food as well as managing packaging and food waste and nutrient 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 are 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 resilience of the farm system in the context of significant major driving forces such as development pressures, climate change impacts, GHG emissions reductions, increasing transportation costs, pandemics and global health crises, international conflicts, and droughts, floods and an increased incidence of severe weather events, to name a few. Transitioning 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.

FOOD SYSTEM COMPONENTS





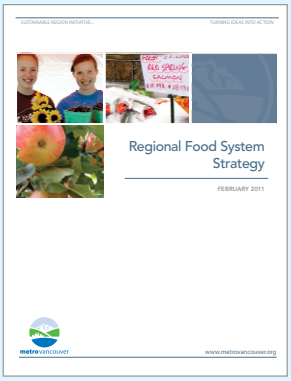
1. Food System Strategy

A key step in examining the resilience of Metro Vancouver's food system is to update the existing *Regional Food System Strategy*. This would allow for a separate process to answer the challenging questions about sustainability, adaptability, and resilience 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, Indigenous knowledge of food biodiversity and its cultural significance, inefficiencies in the transportation system, reducing agricultural and pre- and post consumer waste, and Agri-tech and the role of technology and innovation.

2. Systemic Agricultural Changes

Large portions of the region's most productive agricultural lands that occupy low-lying reclaimed coastal regions are susceptible to coastal flooding and are at risk from increased soil salinization, widespread water inundation, and crop loss. A significant amount of work has already been done to examine how communities can manage sea level rise; however, on-going frequent coastal flooding has driven new research to focus on how this is impacting the agricultural community. A general lack of understanding is still present however, on what systemic changes are needed to ensure the long-term viability of the region's farms. Focusing on cover crops, improving soil structure, switching to salt-tolerant crops and ensuring long-term protection of agricultural areas from the negative impacts of adjacent urban development (e.g., on farm changes in hydrology and drainage patterns) are all elements that need to be examined in more detail and applied at a regional scale.

Regional Food System Strategy



In 2011, the MVRD Board endorsed the *Regional Food System Strategy* to create a collaborative approach to a sustainable, resilient, and healthy food system. Since that time, the Metro Vancouver region has experienced a significant amount of change including:

- A considerable increase in region-wide urban growth placing unprecedented pressure on agricultural lands to accommodate non-farm uses, urban transportation overflow, and space for recreational uses;
- An increase in food insecurity among vulnerable populations as well as new demographic sectors as a result of a global pandemic, military conflicts, and inflation;
- A change to local weather patterns such as heat domes and extended droughts resulting in crop damage and food unavailability.

These changes place substantial pressures on the regional food system increasing food insecurity for all residents.

These issues, as well as a gap in the acknowledgement and strengthening of Indigenous food sovereignty, will need to be examined within the broader framework and context of the complete regional food system. To accomplish that effectively, the *Regional Food System Strategy* will require an audit to determine if its policies are still relevant and are broad enough to address the identified gaps.

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. work with First Nations, the BC Government and the Indigenous Advisory Council on Agriculture and Food, to identify opportunities to strengthen Indigenous food systems and increase Indigenous participation in the agriculture and food sectors;

v. 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;

vi. 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;

vii. determine the content for a step-by-step instructional toolkit to be used by new or young farmers interested in starting a farm operation within Metro Vancouver; and

viii. address the tension that exists between food safety (e.g., health protection that places restrictions on food processing) and food security (e.g., health promotion that can be disconnected from food safety requirements) activities.

Long-Term Investment: Enable and Support Resilience and Economic Opportunities

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

AGPAL Program and Service Finder

BC Agritech

1. Champions and Strong Leadership

For the agricultural sector to make the necessary adjustments to manage for climate change, long-term investment in agriculture and farming operations is necessary at all levels and through multiple streams, including: financial, support services, leadership, innovation, education, policy, and regulation. While climate adaptation requires changes to business practices, these changes are often unsuccessful without the necessary champions and leaders (e.g., BC Climate and Agricultural Initiative). For agricultural producers to be successful, regulators will need to show leadership and an understanding that conventional farming models will likely require adjustments 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.

2. Policy, Regulatory and Financial Support

For the agriculture 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 to create opportunities for businesses to be flexible to adjust to changing international, national, local, and sector needs. These adjustments will likely require new policy, regulatory, and financial support mechanisms and support structures will include simplifying and adjusting complicated tax structures, finding ways to reduce the impact of the high cost of land in the Metro Vancouver region, and offering programs that provide specialized agricultural advice to primary producers to support new technology or pilot program trials, and to supply extension services that support marketing and distribution commitments.

3. Extension Services

The agricultural sector is governed by extensive regulations and licensing requirements and is abundant with ideas on how to adjust production practices or use new ag-focused technologies and resources. Many of these new practices however, require data collection or testing services that are often not available to producers in an accessible or cost-effective manner. Many farmers are keen to implement new practices or try new equipment but lack the resources to determine if a new farming method is viable. Online programs like AgPal (Government of Canada) allow farmers and agri-businesses to find relevant resources and information (e.g., funding and grants, licensing and regulations, business practices, science, environment and sustainability) in an easy to access platform that can be used at a time that is suitable to them. Expanding and supporting these types of resources goes a long way in increasing a farmer's ability to be self-sufficient and able to adjust and pivot to outside changes and pressures.



GREENHOUSE FOOD PRODUCTION

4. Technological Solutions

The agricultural sector is making great strides in using regenerative agricultural practices and ecosystem services to create sustainable farming operations and in using technology to play a vital part in helping farmers adjust to climate change and increase overall operational resilience. Supporting technology to optimize fertilizer application, generating renewable energy from agricultural residues, and assisting with pest, water and soil management are great examples of how farming is benefiting from high-tech innovations. Continuing to innovate and use new technology, combined with Provincial programs such as Agritech, which 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

Barriers to achieving a net zero carbon and resilient agricultural sector are plentiful and challenging to overcome. In some instances, great effort re-imagining solutions beyond what we are aware of in the present day will be required to meet the vision and goals established for farming in this region. While it's important to get a clear picture of the challenges ahead, it is also beneficial to determine if there are opportunities that can be leveraged to reduce the negative impact of the barriers that have been identified to-date.

INTERNATIONAL PRESSURES

	BARRIER	OPPORTUNITY
1.	Farm businesses are expected to accommodate all climate-related policy and regulatory changes while working with global commodity prices, and competing with cheaper imports.	▶ Solutions can be shared across the globe by those actively engaged in the research and development of sustainable farming practices.

SEA-LEVEL RISE AND EXTREME WEATHER EVENTS

	BARRIER	OPPORTUNITY
2.	Salt water intrusion is an on-going issue and drainage problems and flooding pose great risks to agricultural production; the extreme land shortage in the Metro Vancouver region doesn't provide opportunities to "move" farmland somewhere else. (Note: See also *Nature & Ecosystems Roadmap*)	▶ On-going challenges necessitate collaborative solution development between the agricultural sector, researchers and all levels of government. ▶ Supporting salt-resistant crop diversification in flood plains is an opportunity to increase resilience. ▶ Vertical farming production may create opportunities to replace some vulnerable crops in flood plains.
3.	Consumers lack a deeper knowledge and understanding of how extreme weather events 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.	▶ Using imaginative educational information campaigns can memorably connect with consumers about the challenges of the farming sector.
4.	Significant rainfall events are increasing in frequency in the region, particularly at the end of farming season when fields are harvested and soil is left bare and susceptible to rain erosion and runoff. Continued and ongoing erosion degrades soil quality overtime reducing yields and significantly affecting overall productivity.	▶ Expanding cover crop programs on agricultural land is an opportunity to improve soil structure and retain the viability and productivity of open field farming.
5.	Ongoing insufficient access to water for irrigation for agricultural purposes.	▶ Utilizing regenerative agricultural practices is an opportunity to better manage water resources more efficiently.

LOCAL DECISION MAKING

	BARRIER	OPPORTUNITY
6.	Financial costs from the effects of climate change hinder the agricultural sector's ability to produce food in the long term.	▶ Adjusting policies, regulations, and financial structures collectively can cohesively support the agricultural sector in becoming more resilient to the climate challenges ahead.
7.	Urban development impacts and the effects of climate change have neither been factored into managing and protecting local agricultural land, nor into managing water shortages on farmland.	▶ Complex challenges create opportunities to showcase leadership in collaborative solution development and strategy execution.
8.	The agricultural sector faces significant financial and operational challenges that are often misunderstood by consumers who are not aware of risks that go into local farming.	▶ Communicating with surrounding urban residents about the realities of agricultural production is an opportunity to establish a relationship with local farmers.
9.	Agricultural production is often impeded due to the lack of access to irrigation for a myriad of reasons including: water licences being over prescribed; water removed from waterways without a licence; marginal ground water quality; and difficulty accessing ground water sources.	▶ Utilizing alternative water storage and recycling methods can showcase leadership in collaborative solution development and strategy execution.
10.	Agricultural producers are impeded in being able to fully integrate adaptability and sustainability into their farm operations due to their limited capacity to manage these types of process changes and due to lengthy, costly, and prohibitive application and permitting processes.	▶ Supporting existing programs or expanding extension services exponentially increase the capacity of agricultural producers.
11.	The high percentage of non-farm landowners in the Agricultural Land Reserve (ALR) restricts the ability for local farmers to expand operations and restricts comprehensive use of agricultural land for climate change management. Absentee landlords in the ALR make it difficult to access underused, idle agricultural land.	▶ Adjusting policies, regulations, and financial structures collectively to increase the viability of agriculture can cohesively support the sector in becoming more resilient.
12.	Ongoing tension and pressure from urban areas to expand into and convert agricultural land to ease regional industrial land and housing shortages.	▶ Complex challenges create opportunities to showcase leadership in collaborative solution development and strategy execution.
13.	Ongoing degrading of soil and changes in hydrology of farm land adjacent to urban land uses due to increases in runoff and changing drainage patterns supports continued expansion of urban uses into farmland.	

ONGOING RESEARCH AND SUPPORT

	BARRIER	OPPORTUNITY
14.	Switching to high-value crops may be challenged by exposure to pests, soil salinization, etc.	▶ Creates opportunities to utilize research and / or technology to support adjustments in agricultural production.

The Journey: 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, and other important public benefits including flood management, carbon sequestration and wildlife habitat; however, some agricultural activities also generate emissions of GHGs and other air contaminants.

Linkages to Other Issue Areas

There are several climate 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 the impacts and actions related to climate change. Other climate related issues connected to agriculture are addressed in the following:

Land Use & Urban Form Roadmap – Containing urban growth protects agricultural land for farming over the long term. Agriculture is vulnerable to impacts from adjacent land uses, new development, and the expansion of transportation infrastructure.

Human Health & Well-being Roadmap – Fresh local and imported food, especially fruits and vegetables, support healthy communities; food choices affect health, emissions, and agricultural viability.

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

Waste Roadmap – Food loss and food waste increase greenhouse gases.

Energy and Industry & Business Roadmaps – 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 GHG emissions from manure and industrial energy use.

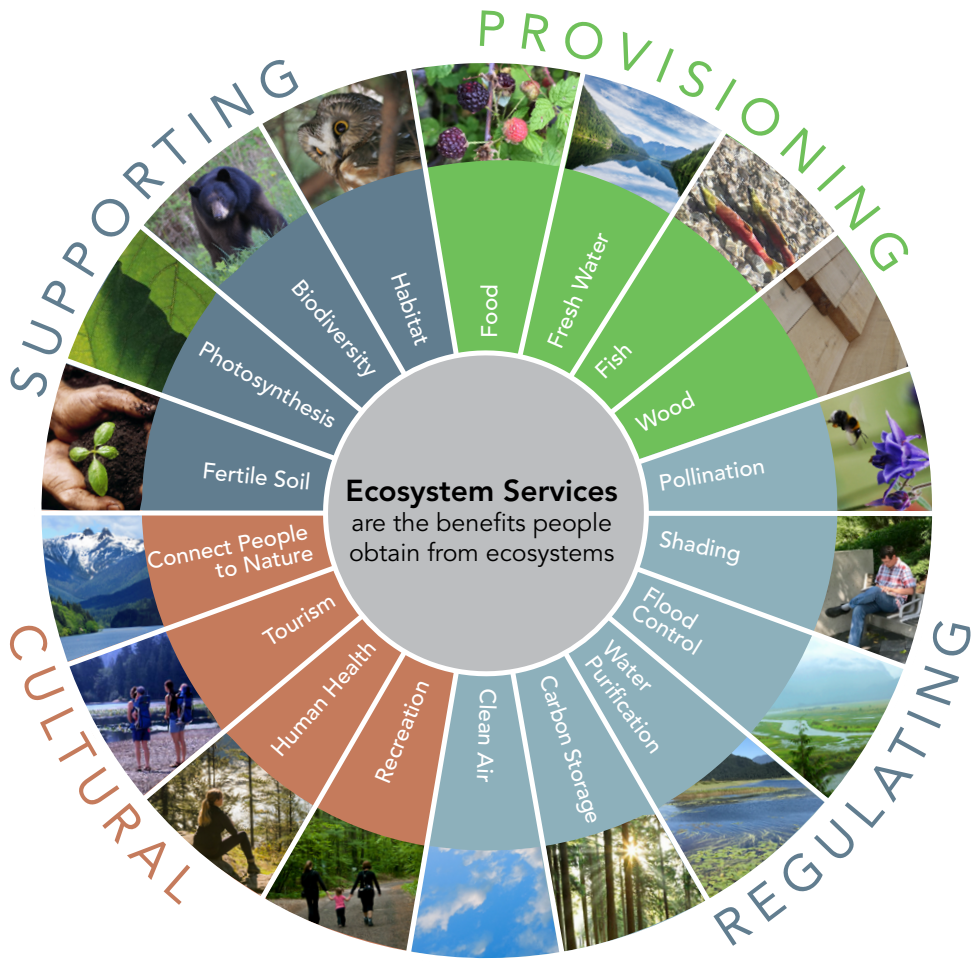
Nature & Ecosystems Roadmap – Protecting, restoring and connecting natural areas, and enhancing ecosystem services on agricultural land support a climate resilient agriculture sector. The significant connection the *Nature and Ecosystems Roadmap* has to the agricultural sector is explored in more detail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

Climate 2050 Nature & 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 & Ecosystems Roadmap* is the most inter-connected and related to the *Agriculture Roadmap*.

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

- **Ecosystems** provide crop pollinator habitat, flood and erosion control and natural pest management; and
- **Agricultural lands** support ecosystems by providing a wide range of bird and wildlife habitat, hosting regional park space, supporting natural asset management (e.g., stormwater and flood control overflow), and providing potential connections and linkages to the Regional Green Infrastructure Network.



ECOSYSTEM SERVICES PROVIDED BY HEALTHY ECOSYSTEMS

Strategies and Actions

Roles and Responsibilities

Under authority delegated by the BC Government through the *Environmental Management Act*, Metro Vancouver is responsible for managing and regulating air quality and GHG emissions in the region, including air contaminants from agricultural sources. Metro Vancouver is also responsible for developing, implementing, and stewarding *Metro 2050*, the Regional Growth Strategy. *Metro 2050* contains Metro Vancouver's GHG reduction targets and includes strategies to protect agricultural land and promote agricultural viability through the Agricultural regional land use designation and 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 agencies and organizations that fill key roles in reducing agricultural emissions and that are helping increase the resilience of Metro Vancouver's agricultural community are outlined below:

KEY STAKEHOLDER ROLES AND RESPONSIBILITIES

ENTITY	ROLE
BC Ministry of Agriculture, Food and Fisheries	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	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	Responsible for the protection, management, and conservation of BC's water, land, 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 renewable energy sources.
Farm Industry Review Board	An independent administrative tribunal that is responsible for hearing complaints from persons aggrieved by odour, noise, dust, or other disturbances arising from agriculture; 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 sustain agricultural operations by buying and supporting local food.



AGRICULTURAL LAND IN METRO VANCOUVER

BIG Move **Big Moves** are foundational to achieving the 2030 and 2050 targets, and should lead to the most significant greenhouse gas reductions and/or climate resilience.

METRO 2050 **Metro 2050** identifies actions that are already adopted through *Metro 2050*, the regional growth strategy.

Corporate LEADERSHIP **Corporate Leadership** actions are ones Metro Vancouver will implement in its corporate operations to demonstrate leadership and support regional actions.

CAP **Clean Air Plan** actions are ones adopted within Metro Vancouver's *Clean Air Plan*.

Strategy 1: Protect Agricultural Land

Agricultural land in Metro Vancouver is increasingly threatened from urban impacts and encroachment, including from: the piecemeal accommodation of commercial and industrial uses; soil degradation; changes in ground hydrology from urban-sourced runoff; and a proliferation of non-farm uses in agricultural and rural areas such as estate-style housing. Currently, there are more non-farm landowners in the Agricultural Land Reserve (ALR) than there are farm owners and development applications to re-purpose farmland, whether in or outside of the ALR, are ever increasing as land pressures within the Urban Containment Boundary spill onto agricultural areas which are typically cheaper to purchase and develop. A collective, on-going region-wide effort will be required to reduce this pressure and safeguard agricultural land for agricultural purposes to ensure that it continues to supply residents with healthy, fresh food, and continues to support valuable ecosystem services for flood control, wildlife habitat, and clean air.

The constant pressures on agricultural land to accommodate urban uses is a significant barrier to: turning unused or non-productive land into operating farms; to ensuring the ALR is cohesively used to support and expand farming operations; to providing new or young farmers access to farmland on a long term basis; and to ensuring natural areas on agricultural land can be appropriately leveraged to increase the overall resilience of farming and food production in the region. The following actions are intended to protect agricultural land and support a resilient agriculture sector for the long-term within the Metro Vancouver region:

Protect Agricultural Land From the Impacts of Urban Land Development

1.1 Prepare an Agricultural Land Protection and Viability Strategy to identify how to protect and increase the active production of agricultural land within the region including:

BIG Move

- Identifying the most feasible and beneficial opportunities for regional, inter-governmental and industry collaboration;
- Supporting and expanding land matching initiatives; and
- Increasing long term access to farmland for young and new farmers.

1.2 Advocate to member jurisdictions to limit the extension of water, sewer and communication utility services through agricultural land.

METRO 2050

1.3 Work with member jurisdictions, the BC Government, the Agricultural Land Commission, and industry to require and implement soil movement tracking within agricultural areas.

BIG Move

Corporate LEADERSHIP

1.4 Advocate to the BC Government for changes to the tax structure for agricultural properties to include the nuances of production types, yields and sizes into the farm status calculation to reduce incentives for non-farm use development in the Agricultural Land Reserve.

Enable Long-term Soil-based Use of Agricultural Lands

1.5 Work with member jurisdictions, the BC Government, and industry to incentivize, increase the viability of, and prioritize the use of soil-based agriculture in the region.

1.6 Work with member jurisdictions, the BC Government, industry and educational institutions to determine appropriate agricultural-focused and agricultural-supportive uses (e.g., planting woody perennials to capture carbon or supporting ecosystem services to manage flooding) on land classified as having limited potential for soil-based agricultural uses.

Strengthen Regional Land Use Policy

1.7 Work with member jurisdictions to review how regional and local land use policy can be strengthened to reduce the encroachment of urban uses into agricultural areas including:

BIG Move

- Ensuring existing or future agricultural uses are not negatively affected by an extension to regional sewerage services;
- Protecting agricultural uses within the Rural regional land use designation from urban development expansion and impacts;
- Ensuring an analysis of the regional effects of the loss of agricultural land is included with any regional land use amendment application involving the Agricultural or Rural land use designations; and
- Updating policy 6.3.4 of *Metro 2050* to discourage the conversion of Agricultural or Rural designated lands to support urban uses.

1.8 Work with member jurisdictions to review how regional and local land use policy can be strengthened to reduce the negative impacts of urban development on adjacent agricultural uses through the use of agricultural impact assessments.

METRO 2050

1.9 Update Section 2.2 of *Metro 2050* to be consistent with the November 29, 2019 MVRD Board decision specifying that the Regional Industrial Land Strategy support solutions to the shortage of industrial lands that do not include encroachment onto agricultural land.

1.10 Work with the BC Government, Agricultural Land Commission, and member jurisdictions to better define agricultural uses, define agricultural-supporting uses, and clarify the role of rural lands to the viability of the agricultural sector across the region.

1.11 Work with the BC Government, Agricultural Land Commission, and member jurisdictions to develop a comprehensive strategy on how to manage parcels less than 0.4 hectares (2 acres) in the ALR that may fall within the potential exceptions from the restrictions of use in the Agricultural Land Commission Act.

1.12 Work with First Nations, the BC Government, member jurisdictions and the agricultural sector to review how regional policy can recognize and support Indigenous food sovereignty throughout the region.

Corporate LEADERSHIP

Community Efforts...

YOUNG AGRARIANS

The BC Land Matching Program provides personalized land matching and business support services to farmers looking for land to start or expand their farm, and landowners interested in finding someone to farm their land. The program is delivered by Young Agrarians and addresses the high cost of land as a significant barrier for those seeking to enter the agriculture industry in BC.

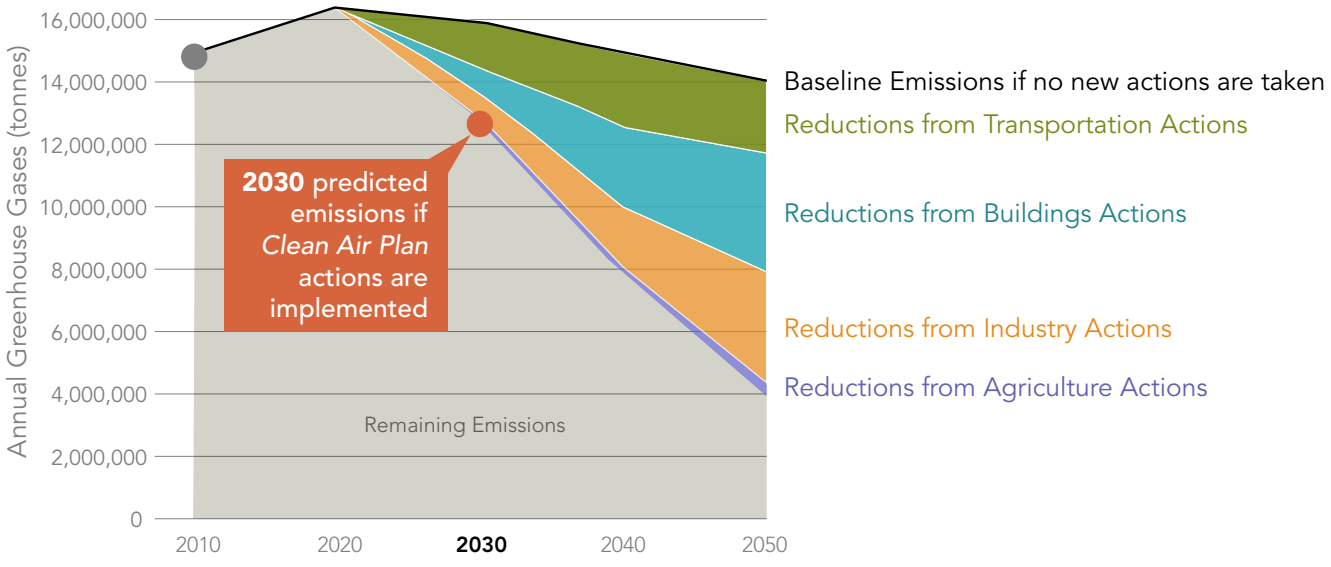
Strategy 2: Support Farmers as Climate Action Leaders

Some agricultural activities generate 4% of regional GHG emissions, including heaters and boilers in greenhouses, agricultural equipment, and the keeping of livestock. Improving energy efficiency and switching to clean, renewable energy for greenhouses and agricultural equipment and using enhanced Beneficial Management Practices will help achieve 2030 agriculture emission targets for GHGs. Expanding smaller-scale composting solutions in conjunction with producing renewable natural gas through anaerobic digestion of agricultural (crop and food) and other waste will help to displace natural gas from fossil fuels in the agricultural sector where zero emission solutions are more challenging.

The agricultural sector has demonstrated its leadership in continually looking at ways to adjust production methods to increase efficiencies and has demonstrated its willingness to continue to innovate and make adjustments to remain competitive, 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 reaching a net-zero GHG emissions future. The following actions, largely identified in the *Clean Air Plan*, are intended to support the farming community expand its role as a climate action leader within the Metro Vancouver region:

STRATEGY 2	Potential Impacts of Strategy	Key Partners
	• Reduce annual greenhouse gases by up to 100,000 tonnes by 2030	• Government of Canada • BC Government • Agriculture Community • Member Jurisdictions

Potential Reductions in Regional Greenhouse Gases



Reduce Emissions from Greenhouses

2.1 Work with the BC Government and industry to explore opportunities to reduce emissions from greenhouses, including:

- improving energy performance; and
- transitioning to clean, renewable energy while also considering the need for supplemental carbon dioxide to support plant growth.

2.2 Prepare passive design standards specific to greenhouse operations.

2.3 Provide online decision support tools to help greenhouse operators manage upgrades.

2.4 Update the regional emissions inventory with greenhouse-specific data.

2.5 Work with the greenhouse industry to collect data on greenhouse carbon dioxide requirements.

Improve Soil Health to Help Address Carbon Emissions

2.6 Expand our collective knowledge and understanding of the role of soil health in supporting long-term agricultural viability and resilience and as a local source that can be used to help reduce carbon emissions within the Lower Mainland.

2.7 Work with the BC Government, member jurisdictions, the agricultural industry and other regional partners to support the long-term collection and open source provision of soil carbon data.

2.8 Work with the BC Government and other key stakeholders to develop actionable programs specific to soil carbon storage and wood perennial sequestration on agricultural lands, including providing benchmarking data.

Industry Efforts…

Dairy Farmers of Canada are committed to reaching net-zero greenhouse gas emissions from farm-level dairy production by the year 2050. Dairy farmers will reach net-zero through emissions reduction, carbon removals and carbon capture. This transition includes using renewable energy through anaerobic digestion, improving animal nutrition to reduce methane emissions, and implementing crop rotation and cover cropping to improve soil health.

Strengthen Outreach Program on Reducing Agricultural Emissions

2.9 Work with the agriculture sector, member jurisdictions and the BC Government, to supplement and expand on existing programs by developing and implementing an awareness and outreach program specific to reducing agricultural GHG emissions (e.g., adjusting cattle feed to reduce methane emissions).

Enhance Funding and Access to Environmental Farm Plans

2.10 Advocate to the Federal Government and the BC Government to enhance funding to develop and implement Environmental Farm Plans to support the reduction of nitrous oxide, methane, carbon dioxide, and other air contaminant emissions from agricultural operations. CAP

2.11 Advocate to the Federal Government and the BC Government to continue to develop and promote Beneficial Management Practices in the application of an Environment Farm Plan. CAP

2.12 Advocate to the Federal Government and the BC Government to continue to provide reliable incentives and technical guidance to farms to support adoption of low emission practices and technologies. CAP

2.13 Advocate to the BC Government to increase awareness of and accessibility to the Environment Farm Plan program including expanding application deadlines, aligning reporting deadlines with production schedules, increasing capacity of program advisors, and adjusting current messaging to better communicate the benefits of the program.

Establish Incentives to Transition to Lower Emission Agricultural Equipment

2.14 Advocate for funding programs (e.g., incentives, tax credits, loans, etc.) that make accelerating the use of cleaner-running agricultural equipment more financially viable to agricultural producers. CAP

2.15 Establish incentives or programs that help decommission old equipment in place of zero emission equipment to make the transition more financially viable to agricultural producers. CAP

Develop Pilot Studies to Test Zero Emission Agricultural Equipment

2.16 Work with the BC Government, industry, and the agriculture community to develop a pilot study to test the feasibility and logistical requirements for the wide-spread use of zero emission agriculture equipment (e.g., electric tractors).

Expand, Support and Streamline the Use of Anaerobic Digestion of Agricultural Waste

2.17 Advocate to the Federal Government, BC Government, energy utilities and member jurisdictions to expand development of anaerobic digestion facilities to process manure, other agricultural waste and commercial food waste. CAP

2.18 Advocate to the Federal Government, BC Government, energy utilities and member jurisdictions to establish financial incentives that help establish new anaerobic digestion facilities, ensuring that any expansion avoids the loss of agricultural land in the Metro Vancouver region. CAP

2.19 Advocate to the Federal Government, BC Government, energy utilities and member jurisdictions to create financial incentives and remove barriers to ensure the successful operation of existing, agricultural waste anaerobic digestion facilities in the Metro Vancouver region. CAP

2.20 Support and streamline the operation of anaerobic digestion facilities in the region by developing an emission regulation for anaerobic digestion of agricultural and commercial food waste that is simple and maintains existing permitting processes while also ensuring equivalent protections for regional air quality and human health. CAP



GREENHOUSE OPERATION

2.21 Support and streamline the operation of anaerobic digestion facilities in the region by developing a multi-stakeholder centralized agricultural waste collection facility in the Metro Vancouver region to support meeting the Provincial Agricultural Environment Management Code of Practice and improve the cost-benefit return on running anaerobic digestors for agricultural producers.

BIG Move | Corporate LEADERSHIP

2.22 Support and streamline the operation of anaerobic digestion facilities in the region by creating a comprehensive information package for the agricultural sector that communicates all permitting and regulatory requirements for the successful operation of an anaerobic digestion facility. (See also Strategy 4.3)

Corporate LEADERSHIP

2.23 Support and streamline the operation of anaerobic digestion facilities in the region by creating a comprehensive information package for member jurisdictions on how to accommodate anaerobic digestors in their community including sample land use policies and zoning regulations that can be applied at the local level.

Corporate LEADERSHIP

Encourage and Prioritize Local Agriculture

2.24 Advocate to member jurisdictions and other regional partners to address regional food security, encourage more local food production, and prioritize agricultural practices that reduce emissions or help maintain or sequester carbon.

CAP

Strategy 3: Support Long-Term Farm Health and Resilience

Farmers and agricultural producers have successfully adapted and evolved over time accommodating changes in economics, consumer choices, weather patterns, technology, transportation, and market demands. Resilience, while not a new concept, is becoming increasingly important to plan for and accommodate in agricultural operations as the degree to which farmers need to adapt to continue to succeed in the face of an ever-changing climate is evolving rapidly.

Farmers and their businesses will be significantly challenged to withstand the effects of climate change, feed present and future populations, and provide ecosystem services to adjacent urban areas without adjusting practices to ensure the long-term health and resilience of their farms. These adjustments, coordinated with the use of conventional farming practices, will need to better incorporate and connect to natural ecosystems, biological-focused applications and regenerative techniques more than ever before. This involves first understanding a farm's specific vulnerabilities and second, pursuing actions so that they can directly benefit from the ecosystem services (e.g., soil nutrient and organic matter, pollinator habitat, and flood management) provided by or adjacent to their agricultural land. The following actions are intended to support and increase the long-term health and resilience of the agricultural sector within the Metro Vancouver region:

Plan for Climate Change Impacts on Agricultural Land

3.1 In conjunction with the BC Government's Pilot Extreme Weather Preparedness for Agriculture Program, prepare a regional vulnerability assessment of agricultural lands to identify which areas are the most at risk to specific climate change impacts (e.g., flooding, extreme heat). BIG Move

3.2 Determine how the agricultural sector can benefit from the protection and rehabilitation of natural areas that provide ecosystem services to farms. METRO 2050

3.3 Prepare a comprehensive regional high resolution map of ecosystem services locations on agricultural land identifying the highest opportunities for focused stewardship efforts to support the long-term resilience of the agricultural sector. (See also Strategy 3.7)

3.4 Work with the Federal Government, BC Government and agricultural sector to introduce and support the use of biovigilance by local farmers to increase resilience against the impacts of new pests and invasive species.

Industry Efforts...

FARMLAND ADVANTAGE

Farmland Advantage (FLA) is a research and development program that works with farmers to protect and conserve critical natural lands, streams, and habitats in British Columbia. FLA helps farmers identify natural values, or ecosystem services, on their land which can be protected and enhanced. FLA also develops recommendations and plans for preservation and ensures farmers are compensated for stewardship actions and regenerative agricultural practices that support ecosystem services. FLA is an Investment Agriculture Foundation of BC program.



WETLAND ECOSYSTEM SERVICES ON FARMLAND

Support Long-term Use of Ecosystem Services

3.5 Estimate the financial value of ecosystem services on agricultural land in the Metro Vancouver region and determine how farmers and land owners can be compensated for setting aside natural areas for the benefit of ecosystem services.

3.6 Collaborate with the BC Government and member jurisdictions to explore and build a long-term funding mechanism that includes payment for ecosystem services on agricultural land.

BIG Move | Corporate LEADERSHIP

3.7 Review and assess options to align with the ongoing work to establish a Regional Green Infrastructure Network to support ecosystem services on agricultural land.

3.8 Develop guidance materials to support natural asset management and provide a forum to share best practices among member jurisdictions. (Note: See also *Nature & Ecosystems Roadmap*; Action 3.4)

Expand the Use of Regenerative Agriculture

3.9 Work with the BC Government and member jurisdictions to address the knowledge gap between the agricultural sector and the benefits and applications of regenerative farming practices including providing examples of its economic benefits and how they can be applied and combined with conventional farming practices.

3.10 Work with the BC Government and member jurisdictions to establish and support pilot projects or demonstration projects that illustrate how regenerative agriculture can be applied to agricultural operations, both large and small, and how transitions to regenerative practices can be supported from a financial risk perspective.

3.11 Monitor the outcome of the Agricultural Climate Solutions BC Living Lab research and pilot projects to determine alignment with regional policies and projects.

3.12 Work with the BC Government, member jurisdictions and the agricultural sector to develop a pilot program focused on expanding pollinator populations (e.g., honey bees) in the region.

Ensure Long-term, Reliable Access to Water

3.13 Work with the BC Government, water districts and member jurisdictions to develop a comprehensive analysis of the sub-regional sources of water used by the agricultural sector in Metro Vancouver and the ongoing challenges with accessing that water for agricultural purposes.

3.14 Work with the BC Government, water districts and member jurisdictions to provide viable and tangible solutions to ensuring water resources needed by the farming community are provided in a sustainable, consistent, and reliable manner.

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3.15 Explore innovative sources and new technologies for water reuse (e.g., municipal waste water, agricultural drainage water) and water conservation (e.g., applying mulches to field crops).

BIG Move

3.16 Explore ways to take advantage of rainfall collection when it is abundant to be used during periods of low or no rainfall during the growing season.

3.17 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.

3.18 Develop a toolkit on how a circular water economy can be supported within the Metro Vancouver farming community, including new technologies and techniques for water reuse.

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Help Farmers Build Capacity to Adapt to Climate Change

3.19 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 business operations, including:

BIG Move

- Aiding in the farm-level preparation of emergency plans;
- Helping producers implement water back-up plans;
- Increasing producer access to programs, tools, practices, equipment and finances to help them self-monitor and manage soil (e.g., US Department of Agriculture online COMET carbon sequestration evaluation tool); and
- Helping farmers prepare business continuation plans for prolonged extreme weather events and disruptions to water and energy supplies.

3.20 Work with member jurisdictions to examine the feasibility and benefits of committing to established reporting frameworks that use measurable targets to determine the effectiveness of adaptation policy for agricultural operations, for example, the:

- Previous Mexico City Pact; and
- Milan Urban Food Policy Pact.

Strategy 4: Support a Viable, Profitable and Stable Agricultural Sector

The agricultural sector 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, and places of worship). Farming, as the cornerstone to the agricultural sector, is a vital component of the local and regional economies and stimulates links with restaurants, retail businesses, food processors, transportation companies and tourism, making its long-term viability and profitability a regional priority.

The current imbalance of land ownership of agricultural land by non-farmers, the encroachment of urban uses into the ALR for non-farm purposes, and the significant costs and barriers borne by producers to adjust their practices to meet resilience and GHG emissions reduction goals, represents a loss of economic prosperity for the region. The following actions are intended to support a viable, profitable and stable agricultural sector for the long-term within the Metro Vancouver region:

Continue Long-term Financial Investment in the Agricultural Sector

4.1 Work with the Federal Government and BC Government to support financial investment in the agricultural sector by:

- Providing incentive programs to help farmers adjust their operations to become more sustainable;
- Supporting long-term, consistent and reliable funding for agricultural producers to advance the resilience of farming operations in the Metro Vancouver region; and
- Designating resources for testing practices and technology to help farmers effectively use soil as a means to store carbon.

Collaborative Efforts…

Sustainable Canadian Agricultural Partnership
Competitive. Innovative. Resilient.

The Sustainable Canadian Agricultural Partnership brings together federal, provincial and territorial governments with a $3.5 billion, 5-year agreement to strengthen and grow Canada's agricultural sector.

Increase Access to Information for Local Farmers and Agricultural Producers

4.2 Work with the BC Government to develop an agricultural information network that provides peer-to-peer knowledge sharing opportunities about research and pilot project outcomes focusing on the cost benefit analysis needed for farmers to make decisions about implementing new innovations into farming operations.

4.3 Work with the BC Government, educational institutions and industry partners to prepare an interactive information resource toolkit that brings together Federal, Provincial, Regional, and Municipal legislation, bylaws, regulations and permitting requirements applicable to agriculture to help the farming community navigate through the array of regulatory information that applies to agricultural operations in the Metro Vancouver region.

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4.4 Collaborate with the BC Government, member jurisdictions and the agricultural sector to support farmers in overcoming the challenges identified as part of the Provincial Stewarding Agricultural Watercourse study.



Support Long-term Local Food Production

4.5 Work with the BC Government, member jurisdictions, industry, First Nations and other regional partners to undertake a review of the Regional Food System Strategy to address:

Corporate LEADERSHIP

- Climate-related food-specific challenges, gaps and opportunities;
- Local food production vulnerability and longevity within the region;
- Role of urban agricultural in regional food security;
- Lack of succession planning and labour shortage and living wage challenges;
- Indigenous food sovereignty;
- Impacts of the global COVID-19 pandemic; and
- Impacts of international conflicts on local agriculture production capacity.

4.6 Work with the BC government, member jurisdictions, and agricultural producers to support pilot projects that focus on diversifying food production in the region to reduce the reliance on food imports (e.g., local citrus fruit production).

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Bridge the Gap Between the Agricultural Community and the Consumer

4.7 Work with the BC Government and member jurisdictions to develop engaging and approachable educational campaigns aimed on connecting consumers more closely with the realities and challenges of producing food in the Metro Vancouver region, including:

- How agriculture 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 resilience through their actions and decision making.

4.8 Work with member jurisdictions to develop a coordinated regional signage campaign to raise awareness and showcase the location and benefits of locally-grown crops.

Increase Entry to Local Farming

4.9 Advocate to the BC Government for changes to the tax structure for agricultural properties to reduce the incentives for non-farm use development in the Agricultural Land Reserve.

Support Innovations in Agricultural Operations

4.10 Work with the Federal Government, BC Government, and industry to establish pilot projects that carry the financial and operational burden of testing new technological and agri-tech systems (e.g., GPS-guided machinery, drone monitoring, and data collection) that can work to increase the resilience and longevity of agricultural operations in the region.

4.11 Work with the BC Government to establish a cost-sharing or group purchase program to spread the risks of the purchasing and operating costs associated with new agri-tech innovations across the agricultural sector.

4.12 Collaborate with agricultural-focused research and innovation entities (e.g., Agri-Food Innovation Council, Agritech BC, Canadian Food Innovation Network) to advance the use of technological innovations into local agricultural production.

Setting the Path Ahead

The "Setting the Path Ahead" section will eventually be found on Metro Vancouver's Climate 2050 webpage 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 in this Roadmap: some actions are already underway, some will be initiated over the next several years and some require an ongoing, consistent infusion of resources to ensure their effectiveness over the long-term.

CLIMATE 2050 AGRICULTURE ROADMAP ACTION TIMELINE

STRATEGY	2023-2025	2026-2030	ONGOING
STRATEGY 1 Protect Agricultural Land	Prepare Agricultural Land Protection and Viability Strategy		
		Advocate to limit utility services extension	
	Implement soil movement tracking within agricultural areas		
		Change tax structure to reduce incentives for non-farm use development in ALR	
	Incentivize, increase viability of and prioritize soil-based agriculture		
		Determine appropriate agricultural-focused uses on land with limited potential for soil-based agriculture	
	Review how regional policy can be strengthened to reduce encroachment of urban uses		
	Review how regional policy can be strengthened to reduce negative impacts of urban development on adjacent agricultural uses		
	Update Section 2.2 of *Metro 2050* to be consistent with November 2019 MVRD Board decision		
		Better define agricultural uses, agricultural-supporting uses and clarify role of rural lands	
		Develop a comprehensive strategy to manage small lot agricultural lands potentially exempt from the ALCA	
		Review how regional policy can recognize and support Indigenous food sovereignty	
STRATEGY 2 Support Farmers as Climate Action Leaders	Explore opportunities to reduce emissions from greenhouses		
		Prepare passive design standards specific to greenhouse operations	
		Provide on-line decision support tools to help greenhouse operators manage upgrades	
		Update regional emissions inventory with greenhouse-specific data	
		Collect data on greenhouse carbon dioxide requirements	
	Expand knowledge and understanding of role of soil health in agricultural viability		
		Support long-term collection and open source provision of soil carbon measuring data	
		Examine ways to financially support data collection of soil carbon measuring	
		Examine actionable programs on soil carbon storage and provide benchmark data.	
		Develop and implement an awareness outreach program specific to reducing agricultural GHG emissions.	
	Expand awareness and outreach programs focusing on reducing agricultural emission		
	Determine how agricultural practices can be adjusted to reduce agricultural emissionss		
		Enhance funding to develop and implement Environmental Farm Plans	
		Enhance funding and develop and promote BMPs to support using Environmental Farm Plans	
		Provide reliable incentives and technical guidance to support low emission practices	
	Increase awareness and accessibility to the Environment Farm Plan		
		Funding for programs that accelerate the use of cleaner agricultural equipment	
		Incentives or programs that help to decommission old equipment in place of zero emission equipment	
		Develop pilot study to test wide-spread use of zero emission agriculture equipment	
		Expand development of anaerobic digestion facilities	
		Help establish new anaerobic digestion facilities	
		Support successful operation of existing anaerobic digestion facilities	
		Develop simple anaerobic digestion emission regulation	
		Develop multi-stakeholder centralized agricultural waste collection facility in the region to support anaerobic digestion	
		Create comprehensive information package for the agricultural sector to support anaerobic digestion facilities	
		Create comprehensive information package for member jurisdictions on how to support anaerobic digestion facilities	
	Address regional food security, encourage local food production and prioritize agricultural practices that reduce emissions or help to sequester carbon		

CLIMATE 2050 AGRICULTURE ROADMAP ACTION TIMELINE – Continued

STRATEGY	2023-2025	2026-2030	ONGOING
STRATEGY 3 Support Long-Term Farm Health and Resiliency	Prepare a regional vulnerability assessment of agricultural lands specific to climate change impacts		
	Determine how agriculture can benefit from restoration and protection of ecosystems		
		Prepare a comprehensive, regional high resolution map of ecosystem services locations on agricultural land	
		Introduce and support biovigilance programs to local farmers	
	Estimate financial value of ecosystem services on agricultural land and determine compensation for farmers		
	Explore and build a long-term funding mechanism to support payment for ecosystem services		
	Align with the Regional Green Infrastructure Network project		
		Develop guidance materials to support natural asset management	
		Address knowledge gap between agricultural sector and the benefits and applications of regenerative agriculture	
	Support pilot projects to illustrate regenerative agriculture		
	Monitor outcomes of the BC Living Lab projects to determine alignment with regional projects		
		Pilot program to expand local pollinator populations	
	Develop a comprehensive analysis of the sub-regional sources of water used by agricultural sector		
	Provide viable and tangible solutions to ensuring water resources needed by agriculture are sustainable		
		Explore innovative sources and new technology for water re-use	
		Explore ways to take advantage of rainfall collection opportunities	
		Update water demand model	
		Develop a toolkit about a circular water economy	
			Increase the agricultural community's capacity to integrate climate change into their business operations
		Examine feasibility and benefits of committing to programs that address the effects of climate change on agricultural operations	
STRATEGY 4 Support a Resilient, Robust, and Healthy Urban Forest	Support financial investment in the agricultural sector through incentive programs and funding sources		
		Develop an agricultural information network focusing on cost benefit analysis needed for farmers	
		Prepare an interactive information resource toolkit	
	Determine how the agricultural community can address issues raised during the Provincial Stewarding Agricultural Watercourse study		
	Undertake a review of the Regional Food System Strategy		
		Support pilot projects that focus on diversifying local food production.	
			Develop engaging and approachable educational campaigns aimed at consumers and the realities of food production
		Develop regional signage campaigns to showcase local food production	
		Advocate for changes to the tax structure for agricultural properties	
		Establish pilot projects that carry the financial and operational burden of testing new technological and agri-tech systems	
		Establish a cost-sharing or group purchase program to share new agri-tech innovations across the agricultural sector	
		Collaborate with agricultural-focused research and innovation entities	



AGRICULTURAL LANDS ON BARNSTON ISLAND

Measuring Our Progress

The table below lists examples of some of the data performance indicators that could be used to help Metro Vancouver measure regional progress towards supporting a net-zero, resilient agricultural sector. The performance indicators used will depend on the availability of this information from other organizations. Because the *Climate 2050 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 towards 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	Agricultural Land Use Inventory	no
Protected Agricultural Land	% ALR actively farmed	Agricultural Land Use Inventory	yes
Regional GHG Impact	The agricultural sector is carbon neutral by 2050	various	yes
	% regional greenhouse gas emissions from greenhouses	various	no
	The agricultural sector produces clean, renewable energy to meet all its production needs by 2050	various	no
	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 multiple levels of government, the agricultural sector, 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 the 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 considered as they arise and reflected through updates to the Roadmap over time.

The project team continues to be open to feedback, at any time, in this *Climate 2050 Agriculture 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@metrovancouver.org or phone 604-432-6200.



AGRICULTURAL LANDS ALONG HIGHWAY 91 IN DELTA

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 refer to any substance that is emitted into the air that (a) injures or is capable of injuring the health or safety of a person; (b) injures or is capable of injuring property or any life form; (c) interferes or is capable of interfering with visibility; (d) interferes or is capable of interfering with the normal conduct of business; (e) causes or is capable of causing material physical discomfort to a person; or (f) damages or is capable of damaging the environment.

Biovigilance describes an innovative, multi-disciplinary approach to understanding and combating the negative effects of newly introduced pests, new agricultural farming practices, new crops, and climate change on plant health. Relies on a continuous cycle of awareness, identification, assessment, understanding, mitigation, and appropriateness to ensure that solving one problem doesn't lead to another. The goal is to proactively mitigate potential threats from plant diseases, weed species, and insects before they impact the agricultural sector on a larger scale.

Carbon dioxide 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 on farmland 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.

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 is the natural, enhanced, and engineered assets that collectively provide society with ecosystem services required for healthy living.

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.

Health-harming 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. Health-harming air contaminants include fine and coarse particulate matter, diesel particulate matter, ground-level ozone, nitrogen dioxide, sulphur dioxide, volatile organic compounds, and ammonia.

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 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. Fossil 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.

Nature-based solutions are actions that protect, sustainably manage, and restore natural or modified ecosystems but also address societal challenges (such as climate change), thereby providing both human well-being and biodiversity benefits.

Nitrous oxide 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.

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 susceptibility to harm and adaptive capacity.


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