CLIMATE **2050 Roadmap**

Industry & Business

Accelerating the transition to carbon neutrality and climate resilience

April 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: q̓íc̓әy̓ (Katzie), q̓ʷɑ:ńƛ̓әń (Kwantlen), kʷikʷəƛ̓əm (Kwikwetlem), máthxwi (Matsqui), xʷməθkʷəy̓əm (Musqueam), qiqéyt (Qayqayt), se'mya'me (Semiahmoo), Sḵwx̱wú7mesh Úxwumixw (Squamish), scәẃaθәn mәsteyәxʷ (Tsawwassen), and sә́lílwәtaɁɬ (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.

The goals and targets at the heart of Metro Vancouver's climate-related plans are based on the best available information. Reaching them is a top priority for the organization and the region. We must take bold action now to become a carbon neutral region by 2050, while recognizing that changes to our climate are already occurring, and that climate resilience must be a central consideration for the development of the region. The *Climate 2050 Industry and Business Roadmap* was developed in alignment with the *Clean Air Plan* and introduced for stakeholder comment before the COVID-19 pandemic. Across the globe, the pandemic response has provided a glimpse of what is possible and what we can achieve with coordinated efforts and common goals in a time of crisis.

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

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.
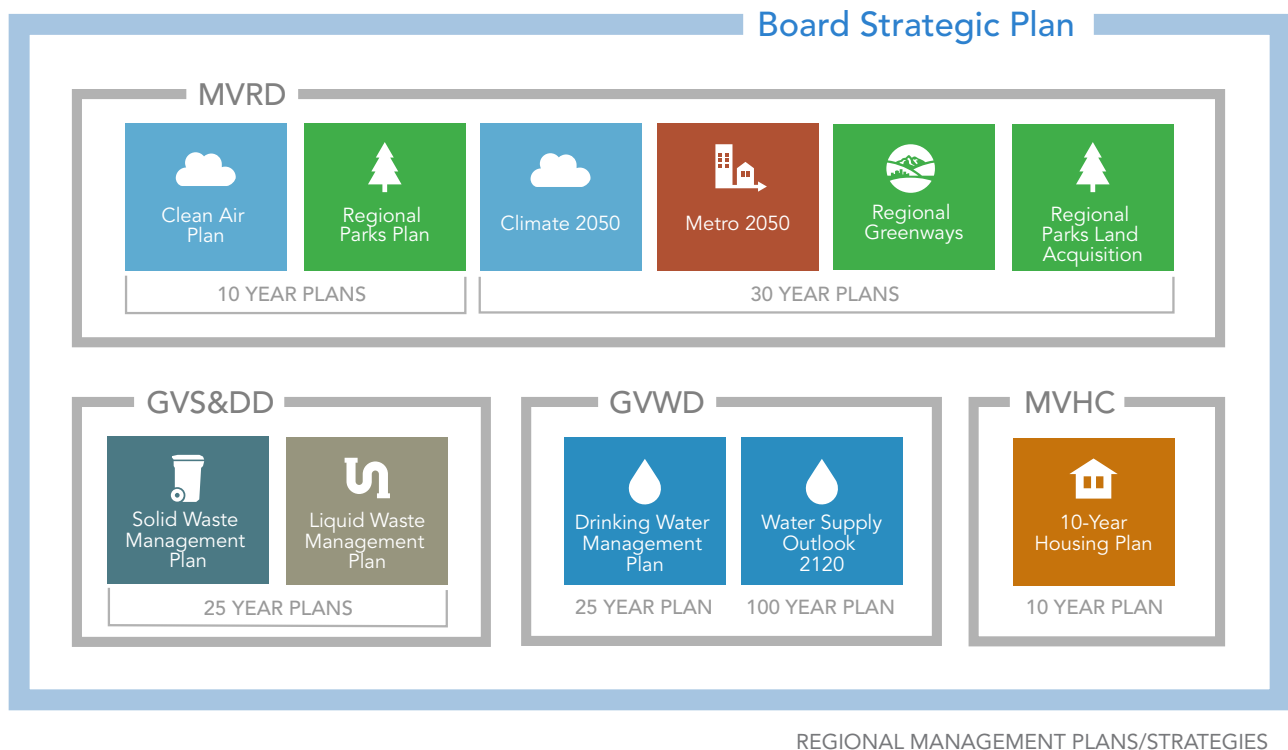
3. **Plan for the Region**

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.

Board Strategic Plan

MVRD

Clean Air Plan	Regional Parks Plan	Climate 2050	Metro 2050	Regional Greenways	Regional Parks Land Acquisition

10 YEAR PLANS	30 YEAR PLANS

GVS&DD

Solid Waste Management Plan	Liquid Waste Management Plan

25 YEAR PLANS

GVWD

Drinking Water Management Plan	Water Supply Outlook 2120

25 YEAR PLAN	100 YEAR PLAN

MVHC

10-Year Housing Plan

10 YEAR PLAN

REGIONAL MANAGEMENT PLANS/STRATEGIES

Metro Vancouver's Roles and Responsibilities for Climate Action

The actions to achieve carbon neutrality and building a more resilient region will depend on the collaborative efforts of many players in the region as well as the federal and provincial government. However, Metro Vancouver has some unique and important roles and responsibilities for advancing climate action.

- Under the *Environmental Management Act*, Metro Vancouver has the delegated authority to provide the service of air pollution control and air quality management and, by bylaw, may prohibit, regulate and otherwise control and prevent the discharge of air contaminants, including greenhouse gases.

- Through the regional growth strategy *Metro 2050*, Metro Vancouver, with its members, plans for compact, complete communities that are foundational to enabling a carbon neutral, resilient region.

- As part of delivering its core services, Metro Vancouver also generates and uses clean, renewable energy from its facilities and is working to ensure core regional services and infrastructure are prepared for and resilient to climate change.

- Invest Vancouver is Metro Vancouver's economic development leadership service with the vision of a dynamic and resilient regional economy that delivers prosperity for all. It aims to foster greater regional collaboration on economic development issues, to advise leaders on sound economic policy and strategy, and to brand the region and its key industries to a global audience with the intention of attracting strategic investment. Invest Vancouver focuses on key export oriented industries in which the region has a productive advantage. This includes many aspects of the green economy, including clean technology, renewable energy and clean transportation.

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

These roles are necessary but not sufficient to achieve our goals of a climate neutral, resilient region. Metro Vancouver will be looking to member jurisdictions, other orders of government, First Nations and other regional partners to lead and collaborate in the implementation of a number of key actions in the *Climate 2050 Roadmaps*.

The Roadmap at a Glance

Climate action to reduce greenhouse gas emissions from industries and business in the region and to build their resilience to the impacts of climate change is at the core of the *Climate 2050 Industry and Business Roadmap*. Commercial activity in the region generates roughly half of the region's total greenhouse gas emissions. As industries and businesses develop and establish their own climate plans, many are already experiencing impacts and disruptions to their operations and supply chains due to climate change.

The *Climate 2050 Industry and Business Roadmap* identifies goals, strategies, and actions for Metro Vancouver and its partners, including businesses, that will contribute towards a carbon neutral and a climate resilient region by 2050. This *Roadmap* focuses on strategies and actions that will reduce emissions from heavy and light industrial facilities and commercial sectors as well as non-road equipment, (e.g., manufacturing, construction, port and trade activities, food processing). In addition, strategies and actions are included for intensifying low carbon procurement by the public sector, and expanding opportunities for carbon capture, utilization, and storage technologies. These strategies and actions are consistent with those adopted as part of the *Clean Air Plan* in 2021. The Roadmap also includes strategies and actions to better understand the region's vulnerability to climate change and enhance the process to increase industries and businesses' resilience to climate hazards.

As part of the transformational change needed in the region, this *Roadmap* aims to provide guidance in to overcome barriers, address challenges and explore new opportunities (see box below) in industries and businesses. Emissions reduction and climate resilience actions for commercial activities related to buildings, transportation, energy, and agriculture are covered in other *Climate 2050 Roadmaps* (references to these other *Roadmaps* can be found throughout the document).

Metro Vancouver, together with its member jurisdictions, has been taking action on climate change for decades. But it has not been enough to achieve the deep reductions in greenhouse gas emissions required and we need to do more to prepare for the impacts climate change is already having on the region. Coordination and collaboration with other orders of government, First Nations, business and industry, and other regional partners will be essential to achieving a carbon neutral and resilient region.

The *Industry and Business Roadmap* lays out actions for reducing emissions and increasing climate resilience, organized under the following strategies:

Strategies for Achieving Carbon Neutrality in Industry and Business:

1 Accelerate Emissions Reduction from Industrial Facilities

2 Reduce Non-Road Emissions and Support Early Adoption of Zero Emission Non-Road Equipment

3 Explore Opportunities for Technological Carbon Capture

4 Reduce Greenhouse Gas Emissions through Procurement and other Business Practices

Strategies for Climate Resilient Industry and Business

5 Assess Climate Vulnerabilities for Businesses in the Region

6 Support Industry and Business Resilience to Flooding through Better Planning and Information

7 Improve Business Resilience to Extreme Heat and Air Quality Events

8 Support Industrial Water Conservation to Increase Resilience to Shifting Precipitation Patterns

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A Vision for Carbon Neutral and Climate Resilient Industry and Business

In 2050, our thriving, diverse regional economy is carbon neutral and resilient to climate impacts. Innovation, creativity, diversity, and carbon neutrality are the characteristics of the Metro Vancouver economy. Businesses operate in zero emissions buildings while people and goods move via zero emissions vehicles and active transportation. Industrial activities have greatly improved energy and material efficiency, shifted to using clean, renewable energy and zero emissions equipment. Through innovation, the region is recognized for advancing innovation in carbon capture, utilization, and storage approaches. Local businesses design and deliver goods and services that are consistent with circular economy principles that generate less waste and minimize emissions of greenhouse gases.

Businesses in the Metro Vancouver region are prepared for and resilient to the impacts of climate change. This is the outcome of a collaborative process to identify climate risks and vulnerabilities to the regional economy and then to develop and implement plans and actions to mitigate the threats from climate change.

The drive to a carbon neutral and resilient region has created the stimulus to make businesses in Metro Vancouver global leaders in the research, development and commercialization of climate solutions. Our low carbon products and expertise in renewable energy, clean transportation, and carbon capture technologies are exported and transferred around the world.

Climate 2050 Industry & Business

Accelerating the transition to carbon neutrality and climate resilience.

The Challenge

While transitioning to a carbon neutral, climate resilient region by 2050 presents opportunities and benefits for business in the region, there are also challenges. Decarbonization across the Metro Vancouver region will require nearly all commercial, institutional, and industrial activity to be powered by clean, renewable energy. This will require rapidly expanding the use of clean renewable energy such as electricity and renewable gas, replacement of thousands of vehicles and pieces of equipment across the region, and investing in new technologies to capture the carbon dioxide that is emitted from chemical processes and any remaining fossil fuel use.

Businesses and governments will also need to plan for and make investments to protect the businesses, residents, and workers within our communities from more frequent flooding, extreme heat events, and other climate impacts that are already locked in and unavoidable given past levels of greenhouse gas emissions. The need to simultaneously reduce emissions while taking action to prevent climate impacts will be a stress on businesses.

Through our engagement with industry and business, we have heard concerns about the actual availability of the technologies and products, the cost of transition, and regulatory certainty. Although many options for clean technologies and clean, renewable energy are already available in the market, it is critical to their widespread adoption that they are competitively priced and more widely available. In the case of specialized applications, some leaps in technical innovation are still needed. New technologies and approaches may cost more for businesses, institutions, governments, and residents. How these costs will be shared across society depends, in part, on government regulations.

The "Barriers and Opportunities" section of this Roadmap explores the unique circumstances of businesses in moving towards carbon neutrality and climate resilience.

Industry and Business in the Metro Vancouver Region

There are more than 100,000 businesses in the Metro Vancouver region, with 1.5 million workers generating GDP in 2019 of $149 billion. These businesses and their workers account for over half of total employment in British Columbia. The businesses comprise a diverse mix of sectors from manufacturing to educational services that have different greenhouse gas emissions profiles and risks associated with climate change.

The regional economy is changing, reflecting the dynamics of a growing metropolitan region that is Canada's Pacific gateway. The strategies and actions in this *Industry and Business Roadmap*, as well as the commercial transportation, commercial buildings, and energy related actions referenced from the other *Climate 2050 Roadmaps* will reduce emissions from a spectrum of businesses, from light and heavy industrial to non-industrial businesses. A number of actions are focused on emissions from industrial businesses (e.g. industrial facilities, non-road equipment) while others are focused on emissions typical of non-industrial businesses (e.g. buildings, vehicle fleet). Climate resilience actions will apply to the spectrum of businesses in Metro Vancouver.

Light to Heavy Industrial Businesses

Non-Industrial Businesses

|	
• **Manufacturing**	• **Accommodation and Food Services**
• **Construction**	• **Retail and Wholesale Trade**
• **Transportation and Warehousing**	• **Health Care and Social Assistance**
• **Utilities**	• **Information, Culture and Recreation**
• **Agrifoods**	• **Finance, Insurance and Real Estate**
• **Professional, Scientific, and Technical Services (including clean technology, digital media, and high tech)**	• **Educational Services**

Invest Vancouver

Invest Vancouver is Metro Vancouver's recently launched economic development service with the vision of a dynamic and resilient regional economy that delivers prosperity for all. Invest Vancouver is a collaboration of leaders from a cross section of the region, including: industry and business associations, community and labour organizations, port authorities, Boards of Trade and Chambers of Commerce, academic institutions, agriculture, First Nations, and Metro Vancouver Directors.

With a mission to position our region for success in a rapidly evolving global economy, Invest Vancouver exists to foster greater regional collaboration on economic development issues, to advise leaders on sound economic policy and strategy, and to brand the region and its key industries to a global audience with the intention of attracting strategic investment.

Climate Change Impacts on Industry and Business

Our region's network of communities, businesses, workers and customers are already being impacted by the climate changes that are locked in due to historic emissions, and these impacts are projected to accelerate despite the significant reductions in greenhouse gas emissions that we aim to achieve in the coming years and decades. The uncertainty created by a shifting climate and the need for resilience means governments and businesses need to think differently about infrastructure and planning.

EXPECTED CLIMATE CHANGE IMPACTS
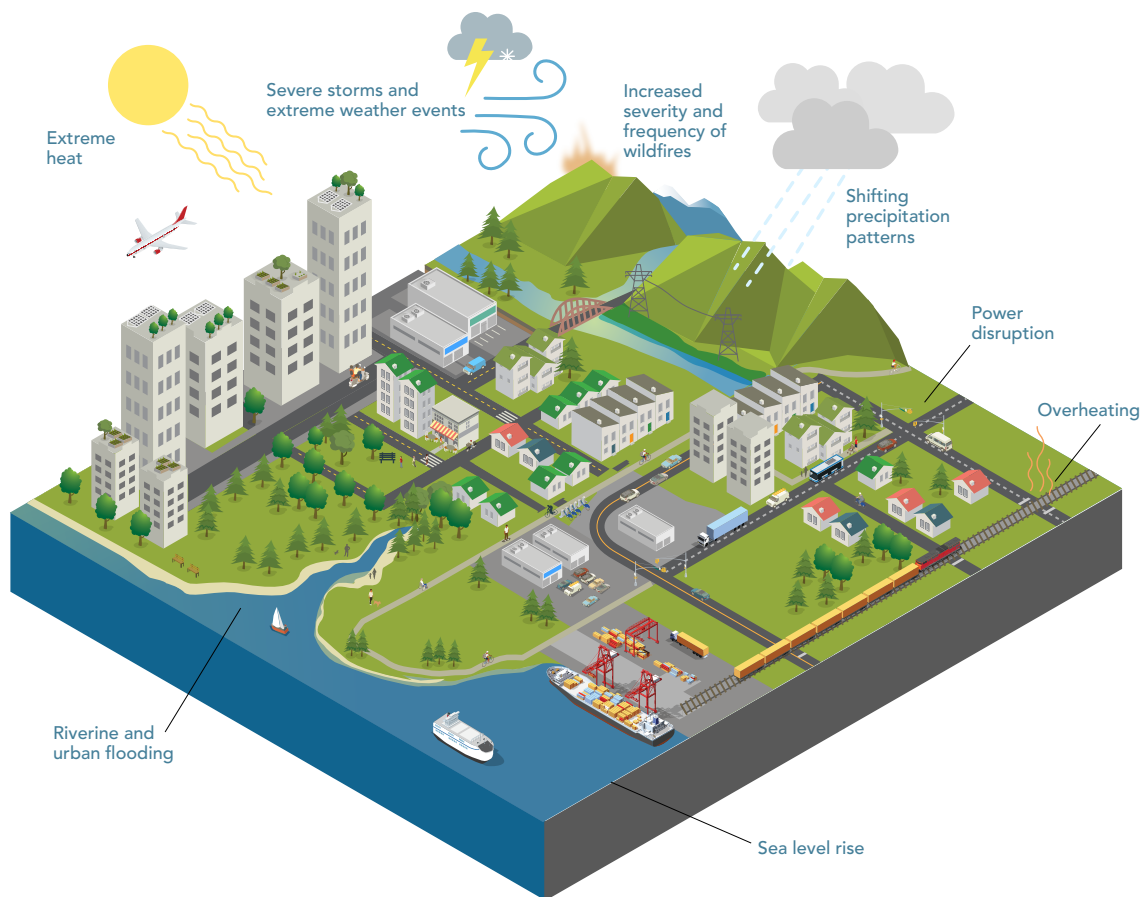
Recent climate-influenced events, including heat waves, forest fires, and extensive flooding, exposed how susceptible infrastructure and commercial activities are to the impacts of a changing climate. Businesses that were directly impacted by floods or fires experienced loss or damage to their assets, and their workers may have seen impacts on their health and safety. In addition, many businesses suffered from disruptions in their supply chains due to failures in the transportation systems.

Across the region, many businesses and industrial land use are in areas that are more vulnerable to flooding and sea level rise. Metro Vancouver has a role to work with governments and other regional partners in planning for and strengthening resilience of industrial land to these climate impacts.

The scientific projections of climate change and their impacts indicate that we can expect the following changes and impacts in Metro Vancouver into 2050:

Climate Changes

Warmer temperatures: with increasing daytime and nighttime temperatures, there will be more hot summer days and fewer winter days with frost or ice.

Longer summer dry spells: summer rainfall will decline by nearly 20%, with increased likelihood of extended drought periods.

Wetter fall and winters: although on average the total annual rainfall is expected to increase by just 5%, there will be a large increase in rainfall during fall and winter.

More extreme precipitation events: more rain will fall during the wettest days of the year and the frequency of extreme rainfall events will increase.

Decreased snowpack: the deep spring snowpack in the mountainous watersheds is expected to decrease by over 50% compared to present day.

Sea level rise: in addition to these weather-related changes predicted in our region, warming global temperature is projected to bring at least 1 meter of sea level rise by 2100, which will impact coastal areas in the region.

Impacts Felt

Heatwaves can impact the safety and comfort of workers due to increased indoor temperatures in commercial buildings and outdoor work environments, where cooling may be inadequate. Heatwaves can also change the operational needs of certain businesses (e.g., refrigerated warehousing and transportation, agriculture.)

Poor air quality from wildfire smoke events, which can compound impacts with existing sources of air contaminants (e.g., ground-level ozone, pollution from traffic and industry). Disruptions to business operations can occur when workers' health and safety is compromised due to poor air quality.

Power disruption due to overloaded grids from increased demand from cooling systems, and from shock events including flooding and storms.

Riverine, coastal and urban flooding caused by periods of heavy rainfall during extreme weather events (e.g., storms), rapid snowmelt, or a combination of both. This can lead to localized flooding in industrial sites and commercial spaces, and disruptions to the commercial transportation system, including truck routes and rail lines which could have cascading effects for supply chains.

Reduced water supply as a result of reduced snowpack and hotter, drier summers that can strain drinking water supplies during times of the year when demand is the greatest.

Sea level rise in coastal areas of our region will increase flood risk for industrial facilities and commercial activities located in low elevation areas, including the ports. Sea level rise can also magnify the impact posed by other hazardous conditions in coastal areas such as subsidence (land sinking), king tides and storm surges, and heavy winds and precipitation caused by storms.

Regional Emissions from Industry and Business

Industrial facilities contribute approximately 17% of the 15 million tonnes of greenhouse gas emissions in the Metro Vancouver region, and when all industrial and business-related activities are considered (including non-road equipment, commercial buildings and transportation), this proportion rises to roughly half of all emissions. The graph below captures the range of activities that generate the region's total greenhouse emissions in Metro Vancouver. Industrial facilities accounted for 2.5 million tonnes (17%) and non-road equipment, 1 million tonnes greenhouse gas emissions (7%), respectively.

| **29%** RESIDENTIAL TRANSPORTATION | **17%** INDUSTRIAL FACILITIES | **14%** RESIDENTIAL BUILDINGS | **11%** COMMERCIAL TRANSPORTATON |
| | **16%** COMMERCIAL BUILDINGS | **7%** NON-ROAD ENGINES / **4%** AGRICULTURE / **3%** OTHER | |
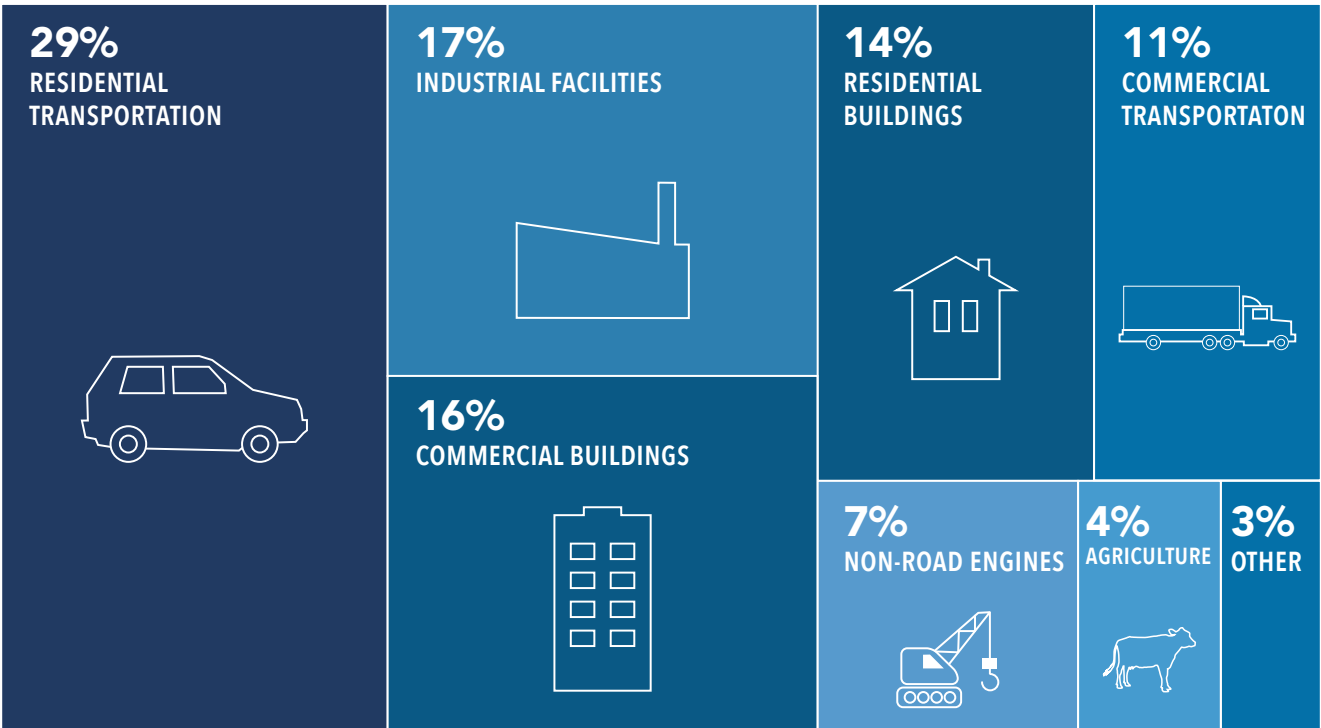
In addition, commercial transportation associated with goods movement (e.g., heavy duty truck, rail, marine and air) and commercial buildings account for about 11% and 16% of regional greenhouse gas emissions, respectively. (Note a small portion of light duty vehicle emissions are also associated with commercial transportation, such as taxis and couriers.) Agricultural activities account for 4% of regional emissions. More information about these emission sources are provided in the *Climate 2050 Roadmaps* for *Transportation, Buildings, and Agriculture.*

The Connection between Climate Change and Air Quality

The *Clean Air Plan* is Metro Vancouver's air quality and greenhouse gas management plan. Actions in the Plan will reduce air contaminant emissions and impacts, including greenhouse gases, in our region over the next 10 years, and in doing so support the interim target of a 45% reduction in greenhouse gas emissions by 2030, and establish the foundation for the 30-year goal of a carbon neutral region by 2050. This management plan also addresses air quality targets for the region.
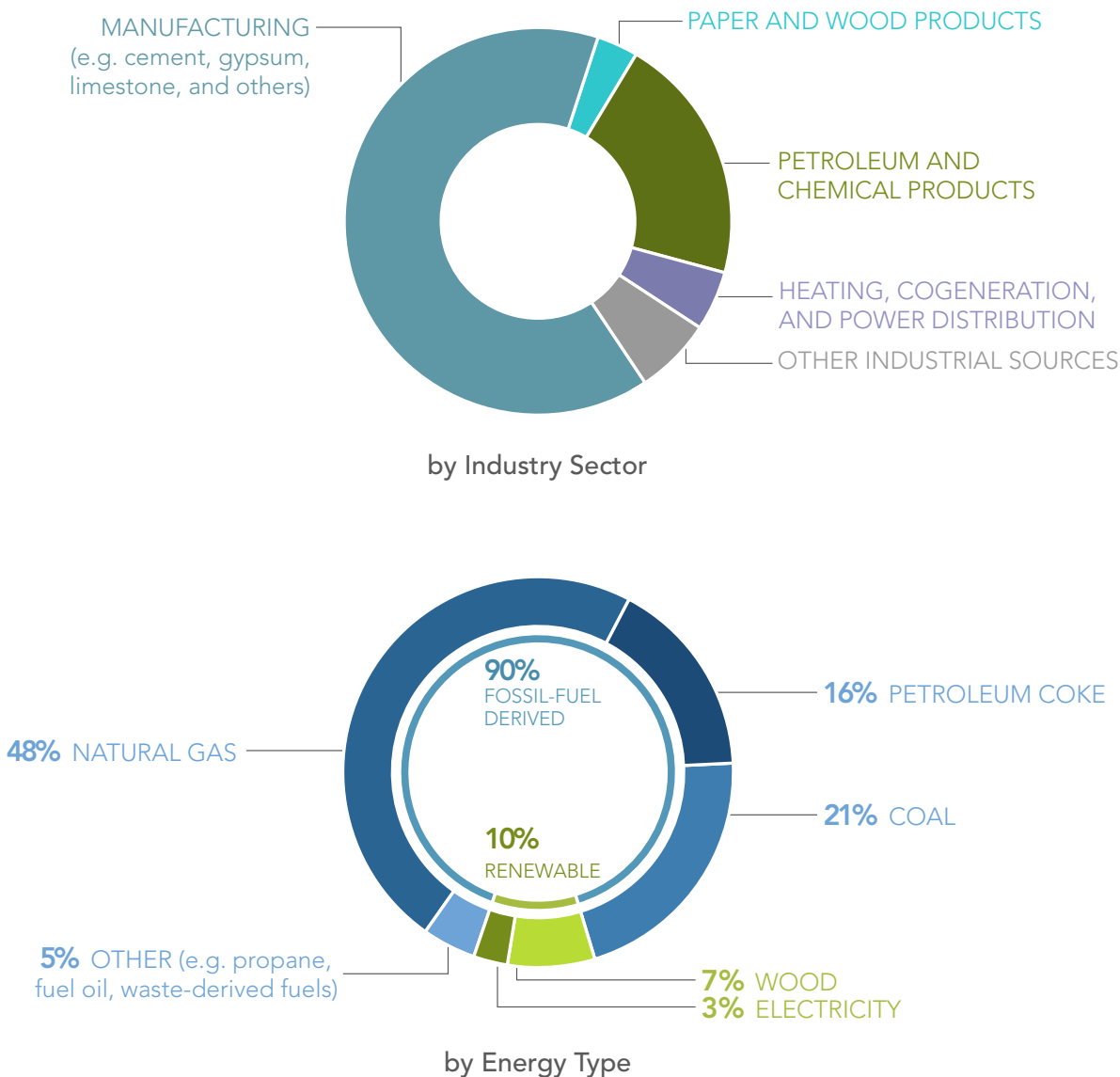
Residents in the region generally experience good air quality. However, health researchers have demonstrated that there are no known safe levels for some air contaminants that are harmful to human health. In the Metro Vancouver region, commercial activities are a significant source of regional greenhouse gas emissions, as well as emissions of health-harming air contaminants that impact regional air quality. Industrial facilities and non-road equipment generate over 25% of nitrogen oxides, over 40% of particulate matter, and over 50% of sulphur oxides produced in the region. Commercial transportation, commercial buildings and agriculture also generate health harming air contaminants.

Metro Vancouver is responsible for managing and regulating air contaminants in the region, including greenhouse gases, under its authority delegated by the BC Government in the *Environmental Management Act*. Metro Vancouver uses this authority to establish emission requirements for industrial facilities and non-road equipment (and other sources) through regulations and permits. The *Clean Air Plan*, Metro Vancouver's air quality and greenhouse gas management plan, will reduce health-harming air contaminant emissions and impacts in the region through to 2030. Many actions that reduce health-harming air contaminants will also reduce greenhouse gas emissions thereby supporting the goal of becoming a carbon neutral region by 2050.

Emissions from Light and Heavy Industrial Facilities

Industrial facilities in the Metro Vancouver region manufacture and process products such as cement, petroleum, gypsum, limestone, paints and chemicals, wood and paper, metal, and food. The greenhouse gas emissions from these industrial facilities are primarily generated from burning fuel during the manufacturing process. More than 75% of the energy used to operate industrial facilities are fossil fuels such as natural gas, coal and coke (see Figure 1). In some cases, the manufacturing process for a product or good (e.g., cement, limestone) includes chemical reactions that release significant quantities of greenhouse gases such as carbon dioxide.

FIGURE 1:
BREAKDOWN OF INDUSTRIAL FACILITY GREENHOUSE GAS EMISSIONS[1]

MANUFACTURING (e.g. cement, gypsum, limestone, and others)

PAPER AND WOOD PRODUCTS

PETROLEUM AND CHEMICAL PRODUCTS

HEATING, COGENERATION, AND POWER DISTRIBUTION

OTHER INDUSTRIAL SOURCES

by Industry Sector

90% FOSSIL-FUEL DERIVED

10% RENEWABLE

48% NATURAL GAS

16% PETROLEUM COKE

21% COAL

7% WOOD

3% ELECTRICITY

5% OTHER (e.g. propane, fuel oil, waste-derived fuels)

by Energy Type

1   Based on 2015 Metro Vancouver Regional Emissions Inventory

Emissions from Non-Road Engines

Non-road equipment is used in many industries and businesses in the region and generates greenhouse gas emissions from the use of diesel or gasoline. Non-road equipment includes cranes, loaders, forklifts, generators, lawnmowers, and other mobile equipment not used for transportation. Industries with the two largest sources of greenhouse gas emissions from non-road equipment are construction and cargo-handling. The use of non-road equipment contributes about 7% of the region's total greenhouse gas emissions.

FIGURE 2:
BREAKDOWN OF NON-ROAD EQUIPMENT GREENHOUSE GAS EMISSIONS BY ENERGY TYPE[2]

by Energy Type
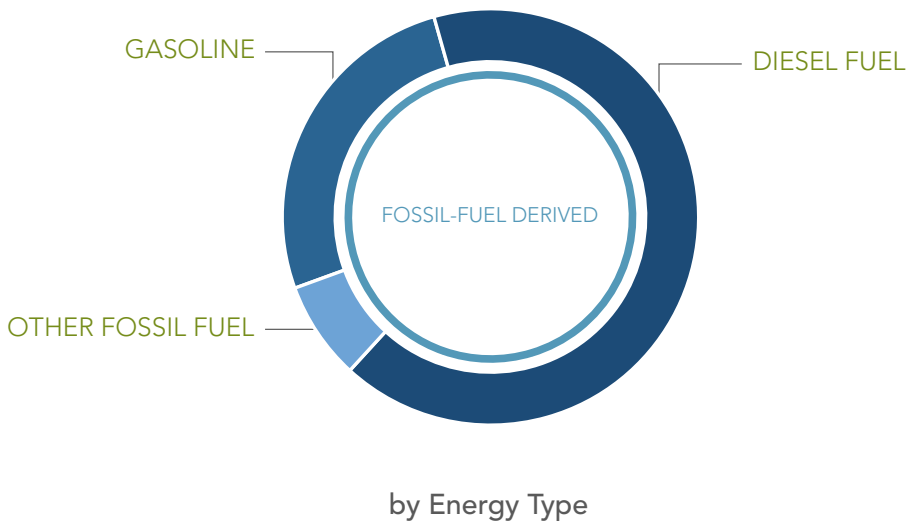
2   Based on 2015 Metro Vancouver Regional Emissions Inventory

Achieving Deep Emissions Reduction in Industry and Business

Nearly all businesses in the region, from small to large, generate greenhouse gas emissions from the use of fossil fuels. Some manufacturing activities also generate emissions from chemical processes. The main technological options for significant emission reductions include: a shift to clean, renewable sources of energy; scaling up adoption of low to zero emission vehicles, engines and equipment; prioritizing use of low carbon materials; and advancing and adopting carbon capture, utilization, and storage technologies. To achieve the deep emissions required to achieve carbon neutrality, adoption of this suite of decarbonization approaches will need to begin now.

Clean, Renewable Sources of Energy

Switching to clean, renewable energy is a central strategy for reducing greenhouse gas emissions across the region. The use of high efficiency electric heat pumps is an effective way of achieving deep emissions reductions wherever lower temperature heat is required, including for space and water heating within industrial and commercial facilities. Higher temperature thermal processes (e.g., in cement production) may require combustion of low carbon biofuels (e.g., renewable gas) or hydrogen instead of fossil fuels.

Hydrogen is expensive to produce and technologically challenging to distribute, store, and use, but it is a promising energy carrier that could be used to decarbonize some hard-to-electrify activities, such as in heavy-duty transportation and industrial applications. The BC Government has developed the *BC Hydrogen Strategy* to guide the transition to hydrogen as a low carbon energy source. The Government of Canada has also developed the *Hydrogen Strategy for Canada* as a framework to position Canada as a world-leading producer, user and exporter of clean hydrogen, and associated technologies.

It is important to recognize that use of low carbon biofuel or hydrogen, while reducing greenhouse gas emissions, may result in emissions of health-harming air contaminants. In addition, an increased demand for the organic feedstock (such as agricultural products or residues, wood waste, or fats from rendering) that are used to generate renewable energy could also have impacts on our agricultural systems, forests, and other ecosystems. An assessment of lifecycle greenhouse gas emissions from renewable energy sources can quantify the environmental impacts associated with all the stages of production and use and can guide decision making on the selection of an energy source.

Powering vehicles and buildings by clean electricity will also be an important strategy for reducing greenhouse gas emissions from commercial and business activities. (see the *Climate 2050 Transportation, Buildings, and Energy Roadmaps* for more detail).

Switching to clean, renewable energy sources will require capital investment, and its use may cost more on per unit basis than fossil fuel energy. These additional costs will need to be offset by energy efficiency improvements and transition support from utilities and governments. To learn more about clean, renewable energy supply, see the *Climate 2050 Energy Roadmap* for more detail.

Zero Emission Non-Road Engines and Equipment

Electrification of non-road equipment is evolving and low-emission technologies have significantly advanced in recent years. Policy actions such as the requirements for cleaner engine standards can accelerate the transition towards low or zero emission equipment, as well as those that accelerate uptake of currently available options. Switching to zero emission non-road equipment not only leads to reductions in greenhouse gas emissions but may also result in improved air quality where that equipment is used, which can benefit worker health.

Electric non-road equipment is becoming increasingly available for various applications, including construction and demolition, commercial and warehousing operations, cargo-handling, and lawn and garden maintenance. Governments can support the uptake of electric equipment through supportive incentives, regulations, and the provision of appropriately located charging infrastructure.

Low carbon biofuels can also play a role in reducing emissions from non-road equipment. Engines that currently use liquid fossil fuels can be readily switched to using biofuels such as ethanol and renewable diesel. While the use of some types of biofuels may require engine modifications, others, such as renewable diesel, can be used directly in conventional engines see the *Climate 2050 Energy Roadmap* for more detail on clean, renewable energy.

Photo credit from Volvo CE develops full power of electric ecosystem with E Worksite

Getting Down to Business
Zero Emission Construction Sites

Cities across the globe are leading the charge to reduce emissions from their non-road equipment fleets. In Oslo, Norway, a pilot program using electric non-road equipment for municipal construction and maintenance projects. This pilot is part of its commitment to achieve zero emissions for all municipal construction sites by 2025 and for all construction sites (public and private) to be zero emissions by 2030. A similar program in Gothenburg, Sweden called "Electric Worksite" involves partnering with manufacturers to test the requirements of zero emission electric construction and maintenance equipment, with the objective to encourage wider adoption. Within North America, California's small off-road engine regulation requires small non-road engines, such as maintenance equipment and portable generators, to be low- to zero emission beginning in 2024.

Prioritization of Low Carbon Products and Services

Most activities involved in providing goods and services (such as design, logistics, manufacturing, transportation, and waste management) are linked to greenhouse gas emissions. The embodied emissions of a good or service is a way of quantifying the emissions associated with its production, transportation, use and disposal. Compared to direct greenhouse gas emissions associated with fossil fuel use and industrial operations, embodied emissions are more complex to estimate, and are not yet widely tracked or reported.

Better understanding of embodied emissions could inform public and corporate procurement policies and programs to advance the use of low carbon products and services, and could reduce greenhouse gas emissions both within and outside our region. Production and procurement of low carbon products should be prioritized to help generate and support jobs in a decarbonized climate-ready future.

Getting Down to Business
Low Carbon Procurement Policies

Governments are implementing measures to support low carbon products in their public procurement processes. The Buy Clean California Act (established in 2017) aimed to limit and reduce embodied (supply chain) emissions in public infrastructure projects. In 2020, Marin County in California set limits for greenhouse gas emissions from concrete products. Similarly, the Bay Area Low Carbon Concrete Code requires all projects using concrete to meet strict emissions intensity standards. Within Canada, the City of Langford within the Capital Regional District may be the first local government to adopt a low-carbon concrete policy. The policy will take effect in mid-2022, and requires municipal projects to submit a third-party verified Environmental Product Declaration (EPD) to track the environmental impacts of purchased concrete materials and demonstrate lower GHG intensity than category benchmarks.

Advancement in Carbon Capture, Utilization, and Storage Technologies

Carbon capture, utilization, and storage refers to technologies that capture carbon dioxide from high-emitting applications, (e.g., cement manufacturing) as well as technologies that remove carbon directly from the atmosphere, and then safely and permanently store the captured gas. These technologies will be required in a relatively small number of industrial and commercial activities that still generate large amounts of greenhouse gases after more conventional efforts to reduce emissions have been adopted. Specific carbon capture, utilization, and storage technologies are advancing at different rates, and some are poised to be used in commercial and industrial applications already. Additional innovation and investment in these technologies and the infrastructure to support them will be necessary for large-scale carbon capture projects, and to find effective, safe and permanent storage solutions. Enabling policies and financial mechanisms (e.g., increasing the price of carbon emissions), are likely to be needed to support the expanded use of carbon capture, utilization, and storage technologies.

Building Climate Resilience in Industry and Business

Building climate resilience for industry and business means addressing the range of climate-influenced hazards that can impact individual businesses and whole business sectors. Examples include: more frequent flooding and landslides due to extreme precipitation; extreme heat; and wildfire smoke.

As Canada's gateway to the Pacific, Federal, Provincial and local governments will need to plan to adapt the region's transportation infrastructure (road, marine, rail, and air) to be resilient to the threats posed by a changing climate. A resilient regional transportation system will be critical for businesses to maintain reliable connections to local or international supply chains. Likewise, businesses will need to ensure that buildings and facilities in which they operate have sufficient cooling and enhanced air filtration to protect workers during more frequent extreme heat and air quality events. Strengthening industry and business resilience to these and other climate impacts will require a shift in planning and investment by both governments and the private sector, informed by up to date climate information.

Awareness of Climate Risks and Vulnerabilities to Business

Connecting businesses to available and appropriate climate data and potential climate impacts can increase understanding of climate risks and the basis for evaluating risk response options. Some jurisdictions have used a "cluster" approach (based on similar climate risks and supply chains) to help tailor climate data, climate resilience tools and guidance for the region's industries and businesses (see example in call-out box).

Getting Down to Business
Italy's Industrial Cluster Approach to Climate Resilience

Industries in Italy have developed a cluster approach to building resilience to the impacts of climate change. The Improve Resilience of Industry Sector (IRIS) program aims to support businesses, especially small and medium sized ones, in becoming more climate resilient through identification of specific adaptation measures. Businesses belonging to the same production area or belonging to the same production chain are grouped in "industry clusters" to assess the associated climate risks and to develop a cluster specific climate adaptation plan.

The program includes operational solutions that are analyzed and proposed to businesses whose production, facilities, or infrastructure may be increasingly at risk for disruptions due to climate influenced events. IRIS actions include: carrying out climate risk assessment in pilot clusters; developing climate adaptation plans in pilot clusters; analyzing opportunities related to financial and insurance tools for business resilience; and developing a web portal for a climate risk self-assessment.

IRIS is the first project in Europe focused on climate change effects in the industrial sector and suggests the cluster approach to increase business resilience. This approach is particularly interesting for small and medium enterprises because it fosters sharing of resources and skills.

SOURCES: IMPROVE RESILIENCE OF INDUSTRY SECTOR (IRIS)

Preparation for Climate Impacts Projected for the Region

Climate change projections are anticipated to impact communities and businesses in the region as was witnessed during the climate-driven extreme weather events in 2021. Businesses can take action now to better manage exposure to risk and minimize damages to their assets. Examples of future-proofing business operations and processes include:

- add space cooling in buildings to prepare for hotter summers,

- improve air filtration in buildings to manage wildfire smoke events,

- prepare heat response plans to protect workers and operations, and

- ensure buildings and other assets in flood prone areas can withstand flood events.

While businesses must manage their own assets and business operations, governments and utilities will need to ensure that the infrastructure that businesses and residents depend on is resilient to extreme events and other climate impacts, including:

- plan for flood protection during severe storms,

- provide reliable access to utilities (e.g., power, water, sewer, fiber optic), and

- ensure a reliable transportation network for the supply chain.

Metro Vancouver's regional growth strategy, *Metro 2050* and *Climate 2050's Land Use and Urban Form Roadmap*, currently in development, will include new policies to strengthen climate resilience action. Metro Vancouver's Regional Industrial Lands Strategy (RILS) establishes a vision on the future of industrial lands in the region, recognizing the role of industrial lands to promote prosperity and sustainability and to provide space for industrial services needed in our growing region. The RILS recognizes the climate risks such as flooding that may impact some industrial land and activities.

Getting Down to Business
Resilient Industry Initiatives

The City of New York developed a resilient industry toolkit that was designed to support industrial businesses located within NYC's floodplain to cost-effectively adapt to climate change. The toolkit includes an overview of flooding vulnerability in industrial areas and identifies relevant flood resilience practices that can be implemented by businesses. Other elements of the toolkit include illustrations and cost estimates for adaptation actions for prototypical waterfront sites (e.g., film studio, warehouse, brewery). The overall program is an example of a public-sector approach to building resilience in specific industrial sectors.

Lower Mainland Flood Management Strategy

The Fraser Basin Council has been leading a multi-year project to develop the Lower Mainland Flood Management Strategy (LMFMS) aimed at reducing flood risk and improving the flood resilience of communities along BC's lower Fraser River and south coast. The LMFMS brings together decision-makers including the Government of Canada, the Province of British Columbia, Lower Mainland local governments, First Nations and non-governmental and private sector entities in the region to work collaboratively on flood management.

Barriers and Opportunities

Alignment in Climate Policies

Policy and regulatory certainty is important for businesses to make long-term capital investments and changes to their practices and procedures consistent with reducing greenhouse gas emissions and increasing their resilience. Businesses are faced with a complex regulatory environment designed to advance climate, social and environmental objectives so the objectives and targets must be clear. In addition, the climate policies and regulations of all levels of governments must be aligned in order to ensure that they are not in conflict, as well as creating a level playing field to ensure that competing businesses are required to meet the same standards and assume similar costs. Alignment of policies across jurisdictions is essential to prevent carbon leakage (see box).

Metro Vancouver recognizes its responsibility to analyze the impact of federal and provincial climate policies, including carbon pricing and border carbon adjustment policies, on regional businesses before developing policies and regulations to reduce greenhouse gas emissions while minimizing the impact on the regional economy.

Carbon Leakage in Industry and Business

Carbon leakage refers to an economic scenario when stringent climate regulations in one jurisdiction push businesses or commercial activities to move to a jurisdiction with weaker climate regulations. In this situation, global greenhouse gas emissions are not reduced. Instead the activity creating emissions just moves elsewhere and may lead to an overall increase in emissions depending on the energy source in the new location and longer shipping distances. Businesses moving out of the region to avoid more stringent emission regulations will likely result in negative economic impacts including job loss and reduced tax revenues.

The "energy-intensive, trade-exposed" industries that operate within the Metro Vancouver region may be at a higher risk for carbon leakage. Energy-intensive, trade-exposed industries are generally capital intensive, require large amounts of energy to operate, generate emissions inherent in the chemical processes, and compete internationally for markets at home and abroad. These industries include cement, lime and gypsum, and chemicals. The capital intensive nature of these businesses means that planning for the replacement and retrofitting of equipment typically occurs over longer time frames.

Market Availability and Cost of Zero Emission Technology

Although many of the technologies and products necessary to rapidly reduce greenhouse gases are already available in the market (e.g., electric passenger vehicles, heat pumps for space heating), in other cases, equipment for specialized applications (e.g., industrial heat pumps, medium/heavy-duty electric vehicles) are not widely available or cost significantly more than their conventional, higher emission counterparts.

The availability of zero emission non-road equipment is a good example. Electric options are available for certain applications (e.g., forklifts), while other technologies (e.g., construction equipment) are not yet widely available in the region, though they are becoming available in other markets. Some types of non-road equipment that already have electric options available (e.g., generators), can still be prohibitively expensive for many industrial and commercial applications compared to their fossil fuel counterparts. Government incentives and other financial support can help offset the cost of adopting zero emission technologies.

Innovation and Technological Development

Certain economic sectors will require significant innovation and technological development to achieve cost effective deep emission reductions and reach carbon neutrality. Carbon capture, utilization, and storage is an example of technology that requires further development to bring down its cost and make it feasible for different sector applications. Other technological areas that require investment in research and development, pilot testing, and finally broad commercialization include new building components and energy storage. The drive to innovate emissions reduction and resilience solutions creates opportunities for job and business growth.

Workforce Transition and Equity in a Low Carbon, Climate Resilient Economy

The impacts of climate change and the shift towards a carbon neutral and climate resilient region are affecting workers, businesses, and communities in different ways. Supportive measures such as training, re-skilling and education incentives, public and private investment stimuli, and other initiatives will be needed to support this transition. The *Climate 2050 Buildings Roadmap* includes actions to support workers transition as the market demand for zero emissions and resilient building design, technology, installation and operation grows. Workers in other sectors (e.g. transportation, manufacturing) will also need targeted support. Managing this transition will require strong commitments from and collaboration with all orders of government, First Nations, and other regional partners to build capacity and knowledge, and increase investments and support for workers.

The transition to a low carbon and resilient economy should also advance the equitable distribution of benefits and avoid an inequitable distribution of costs. Metro Vancouver will work with partners to incorporate the voices and needs of a full range of communities in the implementation of this Roadmap to ensure that fairness and equity are a high priority.

Infrastructure Investment to Support Greenhouse Gas Reductions and Climate Resilience

Investment in public and private infrastructure consistent with deep emissions reduction and strengthening climate resilience is essential moving forward. Significant investments in the electrical grid (e.g., distribution lines, transformers) will be required to support charging for electric vehicles and non-road engines and electrification of buildings and industry. Similarly, changes to the natural gas distribution system may be required to allow hydrogen to be distributed within the system. Enabling carbon capture at a large scale will likely require repurposing some of the region's pipeline infrastructure to transport captured greenhouse gases to storage areas outside the region.

Investments in public infrastructure also underpin industry and business climate resilience. As one example, diking infrastructure is key to protecting industrial and agricultural land that is often located in low lying areas near the region's rivers and coastline. In 2012, the BC Government estimated that the dikes in the Lower Mainland required $9.5 billion in upgrades to address climate and seismic risks. Much of the land protected by these dikes is used for commercial purposes.

Integrating Climate Considerations in Normal Business Practice

As described above, climate change is already impacting industry and business and the transition to a carbon neutral, resilient future will touch on the operations of many businesses. To manage this transition and to be better able to respond to the uncertainty caused by climate change, businesses need to incorporate climate considerations into normal business practice. This may involve accounting for climate risk as part of the existing risk assessment of a business (see box on Managing Climate Risk). Businesses can also incorporate the tracking of greenhouse gas emissions as part of financial reporting to better integrate financial decisions with emissions reduction.

Consumers can be active in driving the demand for low carbon products. This can be supplemented by procurement policies of business, governments and institutions that support the growth of businesses supplying low carbon products to the market.

Managing Physical and Transition Risks of Climate Change

Climate-related risks are often classified into two broad categories: physical and transition risks. Physical risks arise from the changes in weather and climate that impact businesses, supply chains, and the availability of labour, as described above. A changing climate and the transition to a low carbon economy also creates transition risks for businesses, affecting their profitability and competitiveness. Transition risks can be subdivided into several types:

- **Policy and Legal Risks –** the potential for financial impact due to policy changes such as carbon pricing, regulation, regulations around land-use, or legal risk as a result of litigation for failure to mitigate impacts to climate change or enact sufficient adaptation measures.

- **Technology Risk –** technological changes that support the transition to a low carbon economy, including renewable energy technology, could affect the competitiveness of certain industries.

- **Market Risk –** shifts in supply and demand for products and services create a wide range of risks to businesses.

- **Reputational Risk –** consumer and community perceptions of different industries and businesses may change as a result of an organizations perceived contribution to, or detraction from the transition to a low carbon economy.

Disclosure of Climate-Related Risks

In response to investors, governments and other stakeholders seeking to better understand how businesses manage risks. The Task Force on Climate-related Financial Disclosures (TCFD) has emerged as a globally-accepted framework that provides guidance and best practices for businesses to report on climate-related risks. Financial regulators in several jurisdictions, including in Canada, are moving towards requiring publicly-traded companies to disclose climate-related risks. In addition, local governments are considering the value of implementing TCFD.

TCFD or similar frameworks can help identify and quantify climate-related risks to key decision makers within an organization and to external parties. It allows climate risk to be assessed in line with other risks and provides a means to incorporate climate risks, and opportunities, into organizational budgeting and capital planning activities while pushing companies to formalize their climate strategy, metrics and targets to better assess and manage their climate risk.

The Journey to Carbon Neutrality and Resilience

Linkages to other *Climate 2050 Roadmaps*

There are linkages to the industry and business sector in the other *Climate 2050* roadmaps. You can find additional information on these topics in the following:

- **Buildings Roadmap –** actions to reduce emissions from space and water heating in commercial buildings and adapt commercial buildings to climate impacts.

- **Transportation Roadmap –** actions to reduce emissions from the vehicles and other modes of transportation used for the movement of goods (e.g. freight movement, urban deliveries), raw materials, products between industries and consumers, as well as for connecting people from their homes and communities to their places of work.

- **Agriculture Roadmap –** actions to reduce emissions from agricultural activities, operations, and agricultural equipment.

- **Waste Roadmap –** additional consideration of embodied emissions in goods and materials and as part of the circular economy, and final disposal of materials.

- **Land-use and Urban Form Roadmap –** strategies and actions will inform industrial and commercial land planning in response to climate change. It is strongly linked to the regional growth strategy, which sets land use and transportation policies for the region.

- **Energy Roadmap –** actions to increase the use of clean, renewable energy by industry and businesses.

- **Nature and Ecosystems Roadmap –** actions and ideas that protect, connect, and integrate natural, enhanced and engineered systems to store carbon, help communities and businesses adapt to climate change.

CONNECTING THE *CLIMATE 2050 INDUSTRY AND BUSINESS ROADMAP* AND THE *CLEAN AIR PLAN*

Clean Air Plan	Industry and Business Roadmap
• Greenhouse gas reduction goals, strategies and actions.	• Greenhouse gas reduction goals, strategies and actions.
• Air quality goals, strategies and actions.	• Resilience strategies for industry and business
• Goals, strategies and actions for other sectors such as buildings and transportation.	• Challenges, opportunities and benefits of transitioning industry and business towards a decarbonized future.

Climate Goals and Targets for Industry and Business

Metro Vancouver's *Climate 2050 Strategic Framework* has set the following regional vision to guide the region's response to climate change:

- Metro Vancouver is a carbon neutral region by 2050

- Infrastructure, ecosystems, and communities are resilient to the impacts of climate change

Metro Vancouver has also set a regional target of 45% reduction in greenhouse gas emissions from 2010 levels, by 2030.

Achieving this vision means setting goals in each of the *Climate 2050 Roadmaps*, organized by sectors in the region, and contributing towards getting to a carbon neutral, resilient region.

Metro Vancouver has set the following climate goals for industrial and non-industrial businesses in the region to help visualize the region we will live in, and to track progress out to 2030 and 2050. The table below includes goals and targets for industrial facilities and non-road equipment (page 35).

The goals and targets for commercial buildings, commercial transportation and agriculture are also listed (pages 35-38). Refer to the *Climate 2050 Roadmaps* for Buildings, Transportation, and Energy for more information on the strategies and actions associated with these goals.

What is a Carbon Neutral Region?

A carbon neutral region means that we have achieved the deepest greenhouse gas emissions reductions possible across all economic sectors, and any emissions left are balanced out by the carbon dioxide removed from the atmosphere by the plants, trees, and soil in the region, as well as by potential carbon capture technologies that are under development.

Greenhouse Gas Emission Reductions

The long-term goal is that Industry and Business is carbon neutral by 2050.

◎ Goals	◎ Targets
All industrial facilities are carbon neutral	**By 2030:** • A 35% reduction in greenhouse gas emissions from industrial facilities from 2010 levels. **By 2050:** • All industrial facilities are carbon neutral.
All non-road equipment operating within the region use zero emission technologies powered by clean, renewable energy.	**By 2030:** • 35% reduction in greenhouse gas emissions, from 2010 levels. **By 2050:** • 100% reduction in greenhouse gas emissions.
Commercial Transportation	
All medium and heavy duty trucks and rail locomotives operating within the region use zero emission technologies powered by clean, renewable energy.	**By 2030:** • 35% reduction in greenhouse gas emissions, from 2010 levels. **By 2050:** • 100% reduction in greenhouse gas emissions. • All medium duty trucks are zero emission, powered by clean, renewable electricity or hydrogen. • All heavy duty trucks and rail locomotives use either zero emission technologies or biofuels.
All aircraft and marine vessels operating within the region use low emission and zero carbon technologies powered by clean, renewable energy.	**By 2030:** • 35% reduction in greenhouse gas emissions, from 2010 levels. **By 2050:** • 75% reduction in greenhouse gas emissions, from 2010 levels.

◎ Goals	◎ Targets
Commercial Buildings	
All buildings are zero emissions from heating and cooling by 2050.	**By 2030:** • 35% reduction in greenhouse gas emissions from buildings, relative to 2010 levels. • All new buildings are zero emissions in their operations. • All new buildings produce 40% less embodied emissions from construction. **By 2050:** • All buildings are zero emissions in their operation, deriving all energy needs from 100% clean and renewable sources. • All new buildings are carbon neutral in their embodied emissions from construction.
Energy	
All of the energy used in Metro Vancouver is derived from clean, renewable sources	**By 2030:** • 60% of the energy used in the region is derived from clean, renewable sources **By 2050:** • All buildings are zero emissions in their operation, deriving all energy needs from 100% clean and renewable sources. • All new buildings are carbon neutral in their embodied emissions from construction.

Climate Adaptation

Goals	Targets
The region's industries and businesses are resilient to the current and future impacts of climate change.	**By 2030:** • All industrial facilities have identified existing, unmitigated climate hazards that could impact their operations and supply chains. **By 2050:** • 100% of the energy used in the region is derived from clean, renewable sources.
Commercial Transportation	
The regional transportation system is safe, reliable, and resilient to the current and future impacts of climate change.	**By 2030:** • All major transportation infrastructure projects are located outside of areas with known, unmitigated climate hazards. **By 2050:** • All transportation networks and infrastructure are protected from current and future impacts of climate hazard.
Commercial Buildings	
Residents and workers are protected by buildings that are resilient to high temperatures, harmful air quality, severe storms and flooding by 2050.	**By 2030:** • All new buildings utilize world-leading water conservation methods. • Metro Vancouver's most vulnerable residents and workers in the region have access to buildings with cooling and clean air during extreme heat and wildfire events. • All new buildings include cooling and air filtration adequate to protect against extreme heat and harmful outdoor air quality events. • All new buildings are constructed to be resilient to riverine, coastal and urban flooding, and extreme storms. **By 2050:** All Metro Vancouver's residents and workers have access to buildings that: • protect against extreme heat and harmful outdoor air quality events, • are resilient to riverine, coastal and urban flooding, and extreme storms, and • utilize world-leading water conservation methods.

◎ Goals	◎ Targets
Energy	
All regional energy infrastructure is reliable and resilient to the current and future impacts of climate change.	**By 2030:** • All energy providers have identified known, unmitigated climate hazards that could impact energy infrastructure. • All new energy infrastructure is protected from known, unmitigated climate hazards. **By 2050:** • The energy system is protected from the current and future impacts of climate change.

Strategies for Achieving Deep Emission Reductions in Industry and Business

Figure 3 shows the estimated greenhouse gas emission reductions from some of *Climate 2050* strategies addressing greenhouse gas emissions from Industry and Business. It illustrates the potential emission reduction impacts of Strategy 1 for industrial facilities and Strategy 2 for non-road equipment, as well as potential impacts of emissions reduction strategies in commercial buildings and transportation. Further work is required to estimate the impacts of the other strategies in this *Industry* and *Business Roadmap*.

FIGURE 3: POTENTIAL IMPACTS OF STRATEGIES FOR INDUSTRY AND BUSINESS [3, 4]

2030
- Some new medium-duty/heavy-duty vehicles are zero emissions
- Increased stringency of the BC Low Carbon Fuel Standard
- Almost all new buildings, including commercial, are electric
- GHG limits for large existing buildings

2050
- Industrial Fuel Switching Prioritize Low Carbon Materials
- Most medium-duty/heavy-duty vehicles are either zero emissions or using low carbon biofuels
- The majority of buildings in the region are zero emissions or using low carbon energy
- Increased uptake of renewable natural gas by industrial users
- Progressive electrification of non-road equipment
- Commercial transportation such as marine, rail, and aviation are either zero emissions or using low carbon biofuels

3   Remaining emissions include those captured by other strategies or those identified as gaps

4   Based on Metro Vancouver's *Modelling a Carbon Neutral Region* Project. Strategies in commercial buildings and commercial transportation are further discussed in the *Climate 2050 Buildings and Transportation Roadmaps*, respectively.

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.

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.

POTENTIAL IMPACTS OF STRATEGIES   The highest potential emission reductions due to all actions in the strategy, relative to the expected baseline emissions in 2030 and in 2050. Greenhouse gas estimates include carbon dioxide, methane and nitrous oxide.

Emission Reduction Actions for Industry and Business in other *Climate 2050 Roadmaps*

Other *Climate 2050* Roadmaps contain strategies and actions to reduce greenhouse gas emissions from Industry and Business. Below are a few examples of key actions relevant for Industry and Business from the *Climate 2050 Buildings* and *Transportation Roadmaps*, and the draft *Agriculture Roadmap* (for more information on these strategies and actions including the estimated greenhouse gas reductions, see the *Climate 2050* website.)

Climate 2050 Buildings Roadmap

- Greenhouse Gas Performance Requirements for Existing Large Buildings
- New Buildings are Highly Efficient and Electric
- New Financing Tools for Low Carbon Upgrades
- Training and Education in Zero Emissions and Resilient Buildings
- Emissions Requirements for District Energy Systems
- Incorporate Embodied Emissions into the BC Building Code
- Use Building Materials with Low Embodied Emissions.

Climate 2050 Transportation Roadmap

- Require Zero Emission Sales Targets for New Medium and Heavy Trucks
- More Stringent Low Carbon Fuel Standards
- Make Low and Zero Emission Medium and Heavy Trucks More Affordable
- Large Fleets to Adopt "ZEV-First" Procurement
- Reduce Delivery Emissions
- Support Innovation in Zero Emission Technology for Medium and Heavy Trucks
- Use Business Licenses to Support Emission Reductions
- Support Innovation in Low and Zero Emission Marine and Rail Technologies

Climate 2050 Energy Roadmap

- More Stringent Low Carbon Fuel Standards
- Implement Renewable Gas Content Requirements
- Regional Hydrogen Hub
- Phase Down Use of Thermal Coal and Petroleum Coke

Strategy 1: Accelerate emission reductions from industrial facilities

Over 1,000 industrial facilities and related commercial operations operate under Metro Vancouver permits and regulations, which have historically focused on emissions of health-harming air contaminants. These operations make cement, concrete, and forest products, refine petroleum, distribute gasoline, paint vehicles and more. There are technical and cost challenges to decarbonizing some large industrial facilities, particularly the high heat requirements needed for some manufacturing processes. Integrating greenhouse gas requirements into Metro Vancouver's permits and regulations, along with cleaner fuels and more stringent emission requirements, will help achieve the 2030 emission targets for industrial facilities.

STRATEGY 1	Potential Impacts of Strategy	Key Partners
	• Reduce annual greenhouse gases by up to 520,000 tonnes in 2030 • Reduce annual greenhouse gases by up to 2,000,000 tonnes in 2050	• Government of British Columbia • Government of Canada • Industrial facilities

1.1 More Stringent Greenhouse Gas Requirements for Large Industrial Emitters. CAP BIG Move

Advocate to the Government of BC to implement more stringent requirements for BC-based industrial facilities with significant greenhouse gas emissions. This could include increases to or expansion of the carbon tax, as well as mandatory carbon offsets. Requirements would be supported by incentives under Action 1.3 below.

1.2 Integrate Greenhouse Gases into Emission Regulations and Permits. CAP BIG Move

Develop and implement processes to integrate greenhouse gas reduction requirements into new emission regulations, amendments of existing emission regulations, new permits, and permit amendments. Integration would consider greenhouse gas regulations implemented by the Government of BC, as well as the benefits and tradeoffs of reducing greenhouse gases versus improving regional air quality. Integration could

include greenhouse gas emission limits and fees, and could require permitted industrial facilities to evaluate opportunities to transition to clean, renewable energy, better utilize waste heat, or to phase out the use of some fossil fuels.

1.3 Implement Renewable Gas Content Requirements.

CAP **BIG Move**

Advocate to the Government of BC to establish content requirements for renewable gas, in line with targets in the provincial *CleanBC* plan. Renewable gas includes renewable natural gas, which has a lower carbon intensity than natural gas from fossil fuels.

1.4 Industrial Emission Reduction Incentives.

CAP

Advocate to the Governments of Canada and BC to enhance or develop incentives for industrial facilities to reduce emissions of greenhouse gases and other air contaminants. Incentives could include rebates on carbon tax or energy efficiency upgrades, tax credits, and innovative financing mechanisms. Incentives should be based on emission reductions that meet or exceed relevant industrial emission benchmarks.

1.5 Develop Sector-Specific Regulations.

CAP

Develop and update sector-specific regulations to accelerate emission reductions from specific industrial, commercial, or business sectors that operate industrial facilities. Sectors targeted would be based on air quality and climate change impacts, emission reduction potential, emerging issues and other factors related to industrial facilities.

1.6 Provincial and Federal Industrial Emission Standards.

CAP

Advocate to the Governments of Canada and BC to continue developing stringent emission standards for industrial facilities to help improve air quality. Industrial sectors could include chemicals, petroleum refining, pipelines, shipping of bulk goods, and wood products.

1.7 Carbon Tariffs.

CAP

Advocate to the Governments of Canada and BC to establish carbon tariffs or carbon border tax adjustments for imported industrial, manufactured and agricultural goods. This will help industrial facilities and businesses in the region to compete fairly against imported goods with higher carbon content.

1.8 Regional Industrial Facilities Emissions Working Group.

CAP

Work with the Government of BC, local First Nations, regional industry, business associations, academic institutions, port terminals and other partners to explore the opportunities for establishing a regional industrial facilities emissions working group. If established, the working group would collectively identify the best opportunities to both minimize air quality impacts from industrial facilities and reduce greenhouse gas emissions from industrial facilities. The working group could help accelerate emission control innovation at industrial facilities, including supporting pilot projects.

1.9 Phase out High Global Warming Refrigerants.

CAP

Advocate to the Government of Canada to accelerate the phase out of halocarbons that have a high global warming potential, including refrigerants and blowing agents. The accelerated phase out should include coordination with technical and industry associations on certification and solutions for businesses.

ALDERGROVE

Strategy 2: Reduce non-road emissions and support early adoption of zero emission non-road equipment.

Almost 850,000 non-road equipment units are used in the region, primarily for construction and commercial operations, cargo-handling, and lawn and garden maintenance. They are a source of harmful diesel particulate matter, nitrogen oxides, and greenhouse gases. Metro Vancouver's *Non-Road Diesel Engine Emission Regulation* (and the Vancouver Fraser Port Authority's related program) are helping to manage emissions from older, higher-emitting non-road diesel engines. More stringent emission requirements for new and existing non-road engines will help achieve the 2030 non-road targets for greenhouse gases and diesel particulate matter. The Governments of Canada and BC should support development and commercialization of zero emission non-road engines, which would reduce air contaminant emissions over the long term.

	Potential Impacts of Strategy	Key Partners
STRATEGY 2	• Reduce annual greenhouse gases by up to 220,000 tonnes in 2030 • Reduce annual greenhouse gases by up to 1,800,000 tonnes in 2050	• Government of BC • Government of Canada • Vancouver Fraser Port Authority

2.1 Tighten Emissions Regulation for Non-Road Diesel Engines.

CAP BIG Move

Update Metro Vancouver's emission regulation for non-road diesel engines with more stringent requirements that could cover additional air contaminants, equipment types, fuels and engine sizes. These updates should incentivize the early adoption of zero emission non-road equipment. Any updates should be coordinated with Vancouver Fraser Port Authority to align requirements as much as possible.

2.2 Emission Standards for New Non-Road Equipment.

CAP

Advocate to the Government of Canada to establish more stringent fuel economy and emission standards for new non-road equipment. Cleaner non-road equipment standards will improve regional and local air quality and increase the availability of low and zero emission non-road equipment.

2.3 Funding for Cleaner Non-Road Equipment. `CAP`

Advocate to the Governments of Canada and BC to enhance funding (e.g., incentives, loans, tax credits) to replace or retrofit existing non-road equipment to reduce emissions, including greenhouse gases. Higher incentives should be available for zero emission equipment and if old equipment is scrapped.

2.4 Identify Infrastructure Needs for Zero Emission Non-Road Equipment. `CAP`

Work with energy utilities, member jurisdictions, First Nations, the Vancouver Fraser Port Authority, industry and other regional partners to identify the regional infrastructure needs to support a long-term transition to zero emission non-road equipment. This would consider the refueling and charging needs for different types of non-road equipment, funding requirements, potential pilot projects, and should align with similar actions for passenger vehicles and medium and heavy duty trucks in the *Climate 2050 Transportation Roadmap*.

2.5 Encourage Cleaner Non-Road Equipment through Municipal Approvals. `CAP`

Advocate to member jurisdictions and First Nations to implement incentives to encourage the use of low or zero emission non-road equipment for construction, film, and other industrial sectors. For example, builders and developers using cleaner non-road equipment could receive development benefits such as lower building permit fees.

2.6 Awareness Program on Zero Emission Non-Road Equipment. `CAP`

Develop and implement an awareness and outreach program for residents and businesses about the benefits of zero emission non-road equipment, working with member jurisdictions, First Nations and other regional partners. The program would include regularly updated information on the availability of zero emission equipment, and guidance on "right-sizing" non-road fleets, as well as supporting regional coordination of purchases (i.e., bulk buy) to help reduce costs.

2.7 Transition Metro Vancouver's Corporate Non-Road Fleet to Zero Emissions. **Corporate** LEADERSHIP `CAP`

Transition Metro Vancouver's non-road fleet to zero carbon emissions by 2040, and zero emissions by 2050.

Strategy 3: Explore opportunities for technological carbon capture

Long term modelling of regional greenhouse gas emissions indicates that climate actions focusing only on reducing emissions are likely insufficient for the Metro Vancouver region to reach carbon neutrality by 2050. Additional removal of carbon dioxide from the atmosphere is expected to be necessary, to avoid the worst impacts of climate change. While natural carbon sequestration can be increased in the region, any increase is expected to have limited impact on regional greenhouse gas levels, compared to the regional greenhouse gas targets. (This is described in more detail in the *Climate 2050 Nature & Ecosystems Roadmap*.) As such, technological carbon capture will be needed. Initial research on the opportunities for these technologies in the region will support the 2030 greenhouse gas target for industrial facilities.

	Potential Impacts of Strategy	Key Partners
STRATEGY 3	• To be updated as Strategy is implemented.	• Government of BC • Businesses that operate industrial facilities • Associations representing businesses with industrial facilities • Academic Institutions

3.1 Carbon Capture in Metro Vancouver Region. `CAP`
Work with industry, academia and other regional partners to explore the potential opportunities for carbon capture technologies in the region, including pilot projects and uses of captured carbon dioxide.

3.2 Develop Carbon Capture Standards. `CAP`
Advocate to the Government of BC to develop technical standards for carbon capture technologies.

Strategy 4: Reduce greenhouse gas emissions through procurement and other business practices

Businesses in the region are already helping reduce greenhouse gas emissions through climate action initiatives. Additional technical support and guidance will help businesses adopt cleaner operating practices and further reduce their greenhouse gas emissions. Developing regional guidance on buying low carbon products will help reduce the embodied greenhouse gas emissions of goods and services. These steps will help achieve the 2030 regional targets to reduce greenhouse gas emissions. Key partners for this strategy include member jurisdictions, First Nations, business associations, local businesses, and the Governments of Canada and BC.

	Potential Impacts of Strategy	Key Partners
STRATEGY 4	• To be developed as Strategy is implemented.	• Member jurisdictions • First Nations • Government of BC • Industries and businesses

4.1 Regional Low Carbon Procurement.

Work with member jurisdictions, First Nations, industry and business groups, and other regional partners to develop and implement regional guidance on procurement to prioritize low carbon products, equipment and services for construction and other projects. The guidance could outline best practices, available certifications, methods for lifecycle greenhouse gas emissions calculation, circular economy considerations (e.g. disposal), greenhouse gas targets and emission disclosure requirements. Products covered by the guidance could include, for example, low carbon cement and concrete products. The guidance should align with Metro Vancouver's *Climate 2050 Buildings Roadmap* on reducing embodied emissions in buildings.

4.2 Integrate Climate Considerations into Standard Business Practices.

Advocate to the Governments of Canada and BC to integrate climate considerations into financial reporting and other standard business practices. Integration could include public disclosure of business carbon footprints and climate-related risks, as well as changes to legislation or accounting standards. These practices would push businesses and industrial facilities to prioritize management of climate risks in operations and practices.

4.3 Low Carbon Metro Vancouver Corporate Procurement.

Establish low carbon procurement guidance as a Metro Vancouver corporate standard. Products covered by the guidance could include, for example, low carbon cement and concrete products. This could demonstrate how procurement can support low carbon (and resilient) buildings, infrastructure and services. Metro Vancouver will explore opportunities to collaborate with its suppliers on low-carbon innovation and measures to help prioritize low carbon products.

Strategies for Climate Resilient Industry and Business

Climate Resilience Actions for Industry and Business in other *Climate 2050 Roadmaps*

Below are examples of key climate resilience actions relevant for Industry and Business from the *Climate 2050 Buildings, Transportation* and *Energy Roadmaps* (for more information on the strategies and actions in these roadmaps including the estimated greenhouse gas reductions, see the *Climate 2050* website)

Climate 2050 Buildings Roadmap

- Require Cooling Measures in New Buildings and Major Retrofits
- Apply Leading Standards for Ventilation and Filtration in New Buildings

Climate 2050 Transportation Roadmap

- Protect Key Transportation Hubs
- Minimize Risk Exposure for New Transportation Infrastructure
- Build Climate Resilient Transportation Infrastructure

Climate 2050 Energy Roadmap

- Comprehensive Climate Risk and Vulnerability Assessment
- Pilot Innovative Renewable Energy + Storage Systems to Improve Resiliency

Strategy 5: Assess climate vulnerabilities for businesses in the region

To increase regional climate resilience, we need a deeper understanding of the projected climate impacts that the region will experience, and an understanding of how different types of businesses could be affected. Metro Vancouver can work with partners to conduct an assessment of the climate change risks and vulnerabilities to the region including risks to specific industry and business sectors, and communicate those risks to support resilience planning.

5.1 Assess Regional Climate Risks and Vulnerability to Support Business Decision-making.

BIG Move

Work with the Province of BC, industry and business, and other relevant stakeholders to conduct a regional vulnerability assessment to identify climate-related hazards and risks faced by industries and businesses in the region.

5.2 Identify Climate Vulnerability by Clusters with Industry and Business Sectors.

Work with industry associations and other regional partners to identify "industry clusters" with similar and linked climate vulnerabilities and impacts, including vulnerabilities that can affect the industry's value chain (both upstream and downstream of the sector). Metro Vancouver will explore opportunities to build and support climate resilience specific to key industry clusters in the region, for example through sharing of information on projected climate impacts.

Strategy 6: Support industry and business resilience to flooding through better information and planning

The Metro Vancouver region is expected to experience increased flooding due to climate change, and industrial and commercial land can be particularly vulnerable to large flood events. Businesses may also be susceptible to urban flooding caused by extreme precipitation events that overwhelm drainage systems. Addressing the increased risk of flooding to industry and business will require better information on expected changes in precipitation and the annual freshet, as well as other climatic changes. Businesses and governments can use this information to locate businesses in less vulnerable areas, implement flood protection measures, like diking and building design, and prepare response plans for flood events. Reducing the flood risk to individual and groups of businesses will reduce the overall risk that flooding poses to the region.

6.1 Support Knowledge-Sharing to Increase Resilience to Severe Storms and Flooding.

Work with regional partners (e.g. Fraser Basin Council, member jurisdictions, First Nations, and others) to increase industry and business awareness of flood risk and vulnerabilities due to climate change, and to work with industrial and commercial businesses to develop strategies and policy solutions that can increase industry and business climate resilience.

Getting Down to Business
Flood Risk Management at the Port of Vancouver: A Collaborative Effort

The Vancouver Fraser Port Authority, which oversees the lands and waters that make up Canada's largest port, the Port of Vancouver, has collaborated with local municipalities (the City of North Vancouver, Districts of North and West Vancouver) and the Squamish First Nation to conduct a coordinated sea level rise risk study for the Burrard Inlet's north shore, and is also a participant in a regional flood management strategy. The Port Authority also engages tenants (e.g., shipping industry), government and supply chain partners to improve understanding of climate risk and coordination of adaptation planning.

6.2 Coordinate Flood Protection and Flood Risk Management for Industrial Lands.

Work with regional partners (e.g., the Fraser Basin Council, member jurisdictions, First Nations, and others) to coordinate flood protection and flood risk management activities for industrial lands in the region, informed by the results of a regional climate vulnerability assessment and to consider the development and implementation of green infrastructure solutions that can minimize site-level flooding risks to industrial and commercial lands.

Flood Risk to Industrial Lands

Industrial land is critical to the regional, provincial, and national economies, and some of these lands are also vulnerable to flooding risks. Industrial lands accommodate many sectors such as manufacturing, transportation, warehousing, and wholesale that serve the region's needs, as well as goods transportation associated with port and rail facilities located along waterways.

Metro Vancouver's Regional Industrial Lands Strategy (RILS) was developed through a collaborative process to establish a vision and identify priority actions for the future of industrial lands in the region. The recommended actions of RILS recognize that industrial lands are crucial to supporting a prosperous, sustainable regional economy, and to providing space to accommodate the industrial services and jobs needed in our growing region. It identifies several challenges facing Metro Vancouver's industrial lands, including the limited industrial land supply, some of which is being lost through conversion to residential and commercial land-uses.

Another challenge is that some industrial lands are exposed to the impacts of climate change, such as from flooding. In addition to the ongoing implementation of the recommended actions of RILS, Metro 2050, Metro Vancouver's regional growth strategy includes policies to protect and intensify industrial lands, as well as the *Climate 2050 Land Use and Urban Form Roadmap*, identify key land use planning considerations from a climate mitigation and adaptation perspective. As the region's industrial lands are redeveloped, they can be densified and intensified to more efficiently use the limited lands available, with the consideration of resilience. Additionally, directing commercial activities and jobs to denser Urban Centres better supports transit-oriented development and helps protect industrial lands.

Strategy 7: Improve business resilience to extreme heat and air quality events

The increased frequency and severity of extreme heat in recent years has directly and indirectly impacted business operations and supply chains in the region. High levels of ground level ozone and particulate matter from heat and wildfires have made working outside harmful to the health of workers or caused disruptions to the movement of goods. Preparing for extreme heat and air quality events will be important for businesses to protect worker health and well-being, as well as ensuring the continuity of business operations.

7.1   Support Employers in Developing Response Plans for Extreme Heat and Air Quality Events.
Work with the Province of BC, health authorities, workers safety authority, businesses, labour unions and other partners to ensure employers and workers have relevant information to prepare response plans for extreme heat and air quality events aimed at protecting the health and well-being of workers, ensuring continuity of business operations, and increasing resilience of supply chains.

Strategy 8: Support industrial water conservation to increase resilience to shifting precipitation patterns

Climate projections in our region have identified an increase in extreme weather events like heatwaves and droughts, which will impact the region's ability to supply high-quality water to industries and businesses. Water is a resource that businesses rely on for their operations. With an increase in pressure on resources, industries and businesses will need to identify opportunities for resource efficiency and to reduce demand on supply.

A One Water Approach is where water and wastewater utilities shift away from the traditionally separated silos of drinking water, wastewater, and stormwater, towards an integrated systems approach. This is based on the fundamental concept that all water systems are interconnected and opportunities exist to leverage the interconnections of our water resources.

8.1   Apply Leading Water Efficiency Standards to Industry.

Advocate for highest water efficiency in standards for potable water use for industrial and commercial applications. Ongoing updates to strengthen standards for water efficiency in buildings should reflect the continuous improvement in technologies and practices for construction and plumbing.

8.2   Promote Water Efficiency Retrofit Incentives and Rebates for Industries and Businesses.

Advocate to municipalities and the BC government for water efficiency retrofit incentives and rebates for industries and businesses to facilitate the uptake of water efficient practice. The upfront cost is a barrier for implementation for new systems such as the removal of once through cooling, as well as process improvements like increasing the efficiency of cooling towers. Incentives can increase the feasibility of these and other changes.

Setting the Path Ahead

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

The path towards a carbon neutral, resilient region provides an opportunity for a prosperous and sustainable region. There is strong potential and a critical need to achieve significant greenhouse gas emissions reductions among industry and business activities in the region over the next three decades. Reaching success in this will require careful coordination and alignment in climate policies between governments, as well as widespread adoption of zero emission equipment. Increased support for industries and businesses will be needed to advance carbon capture, utilization, and storage technologies – helping these technologies to evolve from research and development to broad commercialization. Increased awareness about the opportunities and benefits of a low carbon economy, powered by clean, renewable energy will help transition towards deep greenhouse gas reduction.

Investments in private and public infrastructure also underpin industry and business climate resilience. Identifying climate risks and vulnerabilities for businesses will better inform business decision-making. Knowledge sharing and better planning will make it easier for businesses in region to respond to the impacts of climate change and make the shift towards a decarbonized future.

The timeline below includes all of the actions included in this Roadmap. Although there is much work to be done, there are a few critical actions that, if started over the next few years, will make a major difference to accelerating the region's drive to a carbon neutral and resilient industry.

CLIMATE 2050 INDUSTRY AND BUSINESS ACTION TIMELINE

STRATEGY	2021-2023	2024-2029	2030-BEYOND
STRATEGY 1 Accelerate Emissions Reductions from Industrial Facilities	1.1 BIG MOVE: More Stringent Greenhouse Gas Requirements for Large Industrial Emitters		
	1.2 BIG MOVE: Integrate Greenhouse Gases into Emission Regulations and Permits		
	1.3 BIG MOVE: Implement Renewable Gas Content Requirements		
	1.4 Industrial Emission Reduction Incentives		
	1.5 Develop Sector-Specific Regulations		
		1.6 Provincial and Federal Industrial Emission Standards	
	1.7 Carbon Tariffs or Carbon Border Tax Adjustments		
	1.8 Regional Industrial Emissions Working Group		
		1.9 Phase out High Global Warming Refrigerants	
STRATEGY 2 Reduce Non-Road Emissions and Support Early Adoption of Zero Emission Non-Road Equipment.	2.1 BIG MOVE: Tighten Emissions Regulation for Non-Road Diesel Engines		
	2.2 Emission Standards for New Non-Road Equipment		
	2.3 Funding for Cleaner Non-Road Equipment		
		2.4 Identify Infrastructure Needs for Zero Emission Non-Road Equipment	
		2.5 Encourage Cleaner Non-Road Equipment through Municipal Approvals	
		2.6 Awareness Program on Zero Emission Non-Road Equipment	
	2.7 Transition Corporate Non-Road Fleet to Zero Emissions		
STRATEGY 3 Explore Opportunities for Technological Carbon Capture	3.1 Carbon Capture in Metro Vancouver Region		
		3.2 Develop Carbon Capture Standards	
STRATEGY 4 Reduce Emissions through Procurement and other Business Practices		4.1 BIG MOVE: Regional Low Carbon Procurement	
		4.2 Integrate Climate Considerations into Standard Business Practices	
	4.3 Corporate Low Carbon Procurement		
STRATEGY 5 Assess Climate Vulnerabilities for Businesses in the Region	5.1 BIG MOVE: Assess Regional Climate Risks and Vulnerability to Support Business Decision-making		
	5.2 Identify Climate Vulnerability by Clusters with Industry and Business Sectors		
STRATEGY 6 Support the Resilience of Industrial Lands through Better Planning		6.1 Support Knowledge-Sharing to Increase Resilience to Severe Storms and Flooding	
		6.2 Coordinate Flood Protection and Flood Risk Management for Industrial Lands.	
STRATEGY 7 Improve Business Resilience to Extreme Heat and Air Quality Events		7.1 Support Employers in Developing Response Plans for Extreme Heat and Air Quality Events.	
STRATEGY 8 Support Industrial Water Conservation to Increase Resilience to Shifting Precipitation Patterns		8.1 Apply Leading Water Efficiency Standards to Industry	
		8.2 Promote Water Efficiency Retrofit Incentives and Rebates for Industries and Businesses.	

Measuring Progress

The table below lists examples of some of the performance indicators that could be used to help Metro Vancouver measure regional progress towards meeting the targets set out for this purpose. The performance indicators used will depend on the availability of this information from other organizations. Because the Industry and Business Roadmap is calling for actions from many different partners and stakeholders, data sharing 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 carbon neutral and resilient future.

ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Accelerate Emission Reductions from Industrial Facilities	tCO_2e attributed to the industrial sector	Regional GHG inventory Province	Yes
	Energy source breakdown for industrial facilities (GJ)	Permits, BC Hydro, Fortis BC	Partial
	tCO2e from energy use at industrial facilities	Permits, BC Hydro, Fortis BC	Partial
	Number of industrial facilities with a demand-side management plan or environmental management system	TBD	TBD
	GHG intensity for industrial facilities	TBD	TBD
Reduce Non-Road Emissions and Support Early Adoption of Zero Emission Non-Road Equipment.	Sale of low- and zero emission non-road equipment including electric, hybrid, hydrogen (number of new equipment sales, % of total sales)	Federal Province Market research firms	Partial
	Regional equipment registration by model year, engine tier and fuel type [fossil diesel, fossil gas, biofuels, electricity, hydrogen (Gigajoules, GJ)]	Metro Vancouver – Non Road Diesel Engine Emission Regulation Port of Vancouver	Partial
	Operational hours by equipment model year, size, engine type (hours)	Metro Vancouver- Non Road Diesel Engine Emission Regulation Port of Vancouver	Partial

ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Reduce Non-Road Emissions and Support Early Adoption of Zero Emission Non-Road Equipment.	Percentage breakdown of registered fleet compared to estimated total regional fleet.	ICBC Metro Vancouver – NRDEE Metro Vancouver BC Hydro Province	Partial
	Regional equipment mix by engine type	ICBC Metro Vancouver – NRDEE	No
Explore Opportunities for Technological Carbon Capture	TBD	TBD	TBD
Reduce Emissions through Procurement and other Business Practices	Number of Metro Vancouver member jurisdiction and First Nations that require product information (e.g., Environmental Product Declarations) in their procurement	TBD	TBD
	Number of companies certified as B corporation in the Metro Vancouver region	TBD	TBD
Assess climate vulnerabilities for businesses in the region	Number of Metro Vancouver member jurisdictions and First Nations that have completed a vulnerability assessment	TBD	TBD
Support the resilience of industrial lands through better planning	TBD	TBD	TBD
Improve Business Resilience to Extreme Heat and Air Quality Events	TBD	TBD	TBD
Support industrial water conservation to increase resilience to shifting precipitation patterns	TBD	TBD	TBD

Glossary

Biofuels are produced using organic matter derived from biomass such as plants. Biofuels can be gaseous, liquid, or solid. Common biofuels include biodiesel, renewable diesel, ethanol, renewable natural gas, firewood, and wood pellets.

Carbon leakage refers to the situation that may occur if, for reasons of cost related to climate policies that aim to reduce emissions within a region, facilities or businesses transfer production to and increase emissions in other jurisdictions where carbon policy is either less ambitious or does not exist. This can lead to a net increase in global emissions.

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

Carbon capture, utilization, and storage (also CCUS) refer to different technological process that involves capturing carbon dioxide emissions from industrial facilities, or directly from the atmosphere. Captured carbon dioxide is then compressed and transported, to be utilized or to be safely and permanently stored.

Carbon sequestration is the removal of carbon dioxide from the air and the long-term storage of carbon to mitigate climate change.

Circular economy is an economy where the value of products is retained after their initial use through reuse, repair and remanufacturing. Keeping products functioning at their highest potential reduces embodied emissions and reduces emissions associated with waste management. Transitioning to a circular economy will gradually decouple economic activity from the consumption of finite resources by designing waste out of the system and helping to regenerate natural systems.

Clean, renewable energy is derived from sources with low or zero emissions or from sources that can be replenished over days or years.

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.

Climate resilience describes the capacity of ecosystems, infrastructure, economies, 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, climate resilience involves changing services and functions so they are more sustainable.

Decarbonization (Decarbonize) refers to the removal of carbon dioxide or greenhouse gases from a system or process.

Diesel particulate matter (DPM) is a form of fine particulate matter from diesel engines that is classified as carcinogenic.

Economy is the system of a country or region, typically involving the production and consumption of goods and services.

Embodied emissions are greenhouse gas emissions associated with the manufacture of goods and products, including the raw materials and the transport of the good or product to where it is sold.

Fine particulate matter ($PM_{2.5}$) is made up of tiny solid or liquid particles that float in the air and can penetrate deep into the lungs and even into the bloodstream. Fine particulate matter can damage people's health by aggravating existing lung and heart diseases, increasing the risk of cancer and reducing life expectancy.

Global Warming Potential refers to the ability of a greenhouse gas to trap heat into the atmosphere over a specific period of time (usually 100 years). In other words, how many kilograms of carbon dioxide released into the atmosphere would it take to equal a single kilogram of the refrigerant gas, if released. Some of the most common refrigerants used in heat pumps today can have GWPs that exceed 750 (e.g., R410a, R407c and R134a).

Greenhouse gases are air contaminants that trap heat and are the cause of climate change. Greenhouse gases include carbon dioxide (CO2) and nitrous oxide (N2O) as well as short-lived climate forcers such as methane (CH4), 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 (sometimes referred to as "climate change mitigation").

Ground-level ozone (O$_3$) can have harmful impacts on everyone, especially children, the elderly, and people with lung and heart conditions. It is primarily formed when nitrogen oxides and volatile organic compounds react in the air on hot and sunny days.

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, landslides and floods.

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.

Industry refers to any group of businesses that produces or distributes a common set of goods or services. For example, the Construction industry includes businesses involved in constructing, renovating and repairing structures, and those working on engineering and infrastructure projects. Other examples include Trade, Transportation and Warehousing, which are associated with distribution and logistics functions, and Manufacturing where businesses transform materials or substances into products.

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.

Lifecycle greenhouse gas emissions refers to greenhouse gases associated with the production and use of a material or energy source, from feedstock extraction, raw materials processing, transportation to end-use. For example, lifecycle emissions of gasoline would span all emissions associated from extraction of oil from the ground till combustion in a vehicle.

Nitrogen oxides (NO$_x$) are a group of gases, which includes nitrogen dioxide, that are produced during high-temperature fuel combustion, and can contribute to the formation of ground-level ozone and fine particulate matter.

Non-road equipment is any machine with an internal combustion engine that is not used or intended for transportation on public roads. Examples include stationary or mobile equipment such as loaders, cranes, generators, tractors, and lawn mowers.

Renewable diesel is also made from vegetable oils and animal fats, but using a different process that makes the end fuel nearly identical to regular diesel. It can be used directly in conventional diesel engines without requiring engine modifications.

Renewable gas is gas produced from renewable resources. This primarily includes green hydrogen, waste hydrogen, and renewable natural gas.

Renewable natural gas is a gaseous biofuel that is mostly composed of methane; it is produced primarily from anaerobic digestion of organic feedstock (such as food, agricultural, and forestry waste).

Sector is a group of industries that produces related goods or provides services.

Supply chain refers to the relationship between a company and its suppliers, including the steps taken from raw materials to getting the product or service to the customer, all aimed for overall customer satisfaction. Supply chains focus primarily on reducing costs and attaining operational excellence.

Value chain refers to a process in which a company adds value to its raw materials to produce products eventually sold to consumers. The value chain gives companies the ability to create value exceeding the cost of providing its good or service to customers – a competitive advantage in the industry, which requires alignment between what the customer wants, i.e., the demand chain, and what is produced via the supply chain.

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.

Vulnerability assessments identify areas or populations most likely to be impacted by projected changes in climate and build an understanding of why these areas are vulnerable, including the interaction between climate change, non-climatic stressors and cumulative impacts. Assessments evaluate the effectiveness of previous coping strategies and target potential adaptation measures.

Zero carbon or **zero carbon** emissions are emissions that generate no net greenhouse gas emissions at the point of use. A zero carbon fuel source either produces no greenhouse gas emissions or any greenhouse gas emissions produced are offset by renewable energy (either generated on-site or purchased).

Zero emission means no greenhouse gas or other air contaminants are generated at the point of use. Zero emission includes zero carbon (see above), and also eliminates emissions of health-harming air contaminants (e.g., fine particulate matter and nitrogen oxides).