CLIMATE **2050 Roadmap**

Transportation

A pathway to carbon neutral transportation in Metro Vancouver

November 2021

FRONT COVER: GOLDEN EARS BRIDGE

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November 2021

The goals and targets at the heart of Metro Vancouver's climate-related plans are based on science. 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 Transportation Roadmap* was prepared in 2020/2021 and introduced for stakeholder comment during 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.

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. Its core services are drinking water, wastewater treatment and solid waste management.

Metro Vancouver also regulates air quality, plans for urban growth, manages a regional parks system and provides affordable housing. The regional district is governed by a Board of Directors of elected officials from each local authority.

Mission

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

1. **Serve as a Regional Federation**

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

2. **Deliver Core Services**

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

3. **Plan for the Region**

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

Building a Resilient Region

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

REGIONAL MANAGEMENT PLANS/STRATEGIES

Metro Vancouver's Roles and Responsibilities for Climate Action

The three broad roles outlined in Metro Vancouver's mission each demonstrate responsibilities related to climate change. More specifically, under the *Environmental Management Act*, Metro Vancouver has the delegated authority to provide the service of air pollution control and air quality management and may, by bylaw, prohibit, regulate and otherwise control and prevent the discharge of air contaminants, including greenhouse gases. Through the regional growth strategy, Metro Vancouver, with its members, plans for compact, complete communities that are foundational to enabling a carbon neutral, resilient region. As part of delivering its core services, Metro Vancouver also generates and uses clean, renewable energy from its facilities and is working to ensure core regional services and infrastructure are prepared for and resilient to climate change.

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

The Roadmap at a Glance

We rely on our regional transportation system every day to work, study, play, and access important services. This system also ensures that goods move efficiently and reliably through our region. However, transportation is the largest source of greenhouse gas emissions in our region as a result of the fossil fuels used to power cars, trucks, trains, boats, and aircraft.

Although it is currently the largest source of regional greenhouse gas emissions, transportation is one of the best opportunities to start reducing emissions, particularly for personal transportation. The region is well positioned to continue with intentional land use planning that supports walking, cycling, transit, and other shared mobility modes. Electric vehicles are widely available and ready to be used on a regional scale.

As personal transportation transitions to being zero emission, medium and heavy trucks, marine vessels, aviation, and rail will become the largest sources of transportation greenhouse gas emissions in the region. Accelerating ongoing actions that support rapid development and scale-up of zero emission and low carbon options for these sectors, as well as new innovations in technology, will ensure that the transportation sector as a whole can transition to carbon neutrality by 2050.

Even as we reduce emissions from transportation, it is critical that we develop a transportation network that is resilient to the impacts of a changing climate. Some impacts from climate change are locked in, and will create vulnerabilities in our existing system. We must protect existing networks and infrastructure, and develop a resilient transportation system moving forward to ensure that regional transportation continues to be safe, reliable, and comfortable.

The *Transportation Roadmap* lays out 52 actions for reducing emissions and increasing resiliency, organized under the following six strategic areas:

1. Reduce Driving through Active Transportation and Public Transit
2. Accelerate the Transition of the Passenger Vehicle Fleet to Electric Vehicles
3. Reduce Heavy Truck Emissions and Support Early Adoption of Zero Emission Heavy Trucks
4. Reduce Marine, Rail, and Aviation Emissions
5. Protect Existing Transportation Networks from Future Climate Impacts
6. Develop Climate Resilient Transportation Networks

Although there is much work to be done, there are some important actions that need to be started soon in order to make a major difference in accelerating the region's drive to carbon neutral and resilient transportation. It is critical that the actions to reduce emissions identified in this *Roadmap* are implemented rapidly to set this transition in motion as soon as possible. Taking early action to reduce emissions can also help improve air quality, support health and well-being through exercise, and enhance low carbon resilience sooner rather than later.

We are not alone in this challenge. The actions in this *Roadmap* demonstrate the importance of working collectively to reach climate objectives, and will complement other plans guiding regional transportation. Working closely with TransLink, the BC government, member jurisdictions, and other key partners will be critical to effectively implement the actions in this *Roadmap*. Together, we can create a carbon neutral and resilient regional transportation system.

CHARGING STATION, BURNABY

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Visioning Carbon Neutral Transportation in 2050

In 2050, everyday movement of people around the region in cars and trucks has transitioned from being the largest source of greenhouse gas emissions in the region to being completely emissions free. More Metro Vancouver residents live in walkable urban centres, can comfortably walk, roll or bike for many of their day-to-day trips, and access convenient, reliable public transit to key destinations. Cars, trucks, and SUVs are powered by electricity and are zero emission, creating almost no air pollution and less noise. The regional transportation system integrates different modes and vehicle charging networks, creating a diverse range of clean, affordable transportation options for residents.

Local goods movement and transit produce no greenhouse gas emissions, with almost all vehicles powered by electricity or hydrogen. Large trucks, trains, marine vessels, and aircraft moving goods and people in and out of the region use low or zero emission engines and fuels. The Metro Vancouver region is a leader in the use of innovative technologies for trains, marine vessels, and aircraft, and is a hub for low emission goods movement. Transportation networks are located and designed to be resilient to the impacts of a changing climate, ensuring safe and reliable transportation of people and goods in the region.

Climate 2050 Transportation Roadmap

A pathway to carbon neutral transportation in Metro Vancouver

The Challenge

Transportation is the largest source of emissions in the region, but also has great potential to drastically reduce those emissions in the next 30 years. Reducing emissions from this sector is critical in order to reach climate targets for both 2030 and 2050. The majority of transportation emissions in our region come from fossil fuels used to power cars and trucks. Once a car or truck is purchased, it usually stays on the road for at least 10 years; most vehicles bought today will be in use in 2030. Trains, marine vessels, and aircraft also produce greenhouse gas emissions. The larger engines used in these modes of transportation pose an even greater challenge, as they are designed to last even longer and are very costly to replace.

Making it comfortable and easy to get around the region by walking, cycling, or using transit, and transitioning to zero emission engines and biofuels as soon as possible is critical in order for transportation to go from being the largest source of emissions to one of the smallest.

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

What is a Carbon Neutral Region?

A carbon neutral region means that we have achieved the deepest greenhouse gas emission 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.

Goals

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

It also sets an interim target of 45% reduction in greenhouse gas emissions from 2010 levels, by 2030.

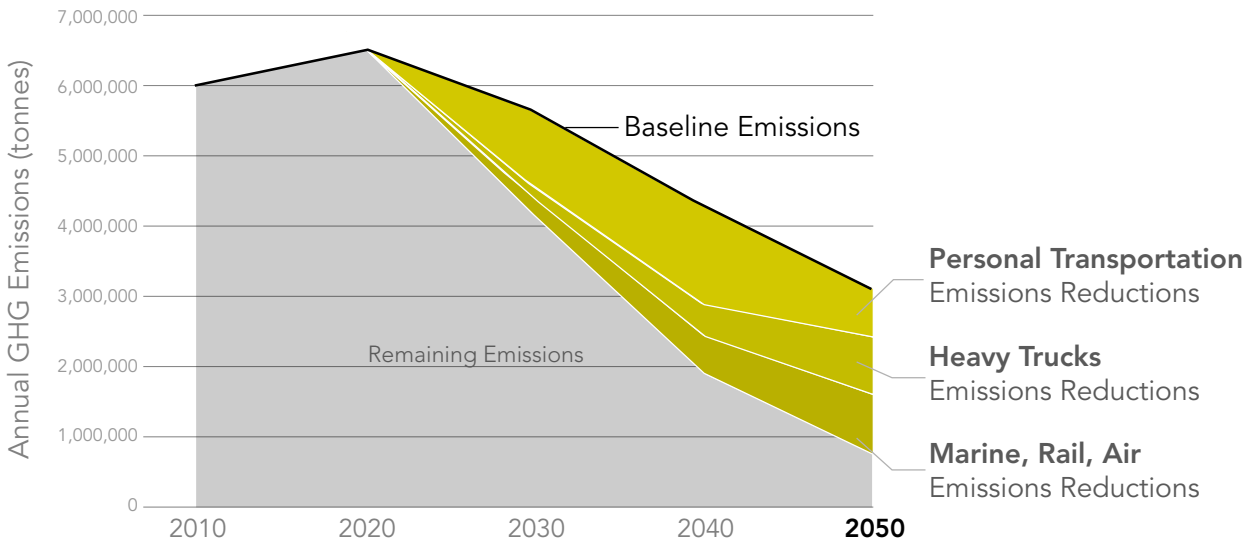
Achieving this vision means setting goals in each of the *Climate 2050 Roadmaps*, in order to ensure that each sector in the region plays as strong a role as possible in getting to a carbon neutral, resilient region.

Metro Vancouver has set these goals for transportation in this region, out to 2030 and 2050.

Goals	Targets
All personal travel within the region is made by active transportation or using zero emission technologies powered by clean, renewable energy.	By 2030: • 65% reduction in greenhouse gas emissions, from 2010 levels By 2050: • 100% reduction in greenhouse gas emissions • All passenger vehicles on the road are zero emission, powered by clean, renewable electricity or hydrogen
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 in 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
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 hazards

The graph below compares a baseline scenario – the pathway we are on now – with the possible impacts of the actions described in this *Roadmap*.

POTENTIAL IMPACT OF ACTIONS DESCRIBED IN THIS ROADMAP



Reaching these ambitious goals will require extensive collaboration with key partners. Many of the actions identified in this *Roadmap* will be led by other governments (e.g., national, provincial, local, First Nations), TransLink, and industry. Metro Vancouver has a long history of working with all levels of government towards common goals. Fortunately, many of the organizations needed to make this transition are already actively working toward similar goals, including the Provincial Government and its *CleanBC* plan, the Federal Government's climate plan called *A Healthy Environment and a Healthy Economy*, Metro Vancouver's member jurisdictions, community and corporate climate plans, TransLink, utilities, First Nations, and, increasingly, industry associations.

The Connection between Climate and Air Quality

The *Clean Air Plan* is Metro Vancouver's air quality and greenhouse gas management plan. Actions in the *Plan* will reduce air contaminant emissions and impacts, including greenhouse gases, in our region over the next 10 years, and in doing so support the 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. Transportation generates about half of diesel particulate matter, over half of nitrogen oxides, and roughly a third of sulphur oxides produced by all sectors in the region.

Actions in this Roadmap and the *Clean Air Plan* will help reduce all of these emissions to protect human health. The *Climate 2050 Transportation Roadmap* and the *Clean Air Plan* will work together to reach a common goal of accelerating our path to a carbon neutral region. As a result, the plans share some strategies and actions. Here's what you will find similar and different in each of these plans:

CONNECTING THE *TRANSPORTATION ROADMAP* AND THE *CLEAN AIR PLAN*

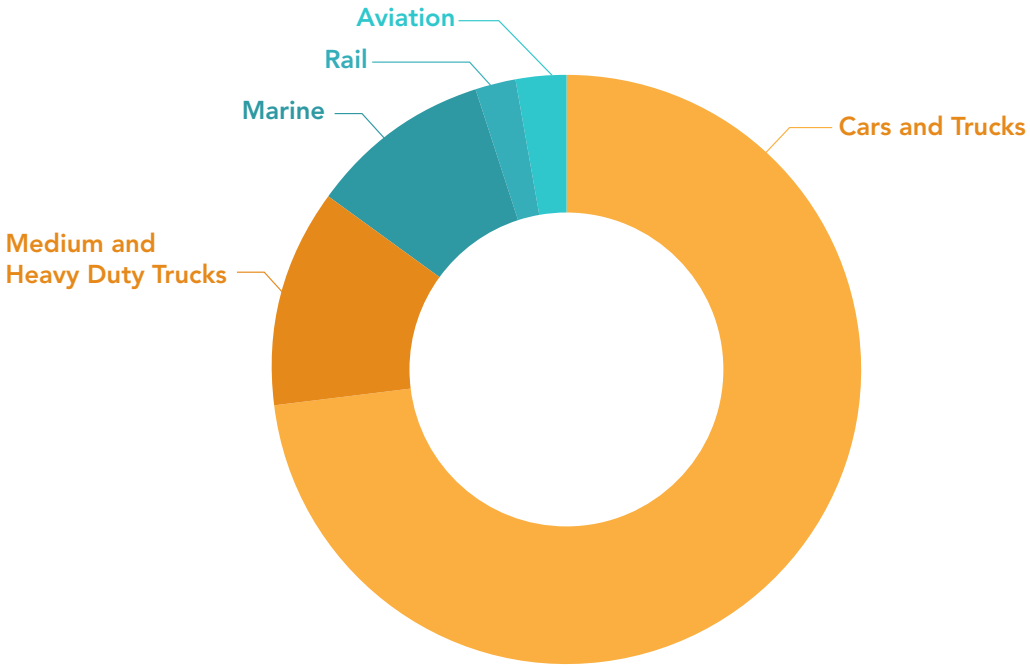
Clean Air Plan	*Transportation Roadmap*
• Greenhouse gas reduction goals, strategies and actions. • Air quality goals, strategies and actions. • Goals, strategies and actions for other sectors such as buildings, industry, and non-road equipment.	• Greenhouse gas reduction goals, strategies and actions. • Resilient transportation strategies. • Challenges, opportunities and benefits of transitioning our transportation system to become carbon neutral and resilient.

Emissions from Transportation in Metro Vancouver

The movement of people and goods – whether by car, truck, train, aircraft or boat – is the largest source of greenhouse gas emissions in Metro Vancouver, accounting for over 40% of total annual regional greenhouse gas emissions. The 1.5 million passenger cars and trucks, including SUVs, registered in the region make up most of those emissions, accounting for almost 75% of transportation emissions. 40,000 medium and heavy duty trucks registered in the region (plus the trucks registered elsewhere that travel in and out of the region) generate over 10% of regional transportation emissions.

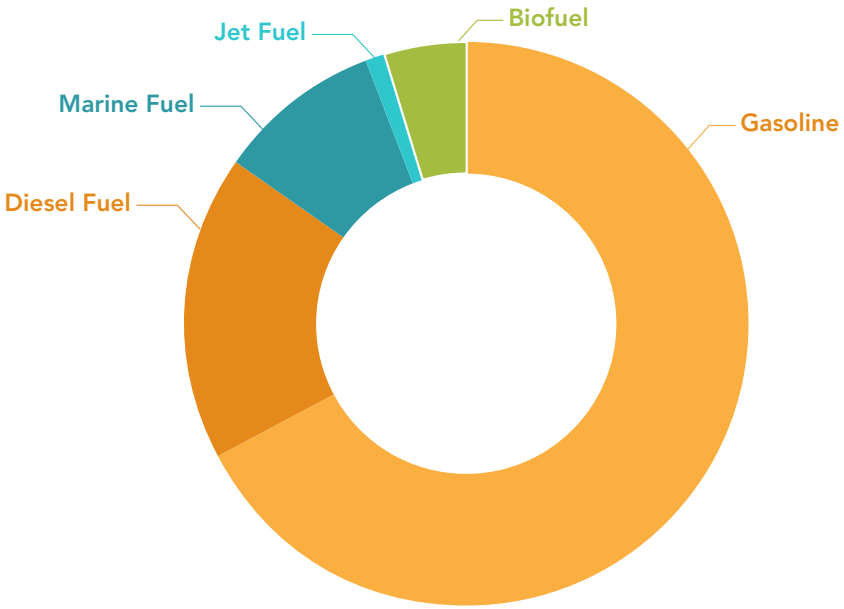
Around 150 million tonnes of cargo are handled at port terminals in the region every year, supporting the regional economy. This cargo movement is the main driver of marine vessel emissions in the region, though passenger ferries, cruise ships, harbour vessels, and pleasure craft are also sources of emissions. Together, marine transportation causes about 10% of transportation emissions. Trains used for goods movement accounts for most rail emissions in the region. Along with a small amount of passenger rail travel, this contributes about 2% of transportation emissions. Airports in the region handle 25 million passengers per year, which generate about 3% of regional transportation emissions. While aviation and marine emissions account for a relatively small amount of local greenhouse gas emissions, they are a significant source of emissions globally.

BREAKDOWN OF METRO VANCOUVER TRANSPORTATION GREENHOUSE GAS EMISSIONS



Virtually all of the energy used to power transportation is fossil fuel based, the majority of which is gasoline and diesel used in cars and trucks. A small amount of natural gas is used as a fuel for compressed natural gas vehicles, such as transit buses. Marine vessels and aircraft use specialized fossil fuels. Most of the trains in the region use diesel, though the SkyTrain network runs on electricity. In recent years, the advent of electric vehicles and biofuels have introduced the use of some zero emission vehicles and low carbon biofuels, but these still account for a very small proportion of overall energy use in transportation.

BREAKDOWN OF BREAKDOWN OF TRANSPORTATION ENERGY USE



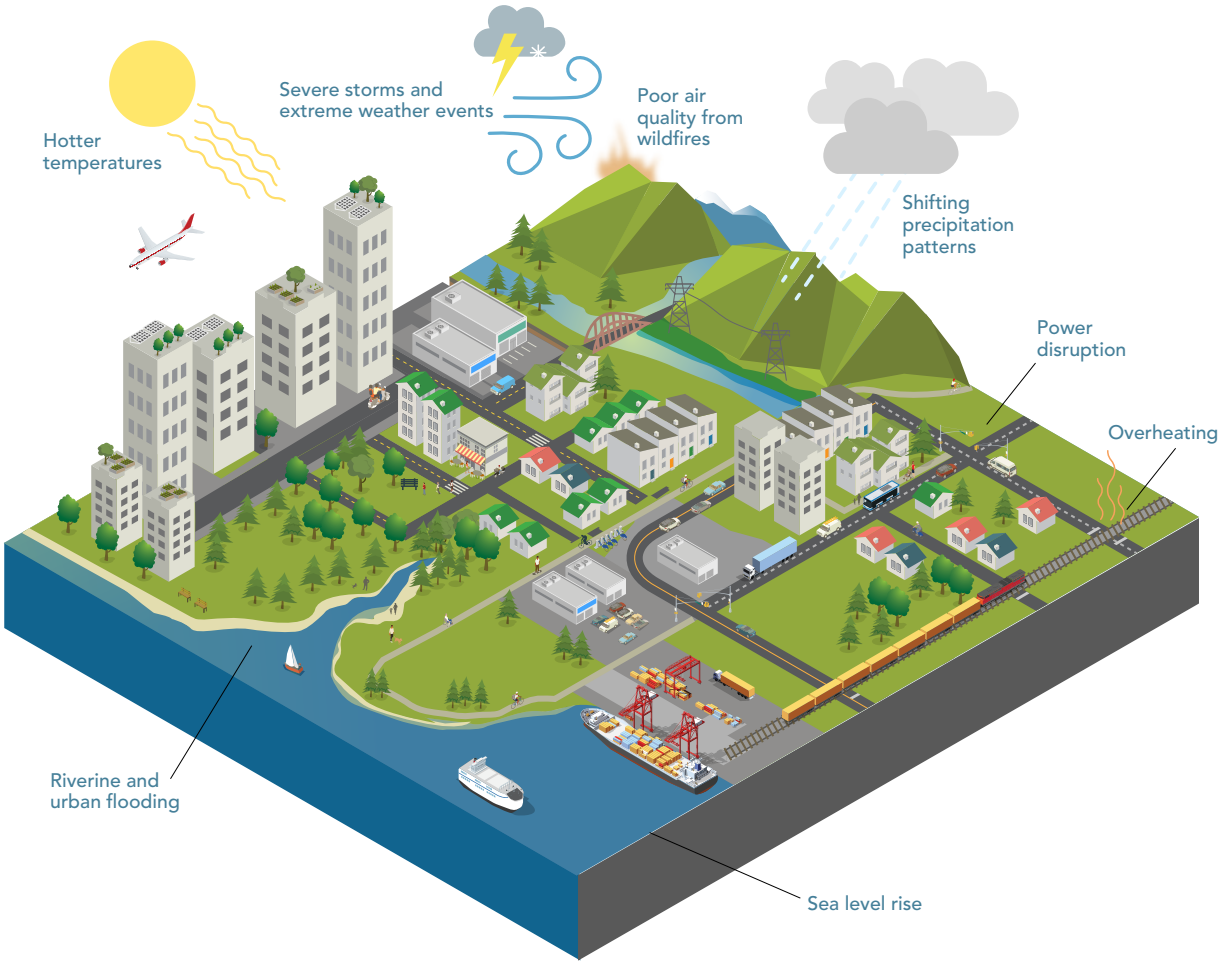
Compressed natural gas not shown as it accounts for less 1% of total energy use. Electricity is not shown; currently, electricity use for transportation is estimated to be small relative to other fuel types.

In addition to creating direct greenhouse gas emissions through fossil fuel use, the transportation sector is connected to emissions embodied in materials used for vehicles and other transportation equipment, upstream energy production, and construction and maintenance of roads, rail lines, and other parts of the transportation system. These emissions are not the subject of this *Roadmap*, but have considerable overlap with related sectors such as industry, waste, and energy production.

Climate Change Impacts on Transportation

We rely on our transportation system to reliably and comfortably get around the region and beyond, and for the supply of goods that we use every day. Ensuring that the transportation system is resilient to the impacts of a changing climate is essential. Transportation networks function smoothly due to infrastructure including roads, bridges, rail lines, transit, bike lanes, sidewalks, ports, ferry terminals, and airports. Most of this infrastructure lasts for decades, but has not always been designed to accommodate the anticipated impacts of climate change.

EXPECTED CLIMATE CHANGE IMPACTS



Transportation and Regional Resilience

While the resilience sections of this *Roadmap* focus on adapting transportation to impacts of climate change, transportation infrastructure itself can exacerbate climate change impacts. For instance, asphalt and concrete in roads and sidewalks often displaces natural ground cover, and these impervious surfaces can worsen the impacts of extreme heat and floods. Solutions to these issues will be addressed in their respective *Roadmap* issue areas, such as infrastructure, land use and growth management, and nature and ecosystems.

Metro Vancouver Climate Change Projections

While reducing regional greenhouse gas emissions will contribute to the global effort against climate change, some impacts from a changing climate are locked in and are likely to occur even with drastic emission reductions. There are already a number of projected changes to local climate conditions in Metro Vancouver:

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 metre of sea level rise by 2100, which will impact coastal areas in the region.

FRESHET

KING TIDES, WEST VANCOUVER

Climate Change Impacts on Regional Transportation

Existing and new transportation infrastructure will need to adapt to increasing impacts from:

- **Riverine and urban flooding** caused by periods of heavy rainfall during extreme weather events such as storms, or as a result of major spring freshets (snow melts) linked to changing snowpack. This can lead to localized flooding, power failures, landslides, and disruptions to the transportation system.
- **Sea level rise**, which will impact coastal areas in our region, threatening low elevation parts of the transportation network with flooding. 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.
- **Heatwaves, wildfires, and droughts** caused by warmer temperatures and changing precipitation patterns can impact the safety and comfort of walking, cycling, and taking transit. Major wildfire events could also disrupt inter-regional travel.

These impacts could have consequences to this region's transportation networks in numerous ways, such as:

- **Provincial highways and municipal arterial roads** around the Fraser River and Burrard Inlet may be susceptible to flooding that could disrupt emergency services, delay goods movement, and isolate residents and workers. Wildfires and landslides pose additional threats by affecting transportation access in and out of the region.

DROUGHT CONDITIONS WITH WILDFIRE SMOKE, LIONS GATE BRIDGE

- **Public transit** across the region could be impacted by flooding through disruptions to services and infrastructure for SkyTrain, West Coast Express, SeaBus terminals, and roads used by transit buses which would prevent residents and workers from travelling for work, school, recreation, and access to other services.
- **The Vancouver International Airport** is located at sea level so its runways, terminal grounds, and access roads are vulnerable to flooding and sea level rise. Flooding could also impact smaller regional airports such as Boundary Bay Airport, Pitt Meadows Airport and Delta Heritage Air Park.
- **Truck routes and rail lines** servicing the Vancouver Fraser Port Authority and industrial lands in the region could be damaged or disrupted by flooding, sea level rise, storm surges and heat waves, which could have cascading effects for supply chains.
- **BC Ferries terminals** could be susceptible to sea level rise, flooding, and increased delays from high winds, impacting passenger transportation as well as goods movement.
- **Bike lanes and regional greenways** could be prone to flooding if they are located near natural areas or along the Fraser River. Additionally, hotter temperatures and degraded air quality from wildfire activity may result in dangerous conditions for walking, rolling, and cycling.

Zero Emission, Low Carbon Transportation

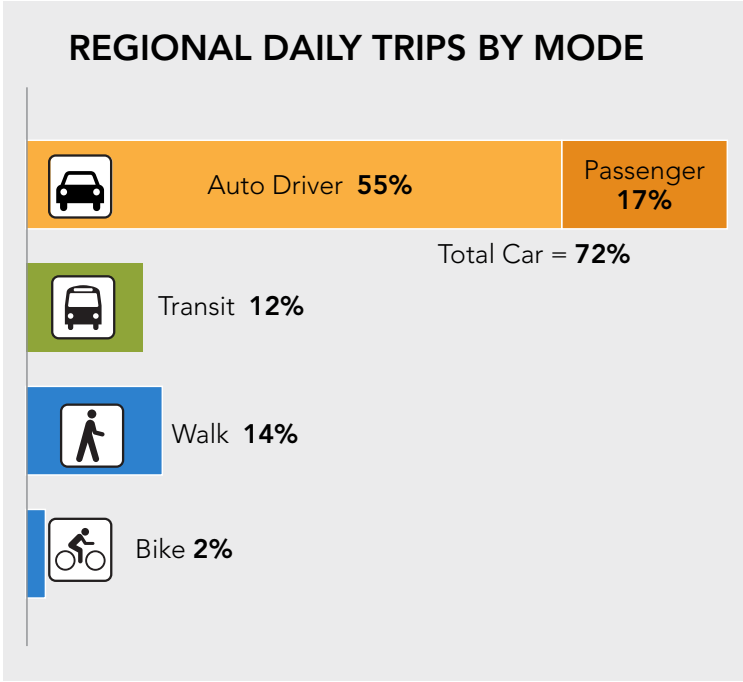
Emissions from transportation are caused by engines using fossil fuels, such as gasoline and diesel. The two key pathways to reducing emissions in transportation are to shift trips to active transportation, transit, and more energy efficient vehicles, reducing the use of fossil fuels, and to increase the use of zero emission vehicles and biofuels. Reducing the amount of driving in cars and trucks is a first step towards reducing transportation emissions, but achieving significant emission reductions in transportation will also mean switching from fossils fuels to clean, renewable energy that is zero emission or low carbon and replenished over days or years. Some modes of transportation, like cars, SUVs, and small trucks, are rapidly developing electric options. Other types of vehicles, such as heavy trucks used for goods movement, are more technologically challenging to electrify, and may rely more on the use of hydrogen or biofuels to reduce greenhouse gas emissions. Trains, ships, and aircraft are large, complex pieces of equipment that move between regions and countries, and face some unique challenges.

Reducing Driving

Over 70% of all trips in the region are made by car, and most of those are made by cars with a single occupant, the driver. However, there are many ways residents and visitors can make their daily trips: walking, rolling, cycling, taking transit, and driving with or without other passengers. These different modes have different impacts on greenhouse gas emissions. When people walk or cycle to their destination, they do not produce any emissions. On transit, one bus or train replaces several individual car trips. Carpooling also reduces the number of cars on the roads. New technologies and services like electric bicycles, car sharing, and ride hailing help reduce the need for people to drive or own their own car. These are all ways to reduce emissions by driving less. Driving less also means using less energy in cars, freeing up clean, renewable energy for use in other modes of transportation or sectors.

NEW WESTMINSTER

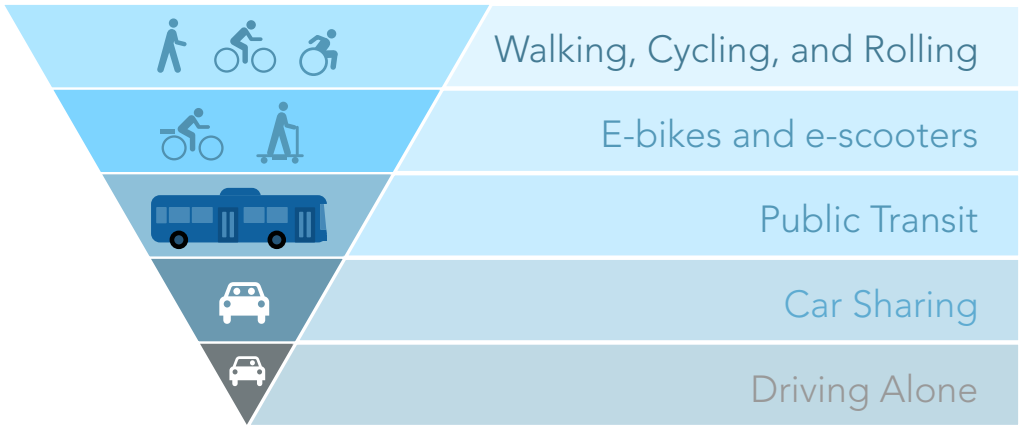
Many of the modes which produce little to no greenhouse gas emissions also have significant co-benefits. People who walk, roll, cycle, and and ride transit enjoy lower transportation costs and improved health and well-being. Reduced driving can lessen road congestion. Having multiple ways to get to and from key destinations also helps create a system that is more resilient to climate impacts.



Land Use

By shaping our neighbourhoods and communities with effective urban design, land use, zoning, and allocation of road space, we can create complete, compact communities that make walking, rolling and cycling well connected and comfortable for most short trips, and result in more efficient trips by car. Complete communities also support a frequent and efficient transit network that connects key destinations with comfortable, reliable service. This facilitates a multi-modal system where transit, active modes, car sharing, and other transportation options are efficiently integrated for convenient trips. However, even as the region continues to build towards well-connected, compact communities served by transit, many trips will be taken by vehicles. In order to eliminate greenhouse gas emissions from personal transportation, we need to find ways to make our vehicles zero emissions.

BETTER TRANSPORTATION CHOICES



Working Together to Reduce Regional Transportation Emissions

Strong regional land use policies are foundational to achieving the targets in the *Climate 2050 Transportation Roadmap*. There are several organizations that manage regional land use and transportation planning:

Metro Vancouver, in partnership with its member jurisdictions, manages regional land use and growth through the *Regional Growth Strategy*, which is being updated to extend to 2050 (*Metro 2050*). The *Strategy* outlines a vision for a compact region with a network of complete communities well connected by public transit.

TransLink is responsible for regional transportation planning, managing regional road networks, and delivering transit services. TransLink is currently developing *Transport 2050*, the region's long range regional transportation strategy, which will guide investment and planning decisions for the regional transportation system over the next 30 years. Together, *Metro 2050* and *Transport 2050* will shape how we live and move.

The **BC Government** is responsible for major transportation infrastructure such as highways, provides funding for capital projects, and sets policy to meet provincial environmental and economic objectives.

The *Transportation Roadmap* links together land use, transportation planning, and emissions reducing technologies to identify a pathway to reaching a carbon neutral and resilient transportation sector. This includes actions by other organizations that affect the regional transportation system.

Zero Emission Transportation Options

Electricity is a well-known zero emission source of energy that we already encounter every day. In British Columbia, almost all of the electricity that we use is generated from hydropower, making electricity a form of clean, renewable energy. When electricity is used as a source of energy to power vehicles in Metro Vancouver, there are no emissions from the tailpipe. Electric vehicles have become an increasingly familiar sight on the road, and are the best known type of zero emission vehicles. TransLink's fleet of transit vehicles also makes use of electric trolleys with overhead wires, and they have committed to transitioning to a 100% renewably powered fleet by 2050 through the *Low Carbon Fleet Strategy.*

British Columbia has world-leading legislation in place (the *BC Zero-Emission Vehicles Act*) that requires that more new cars and small trucks sold in British Columbia are zero emission, reaching 100% of new vehicle sales by 2040. However, because most vehicles stay on the road for at least 10 years after they are purchased, it will take a long time for gasoline and diesel powered vehicles purchased over the next two decades to reach the end of their lifecycle and be replaced with new zero emission vehicles. Additionally, these sales targets allow for the use of plug-in hybrid vehicles. As these vehicles use gasoline or diesel as a fuel in addition to electricity, they are not truly zero emission, but can be a low emission alternative to conventional fossil fuel-powered vehicles.

While electric vehicles are an important technology to reduce emissions from transportation, not all modes of transportation are ready to move to fully electric technologies. Electrifying some types of medium and heavy duty trucks is more challenging due to the heavier loads they carry, specialized operating needs, long driving ranges, and lack of rapid electrical charging in dispersed, remote destinations outside of the region. Electric options for ferries and small aircraft are available, but still very much under development. Larger marine vessels and aircraft are difficult to electrify due to the long distances they travel and specific operating demands, and no fully electric options are available for the largest and most complex of these. Electric rail locomotives are used widely in other parts of the world, such as Europe. However, transitioning inter-provincial railways to these zero emission fuels is costly and requires coordination at the provincial and national level.

Hydrogen can also be a zero emission fuel. Hydrogen technologies are emerging for all transportation modes, and could play an important role in helping some modes that are challenging to electrify transition to zero emission technologies. While hydrogen engines generally produce zero tailpipe greenhouse gas emissions, hydrogen can be produced using carbon intensive means that affect its overall carbon footprint. When produced using clean, renewable energy, hydrogen can be a zero emission and low carbon transportation fuel.

Hydrogen: A Zero Emission Fuel?

There are several different means of production for hydrogen that determine how emission intensive it is:

- **Grey hydrogen** is produced using natural gas, creating significant greenhouse emissions and a reliance on fossil fuels.
- **Blue hydrogen** is also produced using natural gas, but the emissions created during production are captured and stored.
- **Green hydrogen** is produced using electricity, and can be a zero emission and zero carbon fuel if the electricity used is generated from clean, renewable sources.

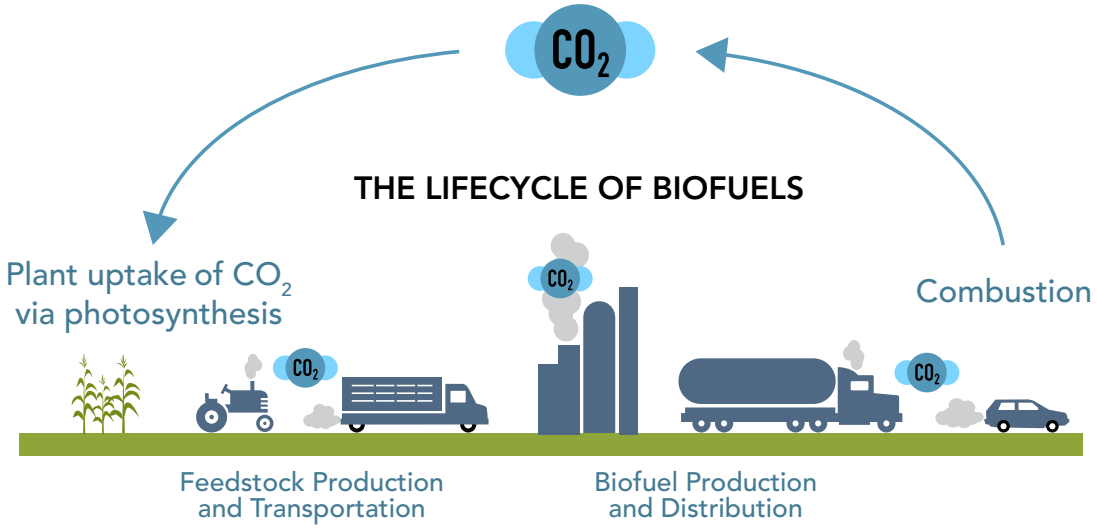
In the transportation sector, hydrogen can be used to power vehicles, marine vessels, trains, and more as fuel for **hydrogen fuel cells or specially designed internal combustion engines.** These technologies release water vapor from the tailpipe, and don't produce direct greenhouse gas emissions. However, hydrogen combustion engines may produce some nitrogen oxides, a health-harming air contaminant.

Strategic Use of Low Carbon Biofuels

In addition to zero emission sources of energy such as electricity and hydrogen, there are a number of fuels that have a low carbon footprint and are produced from organic matter derived from biomass such as plants. These biofuels are renewable and can be a low carbon source of energy. To use some of these fuels, specialized engines may be required, whereas others can be used directly in regular gasoline and diesel combustion engines. While not as visible as electric cars on the road, this is another example of a climate solution we already encounter every day. As a result of the *BC Low Carbon Fuel Standard* and federal requirements, a small proportion of biofuels are blended into the regular gasoline and diesel that we use in British Columbia.

Though biofuels can be low carbon alternatives to gasoline and diesel, they still produce tailpipe greenhouse gas emissions as well as air contaminants that can have negative impacts for public health and the environment. Feedstocks must be carefully managed to ensure that greenhouse gas emissions are balanced with carbon uptake in order for biofuels to be truly low carbon. Additionally, there are a number of ways in which biofuels generate greenhouse gas emissions throughout their lifecycle, from the use of fossil fuel-based fertilizer in feedstock growth to distribution. Some biofuels and renewable gas are produced in the region, including production at a number of Metro Vancouver facilities. However, biofuels produced outside of the region will be needed to meet demand. While biofuels are currently available and used in limited quantities, widespread use could have consequences for the way that we use agricultural land, forests, and other ecosystems. A lifecycle view of the carbon emissions from biofuels is needed to ensure that they are a low carbon alternative to fossil fuels and do not have unintended ecological impacts.

If used strategically, biofuels have the potential to displace the use of fossil fuels in large and specialized trucks, rail locomotives, aircraft, and marine vessels that are difficult to electrify, especially in the short term while new zero emission technologies are developed. Biofuels can also lower the carbon footprint associated with hybrid technologies that are not solely powered by electricity.



Low Carbon Transportation Biofuels

Low carbon diesel fuels include biodiesel and renewable diesel:

- **Biodiesel** is made from vegetable oils (such as canola) and waste animal fats. It can be blended in fossil diesel in amounts up to 20% and used in conventional diesel engines. When used in higher amounts, a specialized engine is required.
- **Renewable diesel** is also made from vegetable oils and animal fats, but is produced using a different process that makes the end fuel identical to fossil diesel. Because there is no chemical difference from fossil diesel, renewable diesel can be used directly in conventional diesel engines in amounts up to 100% without requiring engine modifications.

Ethanol is the most common renewable alternative to gasoline. Made from plants such as corn or sugar cane, it can be blended in regular gasoline in amounts up to 10% before a different engine is required. Flex fuel vehicles that can accommodate gasoline blends with up to 85% ethanol have become increasingly common in North America.

Renewable natural gas is produced from decomposing waste, and can be used in compressed natural gas vehicles and other equipment as a renewable, low carbon alternative to fossil natural gas.

There are specialized types of renewable fuels for aircraft and marine vessels, such as **sustainable aviation fuel**.

Low Carbon Aircraft, Trains, and Ships

All modes of transportation move in and out of the region some of the time, but aircraft, trains, and ships almost exclusively travel in and out of the region.They often travel long distances that cross provincial and international borders. Marine and air movement between countries is governed by international organizations such as the International Maritime Organization and the International Civil Aviation Organization. Policies and standards adopted by these organizations, action taken by other countries, and actions by the federal government are key determinants of whether and how these sectors will reduce greenhouse gas emissions. Rail transport faces similar challenges, as rail lines coming into and out of the region are subject to federal regulations and, when they cross the American border, the United States' regulations. National and international cooperation is essential to find ways to reduce emissions in these sectors.

Working Across Borders to Reduce Emissions

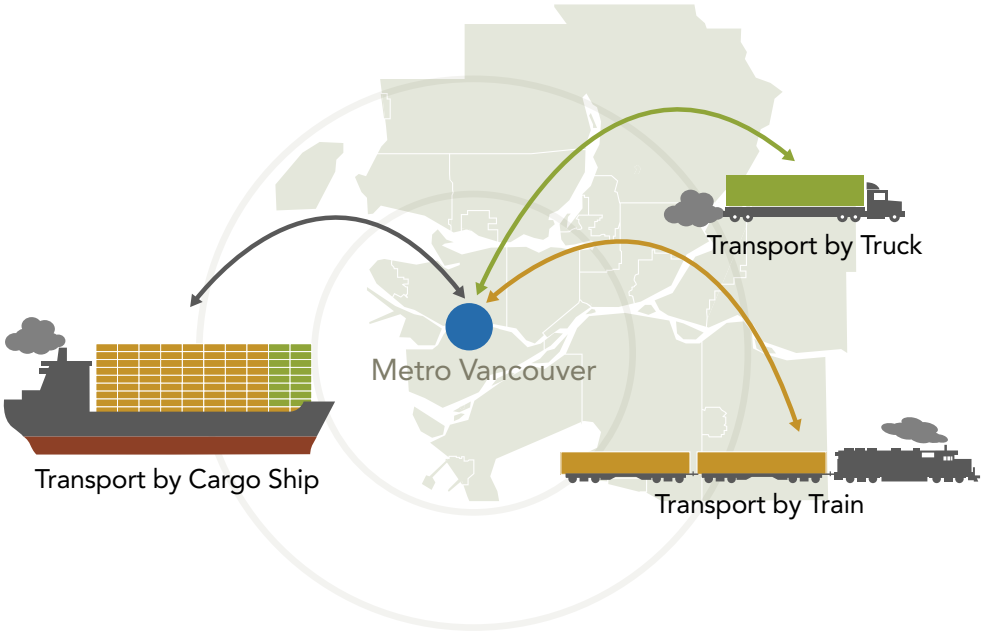
The **International Maritime Organization (IMO)** is a United Nations agency with responsibility for the prevention of marine and atmospheric pollution by ships, as well as their safety and security. It has committed to a target of reducing total annual greenhouse gas emissions from international shipping by at least 50% by 2050 (compared to 2008). The Federal Government is responsible for adopting, implementing, and enforcing IMO requirements within Canada.

The **Northwest Ports Clean Air Strategy (NWPCAS)** is a shared strategy for reducing air contaminants and greenhouse gases from the Port of Vancouver and ports in the state of Washington. Participating ports have committed to implementing port-specific plans to implement the NWPCAS vision of reaching net zero emissions by 2050.

The **International Civil Aviation Organization (ICAO)** is a United Nations agency that facilitates regulatory alignment between 193 member nations. It has adopted the aspirational goals of carbon neutral growth for the international aviation sector from 2020 onwards, as well as 2% annual fuel efficiency improvement from 2021 to 2050. Member nations are responsible for developing their own regulatory approaches to reaching these goals.

Canadian National Rail and **Canadian Pacific Rail** are the two major freight railways in Canada, both of which operate in the Metro Vancouver region. They are subject to legislation and regulation by the federal government. While Transport Canada has regulations in place to manage air contaminants from rail, there is no federal strategy in place to significantly reduce greenhouse gas emissions from rail. Some rail lines in the region also cross the American border, creating a need for international alignment.

The Metro Vancouver region is also a key hub for goods movement and air travel in Canada and the Pacific Northwest through Canada's largest port, The Port of Vancouver (operated by the Vancouver Fraser Port Authority), as well as Canada's second busiest airport, the Vancouver International Airport. The region can leverage this position and accelerate change in these sectors by creating opportunities that support the use of zero emission technologies and biofuels. Developing supply chains for biofuels, offering access to infrastructure for zero emission engines and biofuels, using zero emission technologies for smaller vessels and shorter in-region trips, and establishing requirements for trains, planes, and ships that service the region are important components of a larger national and international approach to reducing emissions in these sectors. Actions taken in the region can help reduce aviation and marine emissions well beyond Metro Vancouver's borders.



Ferries and local airlines move passengers between Metro Vancouver and neighbouring regions. Some of these, such as BC Ferries and Harbour Air, have introduced the use of innovative zero emission technologies. BC Ferries operates a number of battery-equipped ships on shorter routes. The ships are designed for full electric operation, but are fitted with hybrid technology that bridges the gap until shore charging infrastructure becomes available. Harbour Air has demonstrated the world's first fully electric commercial aircraft in a short test flight, and is advancing this technology for use in full length commercial flights in the future.

In addition to reducing greenhouse gas emissions from air, marine, and rail sources, it is critical that key transportation corridors and facilities such as ports, airports, and rail lines are resilient to the impacts of future climate hazards to minimize disruptions to goods movement, supply chains, and personal travel. Ships and aircraft used for goods movement, as well as ferries and rail lines used for passenger travel, must be adapted to a changing climate to ensure that connections to neighbouring regions and islands are reliable and safe.

Social Equity

Equity is the promotion of fairness, justice and the removal of structural barriers that may cause or aggravate disparities experienced by different groups of people. We must ensure no one is left behind in the transition to a carbon neutral and resilient region. Metro Vancouver's efforts to move towards zero emission and low carbon transportation will continue to incorporate the voices and needs of a full range of communities to ensure that fairness and equity are of the highest priority. Organizations responsible for transportation related climate policies must consider whether inequity is created or magnified, and address these inequities to ensure a just transition. Actions that reduce emissions must also support an equitable distribution of benefits and avoid an inequitable distribution of costs.

Integrating equity into Metro Vancouver's air quality and climate change programs is a work in progress. Metro Vancouver will develop a strategic approach to assessing equity in assessing equity in the *Climate 2050 Transportation Roadmap*. This will include community input, health impact assessments and other equity evaluation tools so that all residents benefit from these changes.

Barriers and Opportunities

The transportation sector presents an important opportunity to reduce regional greenhouse gas emissions in the next ten years and beyond, leading early emission reduction efforts in the region. Many member jurisdictions and the BC government are global leaders in taking action to reduce transportation emissions, and have put in to place a number of policies that provide a strong foundation. However, additional action is needed to leverage this opportunity to its full potential.

Reduce Driving through Compact Communities

Underpinning shifts in the technologies and fuels we use to move people and goods will be the continued development of a compact region. Existing compact communities along transit networks and around transit hubs bring people closer to the places they wish to go and facilitate some of the highest public transit ridership levels in North America. However, the population of Metro Vancouver is expected to grow from 2.7 million to 3.8 million, an increase of over 40%, from 2020 to 2050. It is critical that regional growth is concentrated in compact, transit serviced areas to minimize growth in car use and driving distances. Ensuring that more people live in compact communities that are well-connected to work, school, services, and amenities will enable a more affordable, resilient, and efficient transition to zero emission day-to-day trips.

Accelerating Uptake of Low and Zero Emission On Road Transportation Options

A number of the technology solutions and strategies to reduce emissions from on road transportation are already familiar to us. Electric vehicles and biofuels are already in use, and electric and hydrogen vehicle technologies are rapidly continuing to develop. Switching to lower emission modes for both personal transportation and goods movement is supported through existing and emerging regional transportation plans. However, this transition needs to happen faster

in order to meet regional climate targets. Actions such as the establishment of low emission zones can accelerate local uptake of low and zero emission transportation options including transit, active transportation, and zero emission vehicles. Reducing emissions from on road transportation sooner rather than later will also benefit the region by improving air quality, enhancing the resilience of transportation networks, and creating comfortable, affordable transportation options.

Rapid Uptake of Electric Vehicles

Electric vehicle and charging technologies have advanced substantially in recent years. Costs continue to decline, driving ranges are getting longer, and charging is getting faster. More makes and models will soon be available for larger vehicles. However, there are still barriers to rapidly increasing the amount of electric vehicles on the road:

- **Lack of affordable used electric vehicles.** Electric vehicles for personal use are widely available, inexpensive to charge, and declining in up front cost, but they still cost more than their fossil fuel counterparts and there is not yet an affordable used market for them. This creates inequities for lower income groups, and slows down the uptake of electric vehicles.
- **Diverse vehicle models are needed.** A greater variety of different electric vehicle models, such as SUVs, vans, and pickup trucks, are needed to meet diverse needs. Electric options are under development and will be available in coming years, but are not yet widely available for purchase.
- **Access to charging in large buildings can be challenging.** It can be expensive and complicated to access and install charging in large commercial and residential buildings like condos, townhomes, and multi-unit rentals. Better access to charging in these types of buildings is needed to support widespread electric vehicle uptake.
- **Infrastructure to support electric vehicle charging is needed.** As more people start using electric vehicles, new public fast charging stations and networks will be needed to support longer trips. A modernized electricity grid that integrates smart grid technologies can also help to support vehicle charging as electricity demand changes as a result of widespread electric vehicle use.
- **Accelerating electric vehicle uptake.** While the *BC Zero-Emission Vehicles Act* mandates sales targets for new electric vehicles, every new gasoline or diesel car sold in 2021 is likely to remain on the road until at least 2030. Additionally, market demand in the Metro Vancouver region has already exceeded regulated sales targets for early years. Finding ways to further accelerate electric vehicle uptake beyond the Provincial minimums to get more electric vehicles on the road earlier is a critical pathway to drastically reduce greenhouse gas emissions over the next ten years and beyond.

Reducing Emissions from Medium and Heavy Duty Trucks

Medium and heavy duty trucks used commercially will be slower and more difficult to transition to zero emission technologies than smaller vehicles used for personal transportation. It is unlikely that all of these vehicles will be ready to transition to zero emission technologies by 2050, creating a need for low carbon alternatives to bridge that gap. There are a number of barriers to wider adoption of zero emission and low carbon commercial vehicles:

- **Availability of zero emission vehicles is limited**. While there are several electric and hydrogen models developed for medium and heavy duty trucks, very few are in use and they are not yet widely available in British Columbia. The market for these vehicles must be expanded to make it possible to purchase zero emission vehicles in large quantities for a variety of commercial purposes.

- **Existing technologies have high up front costs**. The up front cost of zero emission vehicles is considerably higher than their conventional fossil fuel counterparts. As the market develops and production scales up, these costs are likely to follow trends in passenger vehicles and drop quickly. However, action is needed to accelerate market demand. Financial support will be needed to facilitate this transition.
- **Biofuel supply and availability is not yet developed**. Though some biofuels are already in use in gasoline and diesel used in the Metro Vancouver region, a significant ramp up of supply, production, and distribution of these fuels is needed before they can be deployed on a wider scale. As these supply chains develop, carbon intensity requirements are needed to ensure that biofuels have a lifecycle climate benefit.
- **Recharging and refueling infrastructure requires a multi-jurisdiction approach.** Recharging and refueling options for zero emission and low carbon vehicles will be more difficult to access for commercial vehicles that travel in and out of the region to far or remote destinations where access to fast electric charging, hydrogen refueling, and biofuels may not develop at the same pace as regional infrastructure.

Zero Emission and Low Carbon Technologies for Marine Vessels, Rail Locomotives, and Aircraft

As on-road vehicles transition to zero emission technologies and biofuels, marine vessels, rail locomotives, and aircraft will become the largest remaining sources of regional transportation greenhouse gas emissions. Additionally, as our economy grows, goods movement within and through the region will continue to grow, compounding the need to reduce emissions from marine and rail while maintaining a competitive local economy. However, reducing emissions from these sources is challenging for a number of reasons:

- **Innovative zero emission and low carbon technologies are still under development.** While there are some electric and hydrogen options developed for rail locomotives and small ferries, zero emission options for aircraft, harbour tugs, and large marine vessels are virtually non-existent. Rapid innovation in these modes is needed to develop and scale up production of viable zero emission technologies, especially as many of these engines last for decades and will still be in use in 2050.
- **Global demand for biofuels requires complex supply chains and large quantities of feedstocks.** Widespread use of biofuels for global marine and air movement will require huge amounts of these fuels and a high degree of coordination at production and refueling facilities around the world. A better understanding of global supply and production constraints is needed to effectively build a role for biofuels in sectors with significant international connections.
- **National and international cooperation is needed to effectively reduce emissions.** Cooperating with research institutions, industry partners, international agencies such as the IMO and ICAO, and other governments – locally, provincially, federally and internationally – will be key to developing new technologies and building reliable refueling and recharging networks. A shared vision for emission reductions is needed to ensure these sectors are on a pathway to carbon neutrality.

The Journey to Carbon Neutral, Resilient Transportation

Linkages to Other Climate 2050 Roadmaps

There are many linkages between transportation and other *Climate 2050* issue areas. Some of the related issue areas for transportation include:

Land use and growth management – policies that support more compact, complete communities influence the form and location of the transportation network, how people move and how goods are transported;

Infrastructure – the regional transportation network includes infrastructure such as roads, rail lines, bridges, and bike paths;

Energy – availability of clean, renewable energy to power regional transportation;

Human health and well-being – active transportation modes improve public health;

Buildings – home and workplace charging for electric vehicles will become more common, and;

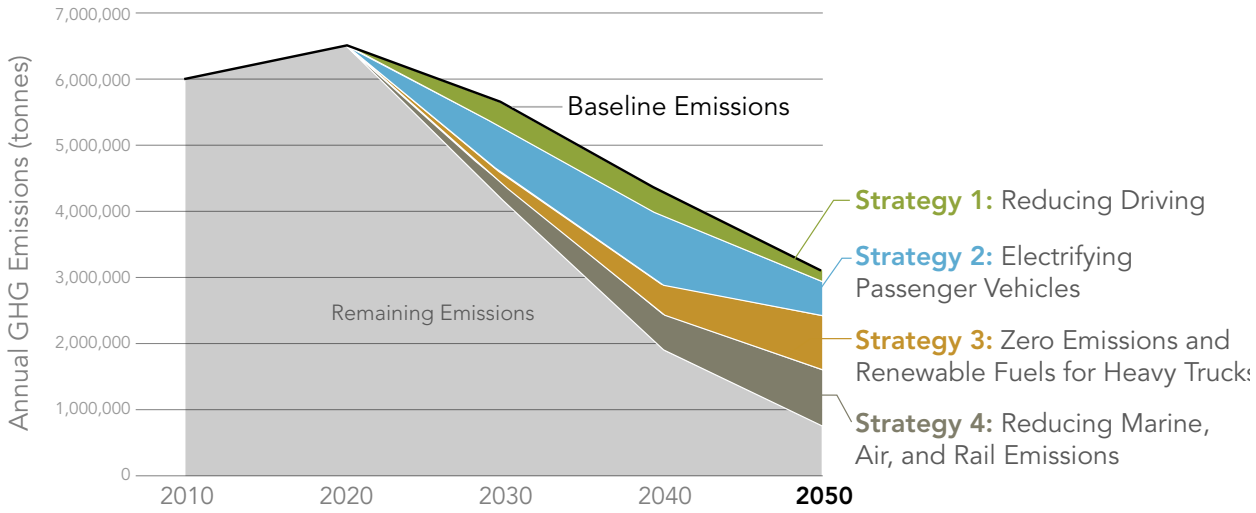
Industry – delivery of goods and provision of services impact the amount and types of transportation that take place in the region. Non-road vehicles and equipment may be impacted by policies applied to on-road transportation.

Linkage to Metro Vancouver's *Clean Air Plan*

Strategies 1-4 (and all the associated actions) appear in both the *Transportation Roadmap* and the *Clean Air Plan*. These two plans are working together to achieve a carbon neutral region. Linking these strategies and actions in both plans ensures a clear action plan for Metro Vancouver and its partners.

SKY TRAIN, SURREY

POTENTIAL IMPACTS OF THE STRATEGIES AND ACTIONS DESCRIBED IN THE ROADMAP



STRATEGY 1: Reduce Driving through Active Transportation and Public Transit

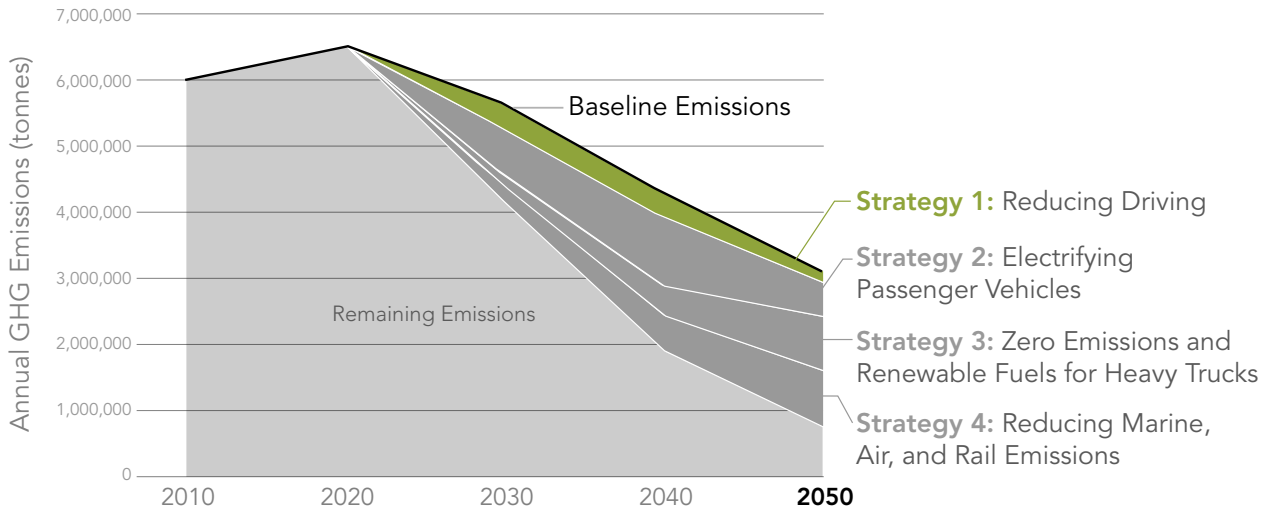
Transportation emissions at the community scale are driven by where people live, work, study and play. The Metro Vancouver *Regional Growth Strategy* and the *Regional Transportation Strategy* both outline policies to help create communities that are complete, compact, and transit oriented. When people live closer to where they work, study and play, more trips can be made by walking, rolling and cycling and on public transit. Emerging technologies and services such as electric mobility devices and and car sharing can also support a wider range of transportation options.

Reducing the amount of driving in the region contributes to many different goals, such as improving air quality and health impacts and managing traffic congestion as regional population grows. Active transportation in particular has important co-benefits such as improved health. However, helping residents and businesses to drive less is a long-term transition, and significant funding is needed to expand public transit and active transportation options.

STRATEGY 1	Potential Impacts of Strategy	Key Partners
	Reduce annual greenhouse gases by up to **280,000** tonnes by 2030 Reduce annual greenhouse gases by up to **170,000** tonnes by 2050	• Member jurisdictions • TransLink • BC Government • Government of Canada

RAPID BUS, MAPLE RIDGE

POTENTIAL IMPACT OF STRATEGY 1 ON GHG EMISSIONS



1.1 Enhance and Improve Regional Transit.

BIG Move

Advocate to TransLink to increase public transit in the region, significantly shifting trips from passenger vehicles to transit. TransLink should increase transit frequency in key areas, transition to using clean, renewable energy, and implement other related air quality and climate actions outlined in the *Regional Transportation Strategy*. Regional emission reductions should be prioritized in transit expansion and service decisions, while ensuring that all residents have access to transportation options in a connected region.

1.2 Use Pricing to Reduce Driving and Emissions.

BIG Move

Work with the BC Government, TransLink, member jurisdictions and other regional partners to develop and implement a policy that puts a price on driving in the region, to help reduce emissions. The program could include mobility pricing, transportation pricing, usage-based insurance, fuel taxes, etc. Any program should prioritize fairness and equity and be supported by transit expansion (Action 1.1). Any program should align with any low or zero emission zones in the region (see Actions 2.2 and 3.1).

1.3 Expand Active Transportation Networks.

BIG Move

Advocate to member jurisdictions to expand regional and local active transportation networks so it's the most convenient choice for most shorter trips. The networks should be well-connected, comfortable for most, and integrated with public transit. Network expansion should prioritize under-served areas to ensure all residents have access to active transportation options in a connected region. Network elements should include walking and cycling paths, regional greenways, separated bike lanes, and end-of-trip facilities suitable for all bike and mobility types, including charging for electric mobility devices such as electric bikes, electric scooters, etc.

1.4 More Stable Infrastructure Funding for Regional Active Transportation Networks.

Advocate to BC Government and Government of Canada to expand stable funding for comprehensive regional and local active transportation networks. The networks should be well-connected, comfortable for most, and integrated with public transit.

1.5 More Stable Funding for Regional Transit.

Advocate to BC Government and Government of Canada to expand stable funding for the regional transit system to cover both operations and capital investments, including investments to transition to zero emission technologies.

1.6 Regional Parking Strategy to Reduce Driving.

Develop a Regional Parking Strategy to prioritize active transportation and other low emission transportation options, coordinating with member jurisdictions and TransLink. The strategy could include replacing building parking minimums with maximums, establishing parking minimums for bicycles, implementing dynamic parking pricing and reducing free parking spaces. The strategy could also support uptake of electric and car-share vehicles by establishing electric vehicle charging requirements for parkades, and enhancing preferential parking rates and spaces for electric and car-share vehicles.

1.7 Support Residents and Businesses in Active Transportation.

Advocate to the BC Government and Government of Canada to provide provide funding (e.g. incentives, tax credits) to residents and businesses to support active transportation, including for buying, renting or sharing all bike and mobility types. Funding availability should prioritize groups who generally cannot access these transportation options, such as low-income residents and households.

1.8 Communicate the Benefits of Walking, Cycling and Public Transit.

Support outreach campaigns led by TransLink, member jurisdictions and health authorities that show the benefits of walking, cycling (including electric bikes) and public transit, including the associated improvements to regional air quality and greenhouse gas emissions.

1.9 Implement Trip Reduction Programs.

Advocate to BC Government to require large employers and major trip generators (e.g., shopping malls) to implement trip reduction programs. Such programs could require large employers and other major trip generators to measure staff or customer driving habits and take action to reduce driving. These programs should consider availability of lower emission alternatives and opportunities for remote and flexible work options.

1.10 Regional Bike- and Car-Sharing Strategy

Develop a regional strategy to support the increased use of sharing services for cars, bikes, and electric mobility devices, including e-bikes, coordinating with member jurisdictions, TransLink and other regional partners. These services have been shown to reduce total driving distances among users.

1.11 Support Low Emissions Commuting by Staff.

Corporate LEADERSHIP

Develop and implement a Metro Vancouver corporate commuting strategy to reduce driving emissions. The strategy would encourage more commuting by active transportation, public transit and car-pooling. The strategy could also review parking policies, explore distributed and remote work options where operationally feasible, and recommend additional electric vehicle chargers at work sites.

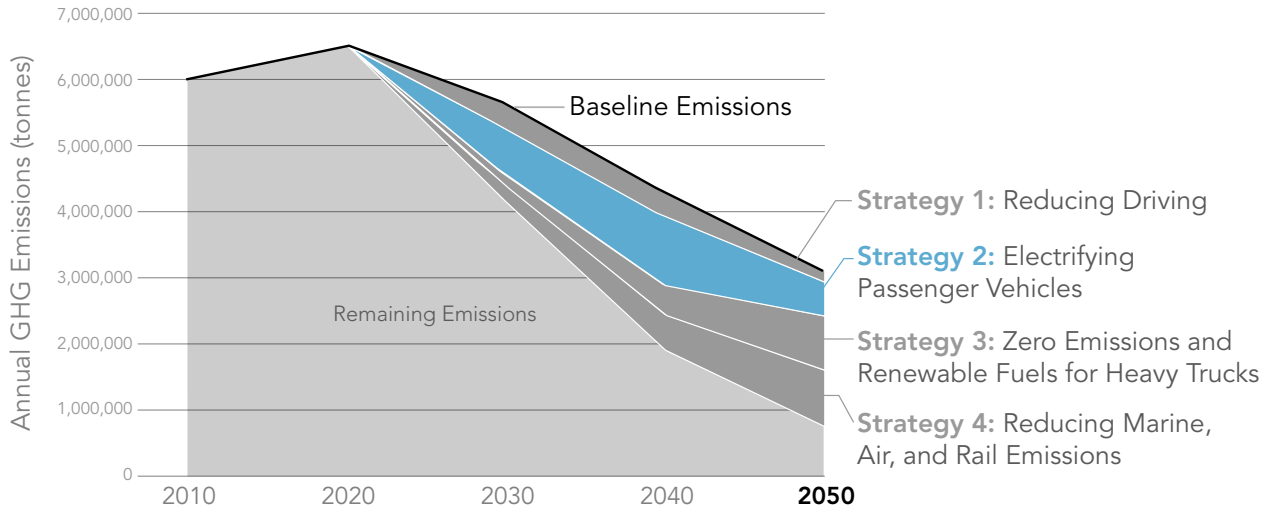
BUS STOP, SURREY

STRATEGY 2: Accelerate the Transition of the Passenger Vehicle Fleet to Electric Vehicles

The 1.5 million passenger vehicles registered in the region are our largest source of greenhouse gases, contributing almost a third of all regional emissions. Electrifying passenger vehicles is a critical way to significantly reduce these emissions, though work is needed to ensure that electric vehicles and charging infrastructure are reasonably accessible to everyone, including lower income households. The *BC Zero-Emission Vehicles Act* provides a pathway to 100% zero emission vehicle sales by 2040, but this timeline should be accelerated to get more electric vehicles on the road faster.

STRATEGY 2	Potential Impacts of Strategy	Key Partners
	Reduce annual greenhouse gases by up to **710,000** tonnes by 2030 Reduce annual greenhouse gases by up to **520,000** tonnes by 2050	• Member jurisdictions • BC Government • BC Hydro

POTENTIAL IMPACT OF STRATEGY 2 ON GHG EMISSIONS



2.1 Accelerate Sales Targets for New Electric Passenger Vehicles.

BIG Move

Advocate to the BC Government to accelerate the sales targets in the *BC Zero-Emission Vehicles Act* to reach 100% zero emission vehicle sales by 2030 (instead of current 2040 target). The BC Government should also modify the Act to prioritize 100% electric vehicles. Advocate to Government of Canada to establish sales targets for zero emission passenger vehicles, reaching 100% by 2030 (instead of the current 2035 target).

2.2 Develop Regional Emission Requirements for Passenger Vehicles.

BIG Move

Develop regulatory emission requirements for existing passenger vehicles, to be implemented by the BC Government or Metro Vancouver. Requirements could include low or zero emission zones, or a vehicle emission levy with rebates for replacing older vehicles. Any regulatory program must consider equity and be coordinated with member jurisdictions. Any program could also support actions focused on reducing total driving distances, including Action 1.2 on pricing driving.

2.3 Make Electric Vehicles More Affordable.

BIG Move

Advocate to BC Government, Government of Canada and other regional partners to continue providing funding (e.g., incentives, loans and tax credits) for the purchase of new and used electric vehicles. Funding should be available for personal and business purchases and should prioritize groups who generally cannot afford these vehicles without funding programs, such as low and middle income households.

2.4 Regional Electric Vehicle Charging Strategy.

Develop a long-term regional strategy for electric vehicle charging infrastructure, coordinating with member jurisdictions, energy utilities, TransLink, industry, and other regional partners. A strategy would identify where additional publicly accessible electric vehicle chargers are needed to ensure equitable access, as well as provide guidance on user fees, design and siting, and consider integration of other electric mobility devices such as e-bikes. The strategy should align with similar actions for medium and heavy duty trucks (Action 3.7).

2.5 Make New Passenger Vehicles Cleaner.

Advocate to the Government of Canada to adopt more stringent fuel economy and emission standards for new passenger vehicles, prioritizing greenhouse gas reductions.

2.6 Expand Electric Vehicle Charging in Buildings.

Work with member jurisdictions, BC Government, BC Hydro and Government of Canada to expand access to electric vehicle charging in buildings. This should include adoption of provincial "Right-to-Charge" legislation as well as code requirements that new or substantially renovated buildings are wired for electric vehicle chargers. Expanding access should also include increased support and funding (e.g., incentives, loans, tax credits) for electric vehicle charging in existing buildings. Funding should prioritize groups who generally would not have access to chargers, such as residents living in rental buildings, strata buildings, non-market housing or secondary suites.

CHARGING STATION, PORT MOODY

2.7 Electric Vehicle Outreach Programs.

Enhance existing and deliver new public outreach programs about the benefits of electric vehicles and how to install electric vehicle chargers at workplaces and multi-family buildings, working with member jurisdictions and other regional partners.

2.8 Electrification Targets for Ride-Hailing Services.

Advocate to BC Government to establish vehicle electrification targets for ride-hailing and taxi fleets.

Corporate LEADERSHIP

2.9 Transition the Corporate Fleet to Zero Emissions.

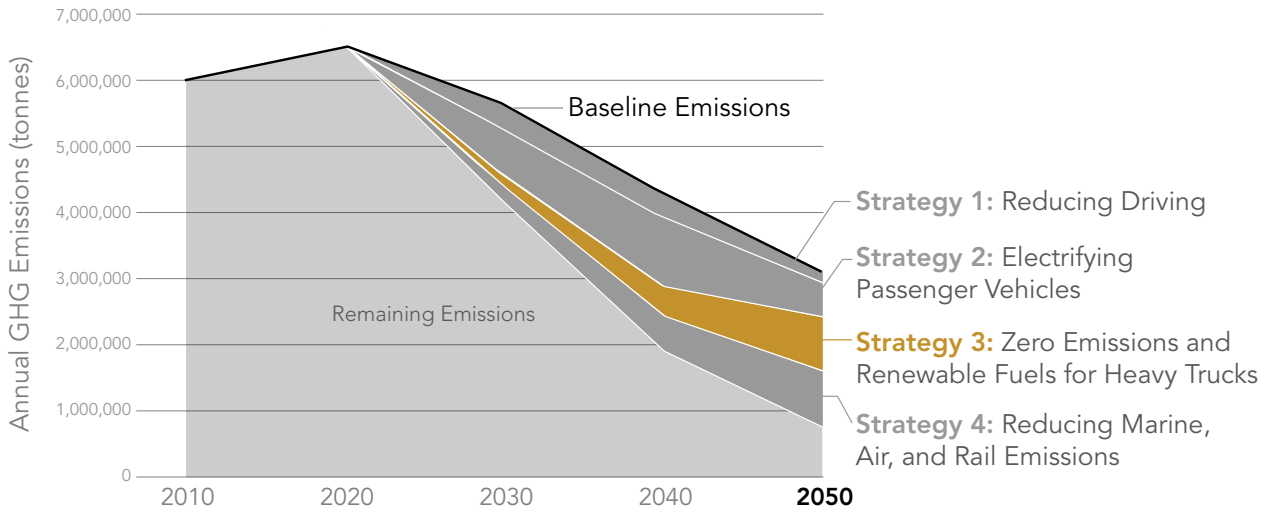
Transition Metro Vancouver's corporate on-road fleet to zero carbon emission between 2035 and 2040, and zero emission by 2050. The transition would include both passenger and medium and heavy duty vehicles.

STRATEGY 3: Reduce Heavy Truck Emissions and Support Early Adoption of Zero Emission Heavy Trucks

As our economy grows, goods movement in the region will continue to grow. Federal emission standards ensure new trucks use fuel more efficiently, and provincial clean fuel standards have reduced the carbon intensity of diesel, the primary fuel for medium and heavy duty trucks. Sales targets, incentives and a regional refueling strategy will accelerate the long term transition to zero emission medium and heavy duty trucks, reducing greenhouse gases and improving regional and local air quality while supporting a competitive local economy. Other medium and heavy duty vehicles used in the region, such as transit vehicles, must also shift towards zero emission technologies and low carbon fuels.

STRATEGY 3	Potential Impacts of Strategy	Key Partners
	Reduce annual greenhouse gases by up to **170,000** tonnes by 2030 Reduce annual greenhouse gases by up to **810,000** tonnes by 2050	• BC Government • TransLink • Trucking industry • Vancouver Fraser Port Authority • Member jurisdictions

POTENTIAL IMPACT OF STRATEGY 3 ON GHG EMISSIONS



3.1 Regulate Existing Medium and Heavy Trucks.

BIG Move

Develop regulatory requirements for existing medium and heavy duty trucks, implemented by the BC Government or Metro Vancouver. Regulatory approaches to reduce emissions could include an inspection and maintenance program that requires repairs on higher emitting trucks, registration requirements targeting older vehicles, and low or zero emission zones (aligned with Action 2.2). Requirements should be developed in coordination with member jurisdictions, Vancouver Fraser Port Authority, TransLink and other regional Requirements would align with TransLink's transition to clean, renewable energy in Action 1.1.

3.2 Require Zero Emission Sales Targets for New Medium and Heavy Trucks.

BIG Move

Advocate to the BC Government to set mandatory zero emission vehicle sales targets for new medium and heavy duty trucks. For medium duty trucks, the zero emission sales target should reach 100% by 2050. For heavy duty trucks, the zero emission sales target should reach 100% before 2060.

3.3 More Stringent Low Carbon Fuel Standards.

BIG Move

Advocate to the BC Government to further increase the stringency of the BC *Low Carbon Fuel Standard* to reduce the carbon intensity of transportation fuels, primarily through increasing use of renewable diesel and ethanol. Advocate to the Government of Canada to adopt a *Clean Fuel Standard,* to include more stringent carbon intensity targets for all transportation fuels (see Actions 4.1, 4.2, 4.5 and 4.6).

3.4 Long-term Emissions Strategy for Medium and Heavy Trucks.

Work with the BC Government and partners to develop a long-term province-wide emissions strategy for medium and heavy duty vehicles. The strategy should identify a phased timeline to implement a suite of policies and programs (including the other actions under Strategy 3) that would accelerate fleet turnover to cleaner vehicles while preparing for the longer term transition to zero emission vehicles. The strategy should target both greenhouse gas emissions and health harming air contaminants, while providing a level-playing field and minimizing stranded assets.

3.5 Make Low and Zero Emission Medium and Heavy Trucks More Affordable.

Advocate to BC Government, Government of Canada and other regional partners to enhance enhance funding (e.g. incentives, loans, tax credits, joint financing) for the purchase of low and zero emission medium and heavy duty trucks. Any funding program should consider whether funds should be targeted to groups less able to afford low and zero emission medium and heavy duty trucks.

3.6 Regulate Fuel Economy and Emissions for Medium and Heavy Trucks.

Advocate to the Government of Canada to adopt more stringent fuel economy and emission standards for medium and heavy duty trucks, prioritizing greenhouse gas reductions. Cleaner trucks will improve regional air quality in the short term and support the long term transition to zero emission vehicles.

3.7 Zero Carbon Refueling Strategy for Medium and Heavy Trucks.

Develop a long-term regional zero carbon refueling strategy for medium and heavy duty trucks, coordinating with member jurisdictions, energy utilities, Vancouver Fraser Port Authority, TransLink, fuels industry, and other regional partners. The strategy would identify where refueling stations are needed for different fuels including electricity, hydrogen, renewable diesel and others. The strategy could identify pilot

ROBERTS BANK, DELTA

projects and should also consider opportunities to leverage public investment in electric bus charging infrastructure for commercial vehicle use. This strategy should align with similar strategies for passenger vehicles (Action 2.4).

3.8 Funding for Zero Carbon Refueling Infrastructure for Medium and Heavy Trucks.

Advocate to the BC Government, Government of Canada and energy utilities to increase funding (e.g., incentives, loans, tax credits) for zero carbon refueling infrastructure for medium and heavy duty trucks. This infrastructure would support early adoption of low and zero emission medium and heavy trucks, prior to wider commercialization.

3.9 Large Fleets to Adopt "ZEV-First" Procurement.

Develop and support implementation of "ZEV-first" fleet procurement policies, coordinating with member jurisdictions and large fleet operators in the region, to transition fleets to zero emission vehicles by the late 2040s. The policies would be supported by regularly updated information on the availability of zero emissions medium and heavy duty trucks and zero emission passenger vehicles. The policies could also include guidance on right-sizing fleets, calculating total lifetime costs of zero emission vehicles, and potential regional coordination of purchases of zero emission vehicles for fleets (i.e. bulk buy).

3.10 Reduce Delivery Emissions.

Work with member jurisdictions, delivery industry, and other regional partners to implement programs to reduce delivery emissions. Programs should prioritize transitioning delivery fleets to zero emissions (aligned with Actions 3.7 to 3.9) and could also include off-peak deliveries, small urban consolidation centres ("microHubs"), and cargo bike deliveries. This should include exploring the emissions impact of growing online deliveries, along with any potential solutions.

3.11 Reduce Refuse Trucks Emissions.

Work with member jurisdictions and other regional partners to accelerate the transition to zero emission refuse trucks. Opportunities could include contracting, procurement, charging infrastructure, and regional coordination of purchases (i.e., bulk buy).

3.12 Support Innovation in Zero Emission Technology for Medium and Heavy Trucks.

Advocate to industry, academic institutions and other governments to accelerate innovation in low and zero emission technologies for medium and heavy duty trucks, including supporting pilot projects.

3.13 Use Business Licences to Support Emission Reductions.

Work with member jurisdictions to explore whether business licences can be used to accelerate adoption of low and zero emission medium and heavy duty trucks.

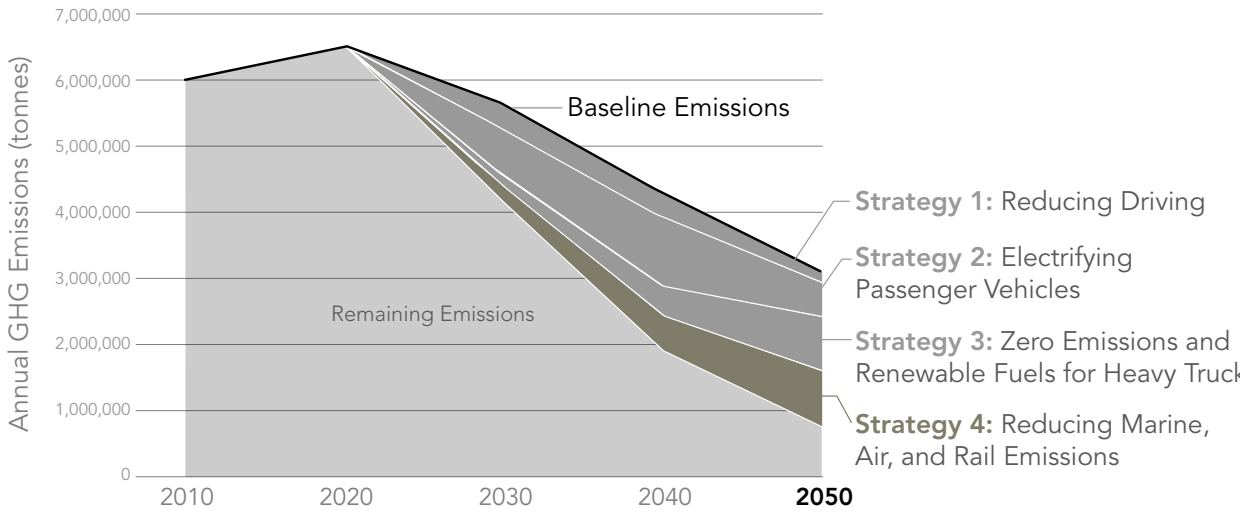
STRATEGY **4:** Reduce Marine, Rail, and Aviation Emissions

Marine, rail, and aviation are significant sources of greenhouse gas emissions globally. While they account for a relatively small amount of regional greenhouse gas emissions, regional rail lines, ports, and airports are important hubs in larger networks that must decarbonize to meet global climate targets. Achieving significant emission reductions in the marine and rail sectors depend on efforts by the Government of Canada and the BC Government to develop and implement strategies to advance cleaner fuels and engine technologies. The Government of Canada also needs to advocate to international organizations such as the International Maritime Organization to accelerate the implementation of more stringent emission standards. Locally, the Vancouver Fraser Port Authority is working to reduce greenhouse gas and health-harming air contaminant emissions associated with shipping in the region.

International standards have improved fuel economy from aircraft and the Vancouver International Airport Authority is electrifying airport operations. While electrification of small aircraft is progressing, achieving significant emission reductions for large aircraft is challenging. In the short term, increasing the availability of sustainable aviation fuel will reduce greenhouse gases from aviation. In the long term, the Government of Canada needs to develop a national strategy to transition to a carbon neutral aviation sector. This likely would include advocacy to international organizations such as the International Civil Aviation Organization.

STRATEGY 4	Potential Impacts of Strategy	Key Partners
	Reduce annual greenhouse gases by up to **250,000** tonnes by 2030 Reduce annual greenhouse gases by up to **860,000** tonnes by 2050	• Vancouver Fraser Port Authority • Government of Canada • BC Government • Airlines • Vancouver International Airport Authority • BC Ferries

POTENTIAL IMPACT OF STRATEGY 4 ON GHG EMISSIONS



4.1 Accelerate Emission Reductions from Marine Vessels.

BIG Move

Advocate to the Government of Canada and BC Government to develop and implement implement long-term strategies to accelerate emission reductions from ocean-going marine vessels, harbour vessels and passenger ferries in the region. Different strategies may be needed for domestic versus international vessels. In the short term, the strategy should prioritize cleaner engines, more renewable fuels and more shore power, particularly for vessels operating in areas that are most impacted by marine emissions. In the long term, the strategy should establish more stringent greenhouse gas emission targets, standards and regulations, to achieve a carbon neutral marine sector by 2050. The strategies should also consider efficiency improvements and the design and supportive funding for regional refueling infrastructure for zero carbon marine vessels.

4.2 Accelerate Emission Reductions from Rail Locomotives.

Advocate to the Government of Canada and BC Government to continue development and implementation of long-term strategies to accelerate emission reductions from rail locomotives in the region. Different strategies may be needed for local versus long-haul locomotives. In the short term, the strategies should prioritize cleaner locomotives, particularly those operating near neighbourhoods and active transportation corridors most impacted by rail emissions, as well as fugitive emissions from rail cars. In the long term, the strategies should establish more stringent greenhouse gas emission targets, standards and regulations for line-haul, switch, and local locomotives, to achieve a carbon neutral rail sector by 2050. The strategies should also consider efficiency improvements and the design and supportive funding for regional refueling infrastructure for zero carbon locomotives.


BURRARD INLET PORT LANDS

4.3 Support Emission Reduction Actions at Vancouver Fraser Port Authority.

Work with the Vancouver Fraser Port Authority to implement actions that reduce port-related greenhouse gas emissions and minimize air quality impacts on port-adjacent neighbourhoods. Areas of collaboration include phasing out older higher emitting equipment, increasing the availability of renewable fuels, developing infrastructure for zero emission equipment (e.g., shore power), and accelerating the adoption of zero emission solutions. Other opportunities include pilot or demonstration projects, and short-sea shipping.

4.4 Support Innovation in Low and Zero Emission Marine and Rail Technologies.

Advocate to BC Government and Government of Canada to help accelerate innovation in low and zero emission technologies for marine vessels, harbour tugs, passenger ferries and rail locomotives, including supporting pilot projects. Emerging engine technologies include hybrid, battery-electric and hydrogen fuel cells. This should include coordination with Vancouver Fraser Port Authority, BC Ferries, rail companies, governments and other regional partners.

4.5 Carbon Neutral Aviation Sector.

Advocate to Government of Canada to develop and implement a long-term strategy to accelerate greenhouse gas emission reductions from the aviation sector. The strategy should include more stringent fuel economy and emission standards for aircraft, to achieve a carbon neutral aviation sector by 2050. The strategy should also increase the availability of sustainable aviation fuel, and could include mandatory carbon offsets or carbon taxes for air travel.

4.6 Develop Local Sources of Sustainable Aviation Fuel.

Support airlines at Vancouver International Airport and other regional partners in increasing local availability of sustainable aviation fuel.

4.7 Technologies for Zero Emission Aircraft.

Advocate to Government of Canada and BC Government to support development of zero emission aircraft, including electrification of small aircraft.

4.8 Support Low Carbon Corporate Business Travel

Corporate LEADERSHIP

Update and adapt corporate business travel policies to reduce emissions, including air travel considerations, corporate carbon offsets, and remote attendance.

Resilient Transportation Strategies

STRATEGY 5: Protect Existing Transportation Networks from Future Climate Impacts

While reducing regional emissions will contribute to the global effort against climate change, some impacts from a changing climate are locked in and are likely to occur even with drastic emission reductions. Rising sea levels, increased frequency and severity of riverine flooding, and more frequent and intense heatwaves, wildfires, and droughts are already recognized as potential climate hazards that are likely to impact regional transportation networks within the next 100 years. Many critical transportation networks and infrastructure will remain standing for decades, but have not been designed to withstand impacts from changing climate hazards. Identifying current and future climate impacts and protecting existing transportation infrastructure from the hazards posed by these impacts is essential in order to maintain a resilient transportation system that is adapted to a changing climate.

5.1 Support Regional Emergency Management Planning.

BIG Move

Work with member jurisdictions, TransLink, neighbouring regions, the Vancouver Fraser Port Authority, and through convening groups such as the Integrated Partnership for Regional Emergency Management (IPREM) to collaborate on data sharing and policy development, and consider critical regional infrastructure interdependencies that could result in cascading effects in the event of regional climate disruption.

5.2 Protect Road Networks.

Work with the BC government and member jurisdictions to ensure that critical road networks, including infrastructure such as tunnels and bridges, are protected from future climate impacts (such as flooding and sea level rise) through projects such as dikes and drainage systems that mitigate potential climate impacts in known risk areas.

5.3 Protect Key Transportation Hubs.

Advocate to the Vancouver Fraser Port Authority, Vancouver International Airport Authority, and Federal government to protect key transportation hubs in low-lying coastal areas from hazards such as sea level rise and riverine flooding.

5.4 Adapt Active Transportation and Transit Networks.

Work with member jurisdictions and TransLink to make sidewalks, bike paths, regional greenways, and transit networks comfortable and safe to use even when impacted by climate hazards such as flooding, hotter temperatures, degraded air quality due to wildfires, and heavy precipitation.

5.5 Prepare for Regional Disruption.

Advocate to TransLink, Vancouver Fraser Port Authority, BC Ferries, and local airports to develop and maintain climate change adaptation plans that establish "safe-to-fail protocols" in the event of severe climate shocks that cause regional and inter-regional disruption, as well as post-event intervention and review procedures.

STRATEGY 6: Develop Climate Resilient Transportation Networks

In addition to protecting critical transportation infrastructure and networks, steps must be taken to proactively build a more resilient transportation system. Defining and assessing future climate risk must look beyond past trends in order to successfully create a transportation network that is resilient to future climate conditions. Climate change adaptation needs to be considered during the location, construction, maintenance, and operation of transportation infrastructure to avoid creating vulnerabilities that make adaptation more difficult and expensive in the future. Long range transportation planning must include hazard, risk, and vulnerability assessments to ensure that all new infrastructure is located in areas without known, unmitigated hazard risks. Land use and development can be coordinated with transportation networks to create robust regional transit, walking, and cycling options that provide a multitude of ways to get to and from key destinations, enhancing low carbon resilience.

6.1 Minimize Risk Exposure for New Transportation Infrastructure.

BIG Move

Work with the BC government, member jurisdictions, and TransLink to ensure that new transportation infrastructure is located outside of areas with known, unmitigated hazards, such as flooding and sea level rise.

6.2 Create Flexible Transportation Networks.

BIG Move

Work with member municipalities and TransLink to develop flexible transportation systems through low-cost, low-emission travel options such as active transportation and transit options that minimize reliance on vulnerable transportation networks, and create multiple travel options in the event of a disruption.

6.3 Reduce Reliance on Transportation Networks.

Work with member jurisdictions to develop complete, compact communities that support transportation demand management measures, reduce the need for long trips, and limit expansion of road space.

6.4 Build Climate Resilient Transportation Infrastructure.

Advocate to the BC government and Federal governments to strengthen climate change resilience design requirements for new transportation infrastructure projects.

6.5 Identify Regional Climate Hazards, Risks, and Vulnerabilities Impacting Transportation Networks.

Work with the BC government, member jurisdictions, TransLink, Vancouver Fraser Port Authority, BC Ferries, and local airports to collect data for baseline, trend, and monitoring purposes, and integrate forward-looking hazard, risk and vulnerability analysis into long-range transportation planning.

6.6 Integrate Resilient Infrastructure in to Transportation Networks.

Work with member jurisdictions, TransLink and the BC Government to consider possible synergies between and co-location of transportation networks with infrastructure designed to address resilience priorities such as storm water management, flooding, and seismic risk.

BIKING IN VANCOUVER

Setting the Path Ahead

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

Transportation is one of the best opportunities for significant early reductions of greenhouse gases in the region, particularly for personal transportation. The region is well positioned to continue with intentional land use planning that supports walking, rolling, cycling, transit, and other shared mobility modes. Electric vehicles are readily available and ready to be deployed on a large scale. It's critical that the actions identified in this *Roadmap* to support faster uptake of electric vehicles are implemented without delay to set this transition in motion as soon as possible. Taking early action to reduce emissions can also help improve air quality, support health and well-being through exercise, and enhance low carbon resilience sooner rather than later. Taking action to improve the resilience of regional transportation networks should also begin right away to adapt to changing climate conditions.

As personal transportation transitions to zero emissions, medium and heavy trucks, marine vessels, aviation, and rail will become the largest sources of transportation greenhouse gas emissions in the region. Action that supports rapid development and scale-up of zero emission and low carbon options for these sectors is needed to ensure that the transportation sector as a whole can transition to carbon neutrality by 2050.

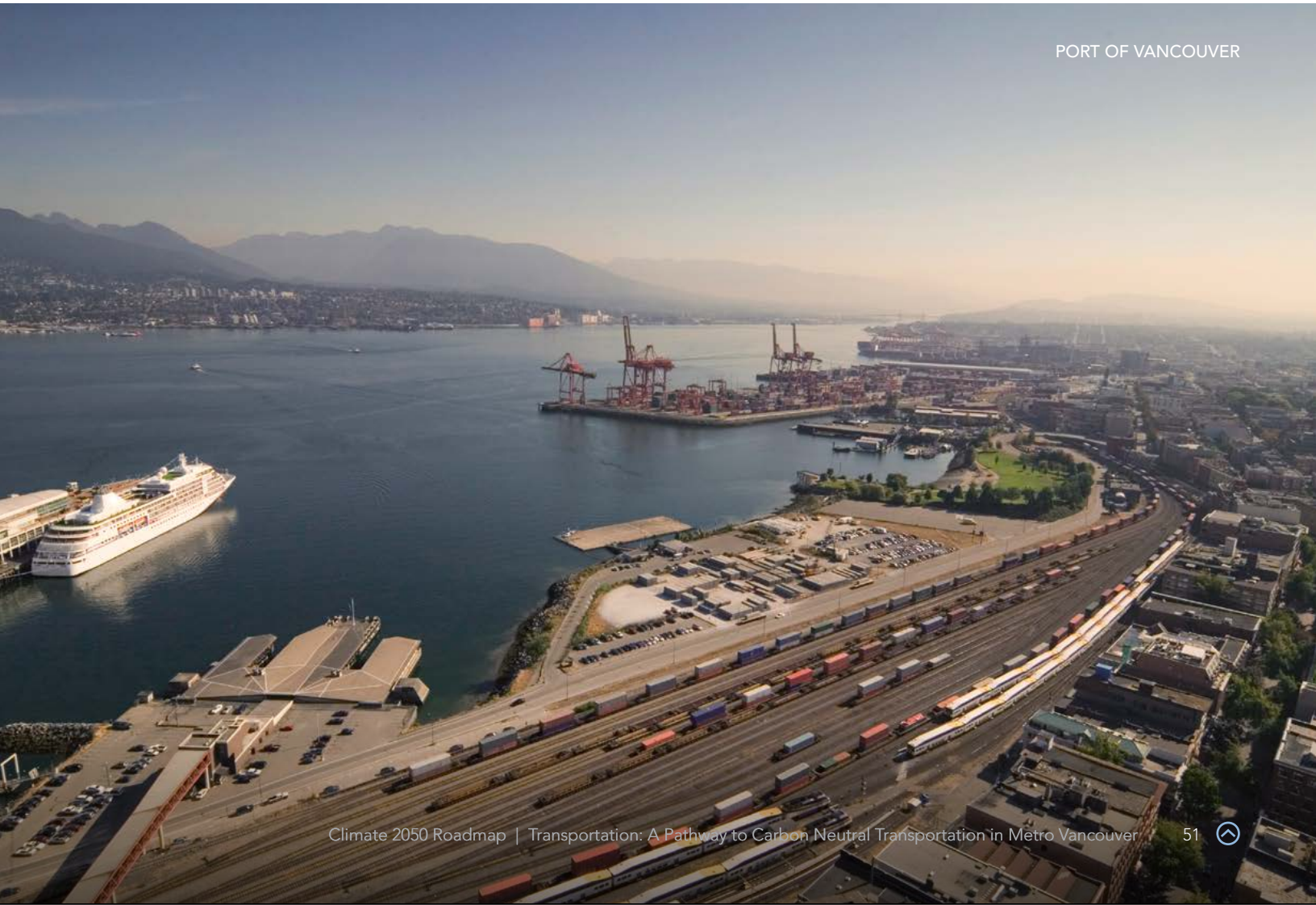
The timeline below includes all of the actions included in this *Roadmap*. Although there is much work to be done, there are some critical actions that, if started over the next two years, will make a major difference to accelerating the region's drive to zero emission and resilient transportation.

CLIMATE 2050 TRANSPORTATION ROADMAP **ACTION TIMELINE**

STRATEGY	2021-2023	2024-2029	2030-BEYOND
STRATEGY 1 Reduce Driving through Active Transportation and Public Transit	Enhance and Improve Regional Transit		
	Use Pricing to Reduce Driving and Emissions		
	Expand Active Transportation Networks		
	More Stable Infrastructure Funding for Regional Active Transportation Networks		
	More Stable Funding for Regional Transit		
	Regional Parking Strategy to Reduce Driving		
	Support Residents and Businesses in Active Transportation		
	Communicate the Benefits of Walking, Cycling and Public Transit		
		Implement Trip Reduction Programs	
		Regional Bike- and Car-Sharing Strategy	
	Support Low Emissions Commuting by Staff		
STRATEGY 2 Accelerate Transition of Passenger Vehicle Fleet to Electric Vehicles	Accelerate Sales Targets for New Electric Passenger Vehicles		
	Develop Regional Emission Requirements for Passenger Vehicles		
	Make Electric Vehicles More Affordable		
	Regional Electric Vehicle Charging Strategy		
		Make New Passenger Vehicles Cleaner	
	Expand Electric Vehicle Charging in Buildings		
	Electric Vehicle Outreach Programs		
		Electrification Targets for Ride-Hailing Services	
	Transition the Corporate Fleet to Zero Emissions		
STRATEGY 3 Reduce Heavy Truck Emissions and Support Early Adoption of Zero Emission Heavy Trucks	Regulate Existing Medium and Heavy Trucks		
	Require Zero Emissions Sales Targets for New Medium and Heavy Trucks		
		More Stringent Low Carbon Fuel Standards	
	Long-term Emissions Strategy for Medium and Heavy Trucks		
	Make Low and Zero Emission Medium and Heavy Trucks More Affordable		
	Regulate Fuel Economy and Emissions for Medium and Heavy Trucks		
		Zero Carbon Refueling Strategy for Medium and Heavy Trucks	
		Funding for Zero Carbon Refueling Infrastructure for Medium and Heavy Trucks	
	Large Fleets to Adopt "ZEV-First" Procurement		
	Reduce Delivery Emissions		
	Reduce Refuse Trucks Emissions		
	Support Innovation in Zero Emission Technology for Medium and Heavy Trucks		
		Use Businesses Licenses to Support Emission Reductions	
STRATEGY 4 Reduce Marine, Rail, and Aviation Emissions	Accelerate Emission Reductions from Marine Vessels		
	Accelerate Emission Reductions from Rail Locomotives		
	Support Emissions Reduction Actions at Vancouver Fraser Port Authority		
	Support Innovation in Low and Zero Emissions Marine and Rail Technologies		
	Carbon Neutral Aviation Sector		
	Develop Local Sources of Sustainable Aviation Fuel		
	Technologies for Zero Emission Aircraft		
	Support Low Carbon Corporate Business Travel		

CLIMATE 2050 TRANSPORTATION ROADMAP ACTION TIMELINE CONTINUED

STRATEGY	2021-2023	2024-2029	2030-BEYOND
STRATEGY 5 Protect Existing Transportation Networks from Future Climate Impacts	Support Regional Emergency Management Planning		
	Protect Road Networks		
	Protect Key Transportation Hubs		
	Adapt Active Transportation and Transit Networks		
		Prepare for Regional Disruption	
STRATEGY 6 Develop Climate Resilient Transportation Networks	Minimize Risk Exposure for New Transportation Infrastructure		
	Create Flexible Transportation Networks		
	Reduce Reliance on Transportation Networks		
	Build Climate Resilient Transportation Infrastructure		
	Identify Regional Climate Hazards, Risks, and Vulnerabilities Impacting Transportation Networks		
	Integrate Resilient Infrastructure in to Transportation Networks		



PORT OF VANCOUVER

Measuring our Progress

The table below lists examples of some of the performance indicators that could be used to help Metro Vancouver measure regional progress towards meeting the targets set out for this purpose. The performance indicators used will depend, to some extent, on the availability of this information from other organizations. Because the *Transportation 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 future. While much of the data needed to measure progress in on-road transportation is already collected, there are significant data gaps for rail, marine, and air transportation. Additional work is underway to understand what key performance indicators and data effectively measure progress towards regional resilience (noted in the table below as "TBD").

ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Reduce Driving through Active Transportation and Public Transit	Mode share by trip (number of trips, % of total trips)	TransLink Statistics Canada Municipalities	Yes
	Kilometers travelled by mode type: walking, cycling, transit, single occupant vehicle, multiple occupant vehicle (Person kilometers travelled, PKM)	TransLink Municipalities	Yes
	Kilometers of bike lanes, paths, and greenways	Metro Vancouver Municipalities	Yes
	Proportion of household and employment growth concentrated in urban centres and frequent transit development areas (FTDAs) (% of households, % of jobs in urban centres and FTDAs)	Metro Vancouver	Yes
	Kilometers of road and road space area	Metro Vancouver Municipalities BC Government	Yes

ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Accelerate Transition of the Passenger Vehicle Fleet to Electric Vehicles	Proportion of new vehicles sales that are electric, hybrid, hydrogen (number of new vehicle sales, % of total sales)	BC Government ICBC Market research firms Vehicle manufacturers	Yes
	Regional vehicle registration by engine type: internal combustion, electric, hybrid, hydrogen (number of new vehicle registrations, % of total registrations)	ICBC	Yes
	Kilometers travelled by vehicle model year, vehicle size, engine type (vehicle kilometers travelled, VKT)	ICBC TransLink Metro Vancouver	Partial
	Fuel use by type: fossil diesel, fossil gas, biofuels, electricity, hydrogen (Gigajoules, GJ)	Metro Vancouver BC Hydro BC Government	Partial
	Regional vehicle fleet make up by engine type: internal combustion, electric, hybrid, hydrogen (number of vehicles, % of total regional vehicle stock)	ICBC Metro Vancouver TransLink	Yes
	Number of electric vehicle chargers	Municipalities BC Government Charging service providers	Yes
Reduce Heavy Truck Emissions and Support Early Adoption of Zero Emission Heavy Trucks	New vehicle sales by engine type: internal combustion, electric, hybrid, hydrogen, compressed natural gas (number of new vehicle sales, % of total sales)	Vehicle manufacturers ICBC Market research firms Industry associations	Yes
	Regional vehicle registration by engine type (number of new vehicle registrations, % of total registrations)	ICBC	Yes
	Kilometers travelled by vehicle model year, vehicle class, engine type (VKT)	TransLink Metro Vancouver ICBC	Partial
	Fuel use by type: fossil diesel, fossil gas, compressed natural gas, renewable natural gas, biofuels, electricity, hydrogen (Gigajoules, GJ)	Metro Vancouver TransLink BC Hydro BC Government Market research firms Industry associations	Partial

ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Reduce Marine, Rail, and Aviation Emissions	Marine vessels with access to shore power by vessel type: cruise, container, tanker, ferry, other (number of shore power terminals, % of marine vessels with access to shore power)	Vancouver Fraser Port Authority BC Ferries and other ferry operators	Yes
	Kilometers travelled by marine vessels using zero or low emission fuels (kilometers, % of total kilometers travelled)	Vancouver Fraser Port Authority International Maritime Organization Metro Vancouver Transport Canada BC Ferries BC Government	No
	Marine vessel fuel use by type: fossil fuels, liquefied natural gas, renewable natural gas, biofuels, electricity, hydrogen (GJ)	Vancouver Fraser Port Authority International Maritime Organization Transport Canada BC Ferries Metro Vancouver BC Hydro	No
	Kilometers travelled by rail locomotives using zero or low emission fuels (kilometers, % of total kilometers travelled)	Canadian National Rail Canadian Pacific Rail TransLink Other rail companies Metro Vancouver Transport Canada	No
	Locomotive and switch operations fuel use by type: fossil fuels, biofuels, electricity, hydrogen (GJ)	Canadian National Rail Canadian Pacific Rail TransLink Other rail companies Metro Vancouver Vancouver Fraser Port Authority Transport Canada	No
	Kilometers travelled by aircraft using zero or low emission fuels (kilometers, % of total kilometers travelled)	Transport Canada Regional airports Airlines	No
	Aircraft fuel use by type: fossil fuels, biofuels, electricity, hydrogen(GJ)	Transport Canada Regional airports Airlines	No
Protect Existing Transportation Networks from Future Climate Impacts	TBD	TBD	TBC
Develop Climate Resilient Transportation Networks	TBD	TBD	TBC

Glossary

Active transportation includes self-powered modes of transportation such as walking, biking, skateboarding, in-line skating/rollerblading, jogging and running, wheel chairing, snowshoeing and cross-country skiing.

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

Biofuels are renewable transportation fuels that have a low carbon footprint and are produced from organic matter derived from biomass such as plants.

Carbon dioxide (CO_2) is the primary driver of climate change, and is produced primarily by burning fossil fuels.

Carbon neutral region means that the region generates no net greenhouse gas emissions. This is achieved through the deepest greenhouse gas emission reductions possible across all economic sectors, with any remaining emissions 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 sequestration is the removal of carbon dioxide from the air and the long-term storage of carbon to mitigate climate change.

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

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.

Equity is the promotion of fairness, justice and the removal of structural barriers that may cause or aggravate disparities experienced by different groups of people.

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

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.

Large fleet operators are organizations that purchase, operate, and maintain a significant amount of vehicles for public sector or commercial use.

Low carbon fuels produce direct greenhouse gas emissions, but have no net greenhouse gas emissions when the fuel lifecycle is taken in to account.

Low emission technologies produce some greenhouse gas emissions or air contaminants, but significantly less than conventional fossil fuel counterparts. This may include high efficiency vehicles or plug in hybrid technologies.

Marine vessels include ocean-going marine vessels (e.g., container, bulk, tanker, fishing, cruise and other specialty vessels), harbour vessels, and passenger ferries.

Medium and heavy duty trucks are mostly freight vehicles such as long-haul trucks and cube vans used for commercial purposes, but also includes buses and refuse trucks.

Mobility pricing refers to fees for transportation services. Some types of mobility pricing (e.g., decongestion charging, low emission zones) are used to manage demand for roads and reduce emissions.

Passenger vehicles include motorcycles, cars, SUVs, minivans and light trucks. Buses are included as part of medium and heavy duty trucks.

"Right-to-charge" legislation provides residents of multi-unit residential buildings with the right to install and use a charging station for their electric vehicle.

Right-sizing fleets means aligning the type and number of fleet vehicles to the true needs of the fleet. Right-sizing fleets reduces costs and emissions.

"Safe-to-fail" protocols anticipate possible system failures so that they can be contained and minimized.

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.

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

Zero emission vehicles (ZEVs) release no air contaminants from their tailpipes. Electric vehicles are the most common type of zero emission vehicle; others include hydrogen fuel cell vehicles.

ZEV-first is a procurement policy where priority is given to purchasing zero emission vehicles, if they are available.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SERVICES AND SOLUTIONS FOR A LIVABLE REGION