



CLIMATE 2050 Roadmap

# Buildings

A Pathway to Zero Emissions and Resilient Buildings

October 2021

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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 Buildings 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, working collaboratively in planning and providing vital utility and local government services to 2.6 million people. Essential services include drinking water, sewage treatment, and solid waste disposal, along with regional services like regional parks, housing, land use planning and air quality management that help keep the region one of the most livable in the world.

## Mission

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

### 1. Serve as a Regional Federation

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

### 2. Deliver Core Services

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

### 3. Plan for the Region

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

# Building a Resilient Region

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



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

Buildings are where we spend most of our lives. They provide us shelter, places to play, create, congregate, and so much more. They are also contributing to climate change. One quarter of all greenhouse gas emissions in the region comes from burning natural gas to heat and cool our homes and buildings, produce hot water, and for some household appliances.

Buildings also last a long time. Decisions that we made a century ago about design and construction are affecting our greenhouse gas emission levels today. Similarly, the decisions we make today will determine the amount of emissions they create well beyond 2050.

The Climate 2050 Buildings Roadmap is about ambitious and necessary change in our buildings. It lays out seven key strategies and 37 actions that will reduce our greenhouse gas emissions and increase the resiliency of our new and existing buildings, in pursuit of a carbon neutral and resilient building stock by 2050.





#### THE SEVEN STRATEGIES ARE:

- 1 Signal the Transition to Zero Emission Buildings through Requirements and Standards
- 2 Accelerate Demand for Zero Emission Buildings through Research, Education and Incentives
- 3 Shift to Zero Carbon District Energy Systems
- 4 Accelerate the Transition to Lower Embodied Emissions in Buildings
- 5 Support water conservation and non-potable water reuse to increase resilience to shifting precipitation patterns
- 6 Support the uptake of building design and retrofit solutions to reduce the impact of heatwaves and wildfires
- 7 Encourage the uptake of design and retrofit solutions that increase resilience to severe storms and flooding in buildings

To achieve a carbon neutral and resilient building stock in this region, we are going to have to make some difficult decisions and investments today, or risk passing them on to our children and grandchildren at higher cost and consequence.

We are not alone in this challenge. All over the world, cities are starting to make big decisions that will transition buildings to be more efficient, and to use clean and renewable energy. Here in our region, zero emissions buildings are possible today. Many of Metro Vancouver's member municipalities have committed to ambitious targets and bold leadership to respond to the global climate crisis. This plan responds to the challenge to come together, think big, and act now.









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# Visioning Zero Emissions and Resilient Buildings in 2050

Our vision is that in 2050, Metro Vancouver residents live in resilient, healthy, zero emissions buildings across the region. Many buildings use so little energy that most of it can be generated on site, and some buildings even send unused energy back to the grid. Cities each retain their unique cultural, geographic and economic qualities, but are similarly compact in their development, with accessible and thriving local services. Buildings are healthy, comfortable and smart – allowing building occupants to easily control and automate equipment and appliances.

In response to climate change, flood protection, increased shading, air filtration and cooling have become a standard in nearly every building, and all public buildings are places for anyone seeking clean and cool air. Our region is known globally as a leader in zero emission and resilient buildings, and we are supported by a thriving circular economy and highly trained green buildings workforce.

# Climate 2050 Buildings Roadmap

A pathway to zero emissions, resilient buildings in Metro Vancouver

## The Challenge

This Roadmap is about ambitious and necessary change in our built environment. It presents a robust plan for this region to have a clean and sustainably powered building stock by 2050.

Buildings contribute approximately 25% of the greenhouse gas emissions in the region, mostly through burning natural gas for space and water heating. Buildings also last a long time – decisions that we made 100 years ago about the design, construction and retrofit of buildings are affecting our greenhouse gas emission levels today. Similarly, the decisions we make today will determine the amount of emissions they create well beyond 2050.

A carbon neutral region is the best option for future generations to maintain a good quality of life, beyond 2050. We have to make some difficult decisions and investments today or pass them 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 emissions reductions possible across all economic sectors, and any emissions left are balanced out by the carbon dioxide removed from the atmosphere by the plants, trees, and soil in the region, as well as by potential carbon capture technologies that are under development.





# 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 buildings in this region, out to 2030 and 2050.



## Goal – Zero Emissions Buildings

All buildings are zero emissions from heating and cooling by 2050.

### TARGETS

By 2030:

- A 35% reduction in greenhouse gas emissions from buildings, relative to 2010 levels.
- All new buildings are zero emissions in their operations.
- All new buildings produce 40% less embodied emissions from construction.

By 2050:

- All buildings are zero emissions in their operation, deriving all energy needs from 100% clean and renewable sources.
- All new buildings are carbon neutral in their embodied emissions from construction.



## Goal – Resilient Buildings

Residents are protected by buildings that are resilient to high temperatures, harmful air quality, severe storms and flooding by 2050.

### TARGETS

By 2030:

- All new buildings utilize world-leading water conservation methods.
- Metro Vancouver's most vulnerable residents in the region have access to buildings with cooling and clean air during extreme heat and wildfire events.
- All new buildings include cooling and air filtration adequate to protect against extreme heat and harmful outdoor air quality events.
- All new buildings are constructed to be resilient to riverine, coastal and urban flooding, and extreme storms.

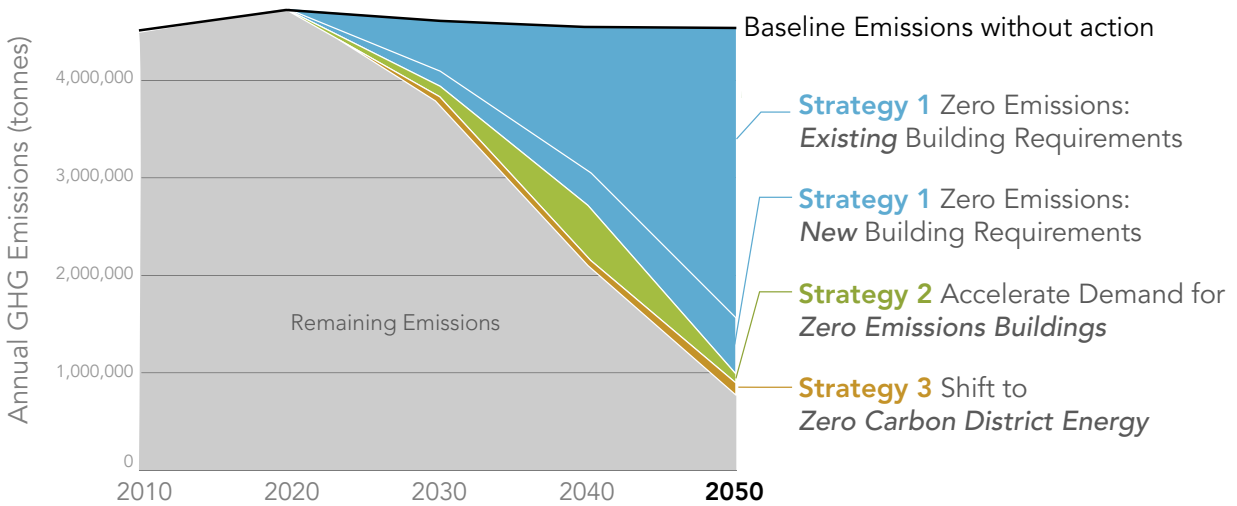
By 2050:

All Metro Vancouver's residents have access to buildings that:

- protect against extreme heat and harmful outdoor air quality events,
- are resilient to riverine, coastal and urban flooding, and extreme storms, and
- utilize world-leading water conservation methods.

The diagram below shows key strategies in this Roadmap that will significantly reduce GHGs and how, collectively, they will close the gap on a carbon neutral building stock.

### GETTING TO CARBON NEUTRAL BUILDINGS: Impact of key strategies



Many of the actions identified in this Roadmap will need to be led by other levels of government (e.g., national, provincial, and local) 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 recently strengthened climate plan called *A Healthy Environment and a Healthy Economy*; Metro Vancouver’s member organization’s own community and corporate climate plans; utilities; 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. Through burning fuels for heating and hot water, buildings generate 9% of all nitrogen oxides emissions in the region and 25% of fine particulate matter emissions, both of which are health-harming air contaminants.

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

The Climate 2050 Buildings 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:

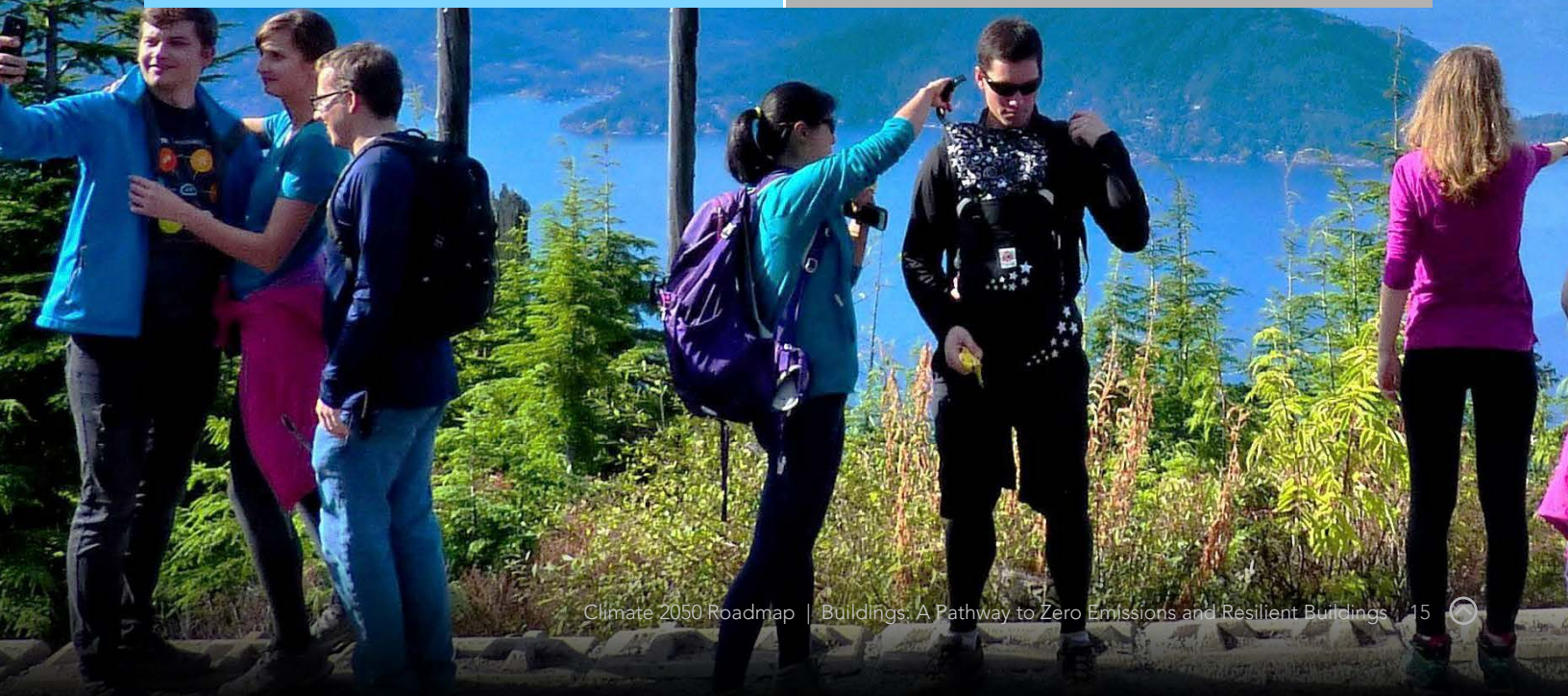
## CONNECTING THE *BUILDINGS ROADMAP* AND THE *CLEAN AIR PLAN*

### *Clean Air Plan*

- Greenhouse gas reduction goals, strategies and actions.
- Air quality goals, strategies and actions.
- Goals, strategies and actions for other sectors such as transportation, industry, and agriculture.

### *Buildings Roadmap*

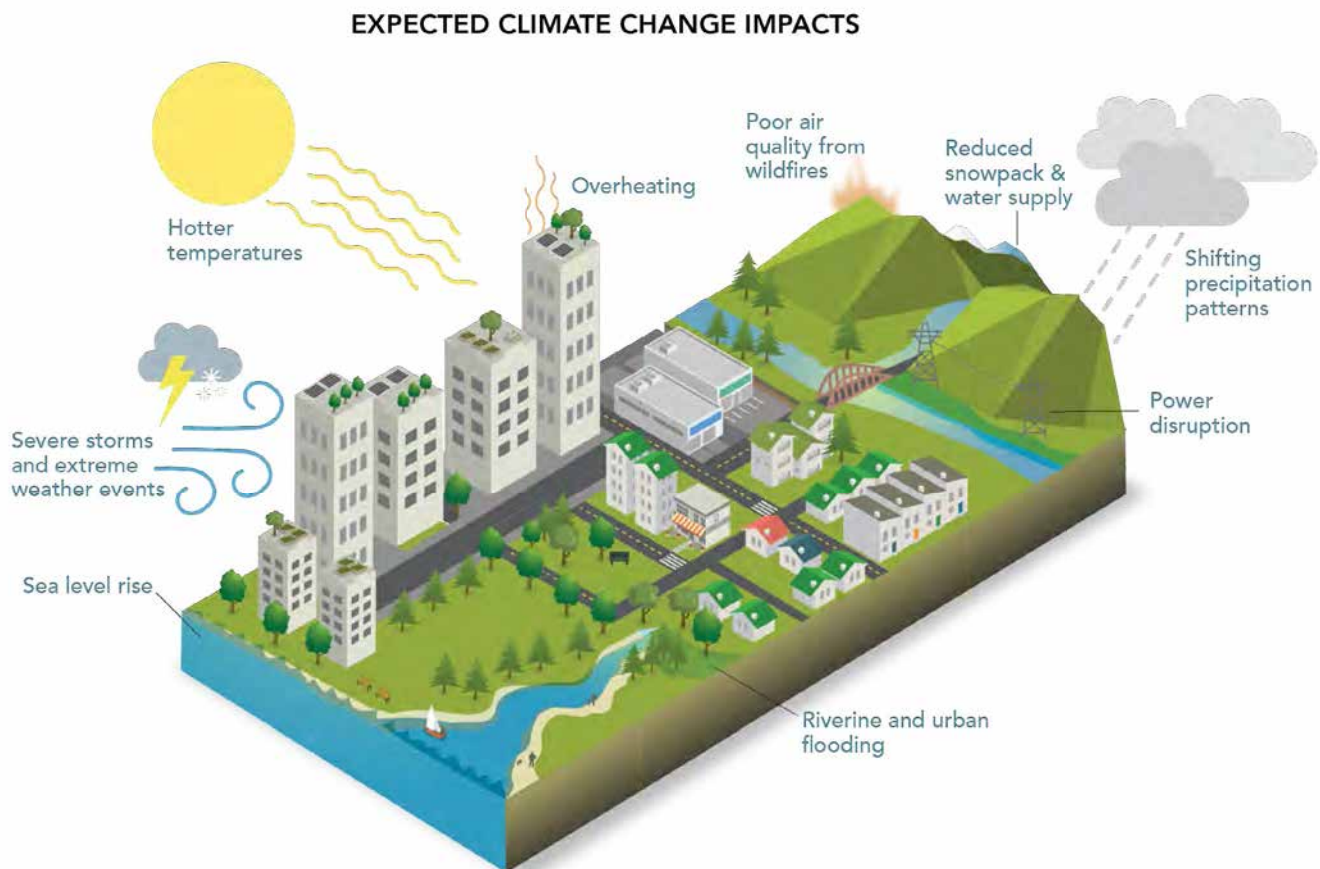
- Greenhouse gas reduction goals, strategies and actions.
- Resilient building strategies.
- Challenges, opportunities and benefits of transitioning our buildings to become zero emissions and resilient.



# Climate Impacts on Buildings

Climate change, while less evident day-to-day, is already impacting our health and our environment, and those impacts will become more evident in coming years. We spend most of our time in buildings and the impacts of a changing climate will also change how well our buildings work for us – the need for cooling in extreme heat, air filtration during wildfire smoke events, and water conservation and flood protection for

droughts and severe storms. These impacts can harm some neighbourhoods, households and individuals more than others, and solutions must consider that some are better able to prepare for and protect themselves from climate change. Metro Vancouver's goal is that zero emission and resilient buildings be standard practice by 2050, both for new construction and major retrofits.





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

## Climate Changes



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



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



**Severe storms and extreme weather events**, including high winds and heavy rainfall.



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

## Impacts Felt



**Overheating** in buildings where cooling solutions do not exist or are inadequate. This poses particular risk to vulnerable populations and those without the means to cope. Reducing this risk requires a thoughtful combination of passive and mechanical cooling measures.



**Dangerous indoor air quality** from wildfire smoke events, which can compound with existing sources of contamination (e.g., ground-level ozone, pollution from traffic and industry). Reducing this risk requires thoughtful ventilation and filtration design, and minimizing sources of pollutants wherever possible.



**Reduced water supply** as a result of reduced snowpack and hotter, drier summers strain drinking water supplies during times of year when demand is the greatest. Reducing this risk requires policies and measures to manage demand, support water conservation and facilitate non-potable water reuse.



**Riverine and urban flooding** from periods of extreme rainfall, which can cause immediate and long-term damage to buildings. This can be addressed through site selection, structural design decisions, strategic location of key mechanical systems, and careful materials selection.



**Power disruption** due to overloaded grids from increased demand from cooling, and from shock events including flooding and storms. This can be addressed through demand management and the installation of low-carbon backup power solutions.





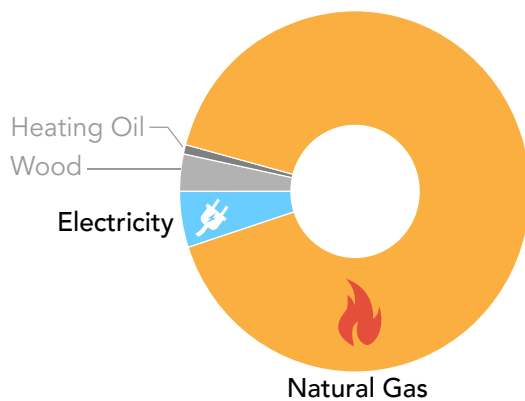
## Emissions from Buildings in Metro Vancouver

There are nearly 500,000 buildings throughout Metro Vancouver that collectively have more than 185 million square meters (2 billion square feet) of floor space.

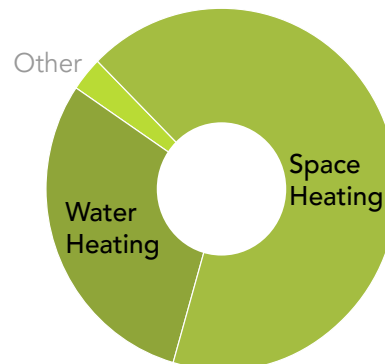
Together, these buildings are the second largest source of greenhouse gas emissions in Metro Vancouver after transportation, emitting over 4 million tonnes per year, which is approximately 25% of the region's total annual emissions. Even with programs and incentives in place, greenhouse gas emissions from buildings have actually

risen 10% since 2010 in Metro Vancouver. This increase is due in large part to the widespread and continued use of natural gas to heat space and water in many of our new and existing buildings. The graphic below shows that in our region, over 90% of the greenhouse gas emissions from buildings come from burning natural gas while close to 3% comes from out-of-region electricity generation, and on the right, that space and water heating are responsible for nearly all of the natural gas use in buildings.

GHG EMISSIONS BY FUEL SOURCE



GHG EMISSIONS BY END USE







## Natural Gas produces **16x** more Greenhouse Gases than Electricity



Electricity is also commonly used in certain building types for space and water heating. Hydro-produced electricity also produces some GHGs, but one unit of natural gas produces at least 16 times more GHGs than one unit of electricity, as shown below.

Given the above information, it is clear that to achieve our target of zero emissions buildings, we need to shift away from the use of natural gas in favour of clean and renewable energy for space and water heating in existing buildings.

For new construction, zero emissions space and water heating systems are available for nearly every type of home and building. It is also much more straightforward to design a new building to be zero

emissions than it is to retrofit an existing one. New construction needs to move swiftly towards zero emissions space and water heating systems – for example, high-efficiency electric heat pumps. This will avoid yet more costly retrofits to get to zero emissions.

For existing buildings, technologies are also widely available to electrify most buildings that use natural gas for space and water heating. The transition for existing buildings will be more gradual primarily because space and water heating equipment is only replaced every 10 to 20 years, and even less frequently for large commercial, residential, and public sector buildings. This equipment lifetime makes it critical to ensure the right equipment goes in at the next opportunity.



# Zero Emissions, Resilient Buildings

Zero emissions resilience involves considering and balancing, wherever possible, the three necessary sides of climate change action:

- 1 Reducing greenhouse gas** emissions that are accelerating climate change,
- 2 Increasing resilience** and our ability to recover by preparing for, and responding to the effects of climate change that we cannot avoid, and
- 3 Protecting the health** of the occupants of buildings.

A “zero emissions and resilient building” is a building that emits no greenhouse gas emissions and better withstands the negative effects of a changing climate, ensuring occupant comfort and health are maintained.

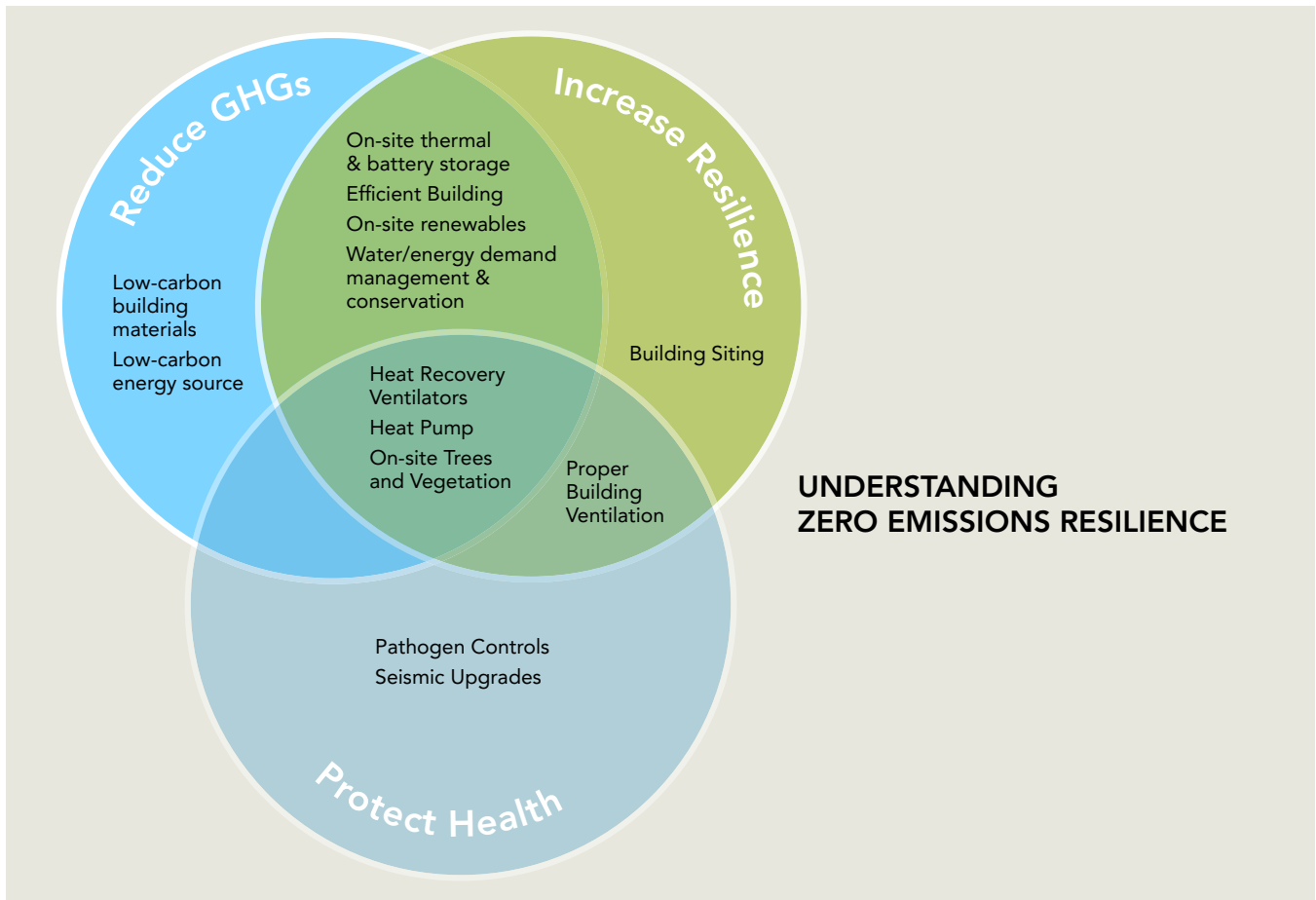
Looking to 2050, this Roadmap seeks to achieve a zero emissions and resilient building stock. By applying these desired outcomes simultaneously at the building and site level, we can identify ways to reduce emissions and vulnerability to climate change impacts at the same time.

## What is the difference between “Zero Carbon”, “Zero Emissions” and “Embodied Emissions”?

**“Zero Carbon” or “Zero Carbon Emissions”** refers to no greenhouse gas emissions at the point of use. A zero carbon fuel source either produces no greenhouse gas emissions, or any greenhouse gas emissions produced are offset by renewable energy (either generated onsite or purchased).

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

**“Embodied Emissions”** are greenhouse gas emissions associated with the construction of goods and products, including the raw materials and the transport of the good or product to where it is sold. Metro Vancouver is working to understand how embodied emissions – emissions from the construction and creation of materials for buildings – can be tracked to ensure we are reducing emissions beyond those created in our region.



The diagram above shows a number of different strategies for addressing greenhouse gas reductions and resilience. All of these strategies work together to provide both a carbon reduction and resilience benefit. The figure also shows which of these strategies contribute to direct health benefits for building occupants.

Applying a zero emissions resilience lens offers benefits, including:

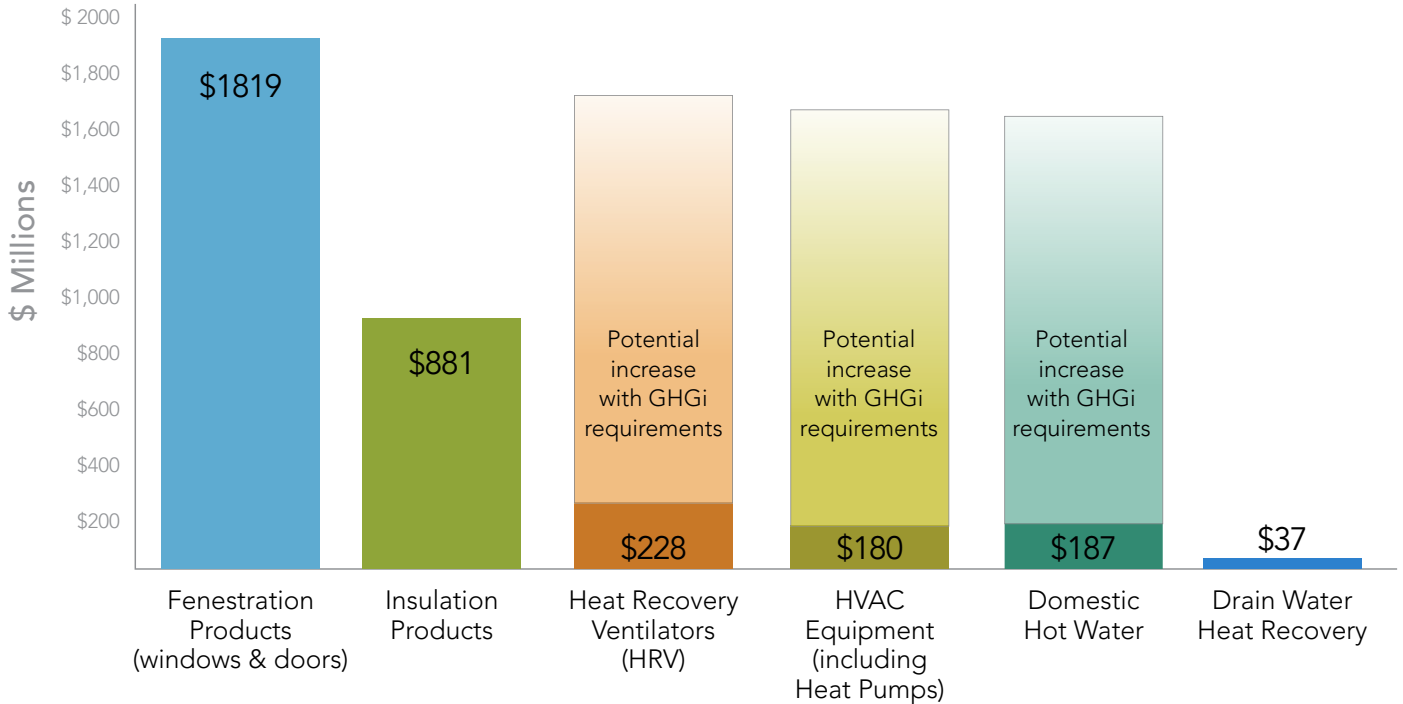
- Identifying strategies that achieve emissions reductions and increased resiliency simultaneously (e.g., heat pumps can both reduce emissions and provide mechanical cooling; trees can sequester carbon, support on-site storm water management, and provide shading to buildings);
- Avoiding conflicting strategies (e.g., adding backup diesel generators to a building can enhance resilience, but will also increase greenhouse gas emissions and contribute to poor air quality);
- Prioritizing building strategies that lead to zero emissions resilience aligns climate action goals with public health and safety objectives.

Many opportunities to achieve a building stock that is both zero emissions and resilient exist today and all organizations should seek these multiple benefits.



## \$3.3B MARKET FOR GREEN BUILDING MATERIALS

Demand forecast, new construction, Metro Vancouver 2019-2032 (cumulative)



## Economic Benefits of Zero Emissions Buildings

Recent studies show the broader economic benefit of improving building efficiency and reducing greenhouse gas emissions:

- The proposed BC Retrofit Code, which will require energy saving retrofits during renovations, is estimated to lead to the creation of more than 4,400 direct jobs and nearly 6,000 indirect jobs between 2019 and 2039 and contribute over \$8.3 billion to the province's GDP. See the "Barriers and Opportunities to get to Zero Emissions Buildings" section to learn more about the BC Retrofit Code.
- The Vancouver Economic Commission estimates that the BC Energy Step Code could help unlock a \$3.3 billion market for high-performance windows, insulation, and equipment in Metro Vancouver by 2032, as shown in the chart below. High-efficiency mechanical equipment alone could support 770 local jobs on an annual basis from 2019-2032 and increase further if stricter greenhouse gas emissions requirements are put in place.

Economic benefits of accelerating building decarbonization must consider economic inequities. These might be costs, or access to training, employment, investment and innovation or others. Over time, factors such as increased supply, improved industry knowledge and capacity, and technology improvements should support equitable benefits.

## 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. In some cases, shifting towards zero emissions and resilient buildings may cost some more than others, and we must ensure no one is left behind in this transition. Metro Vancouver 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 building-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 the *Climate 2050 Buildings Roadmap*. This will include community input, health impact assessments and other equity evaluation tools so that all residents benefit from these changes.

## Healthy Buildings

Health must be considered alongside emissions reductions and resiliency. Many of the ways that we make our buildings zero emissions and resilient are also the ways we make them healthier. Health outcomes will be a driving force behind how we craft our response.

We spend the majority of our lives indoors, so the quality of our buildings plays an ever greater role in our health and wellness. Fortunately, high-performance buildings can have a positive effect on the full spectrum of wellness, including our physical, mental, emotional and social health, including the following:

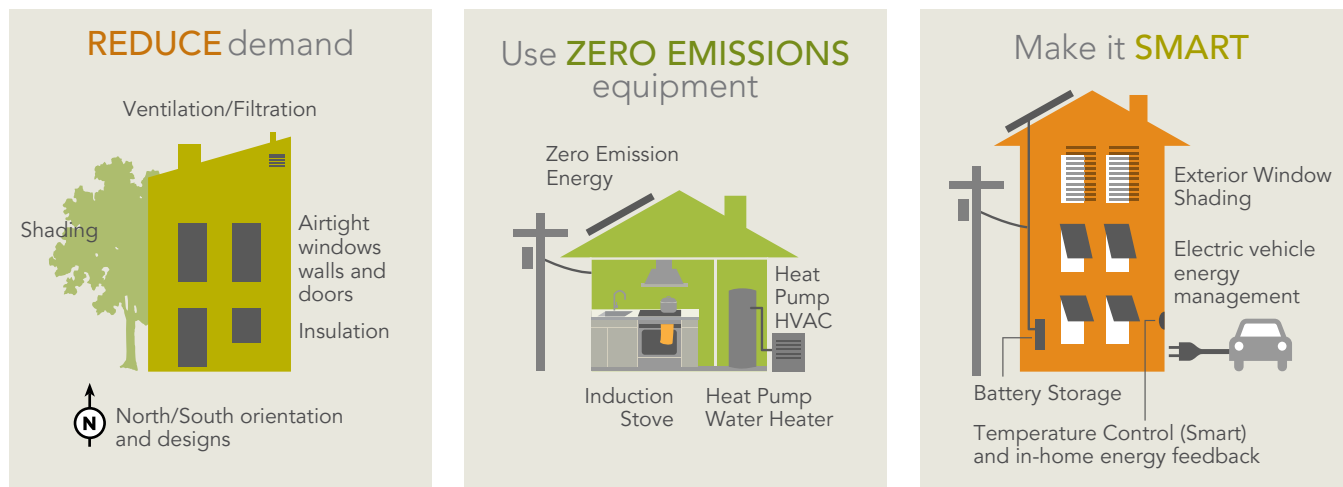
- **Thermal comfort:** Prolonged thermal discomfort can negatively impact physical health (e.g., overheating, heatstroke) and mental health for occupants. Ensuring that buildings remain comfortable in our warming climate requires analysis of future climate projections, and incorporation of passive and active cooling systems that meet future needs.
- **Air quality:** Indoor air quality plays a major role in health and wellbeing. Outdoor air pollution from wildfire smoke, traffic and other sources can enter buildings that have leaky envelopes. In new construction and retrofits, this can be limited by prioritizing an airtight envelope and ensuring that adequate ventilation and filtration systems are in place that promote energy efficiency as well as a healthy and safe indoor environment.
- **Acoustic comfort:** Better designed, insulated, and airtight buildings can reduce sound. Exposure to sounds such as traffic and mechanical systems can disrupt concentration and productivity, and has been linked to sleep disturbance and hypertension.





# Taking a Whole Building Approach

Taking a whole building approach to achieving zero emissions and resilient buildings means looking for opportunities to reduce how much energy a building needs to operate, and how to improve its overall resiliency to a changing climate. This is in addition to using clean and renewable energy sources.



## 1. Reduce Energy Demand

One of the first steps to pursuing zero emissions and resilient buildings is to look for opportunities to reduce how much energy the building needs for heating and cooling. Measures that improve the envelope (or shell) of the building to keep hot or cold air inside, such as weather sealing, improved insulation and windows, and heat recovery systems, will have a direct reduction in energy demand. Since electricity is more expensive than natural gas in BC, keeping the heat inside the building will make the switch to zero emissions electric heat pumps a better economic choice. Measures at the building site, such as shade from trees and green or white roofs can also reduce the amount of energy needed to cool a building, and may even provide some insulation in colder months.

## 2. Use Zero Emissions Energy

With total energy demand reduced, the next important step is to select a heating system that uses low carbon or zero emissions energy. Although renewable fuel sources already exist (e.g., electricity and renewable gas), high-efficiency, all-electric buildings have a number of advantages. A building that uses BC's clean and renewable electricity for its space and water heating ensures long-term and deep greenhouse gas emissions reductions.

For buildings that will be harder to electrify, the same technologies used today for natural gas space and water heating can continue to be used over the next few years because renewable gas can be used to power this equipment without any modifications.

Metro Vancouver is considering what role clean, renewable sources of energy will play in the region's transition to carbon neutral within the Climate 2050 Energy Roadmap.

### 3. Make It Smart

In BC, electrifying many of our buildings will likely increase the amount of electricity needed during peak heating periods and place additional pressure on provincial and local electricity grids. Some of this pressure can be alleviated by taking advantage of smart grid features and other in-home technologies that automate some building systems to use less energy. For example, electric storage batteries located in buildings could be charged by on-site renewables or via the electricity grid during periods of low demand. This stored energy could then be used during times of high demand, making better use of the energy capacity that BC already has in place. Buildings with on-site energy storage and low energy demand will also be better equipped to withstand any short-term power losses that could result from major storm events.

Similarly, appliances and water heaters equipped with demand response technologies could provide BC Hydro with an opportunity to encourage the use of this equipment during off peak periods and to help ensure services such as space heating and cooling are prioritized during periods of unusually high demand.

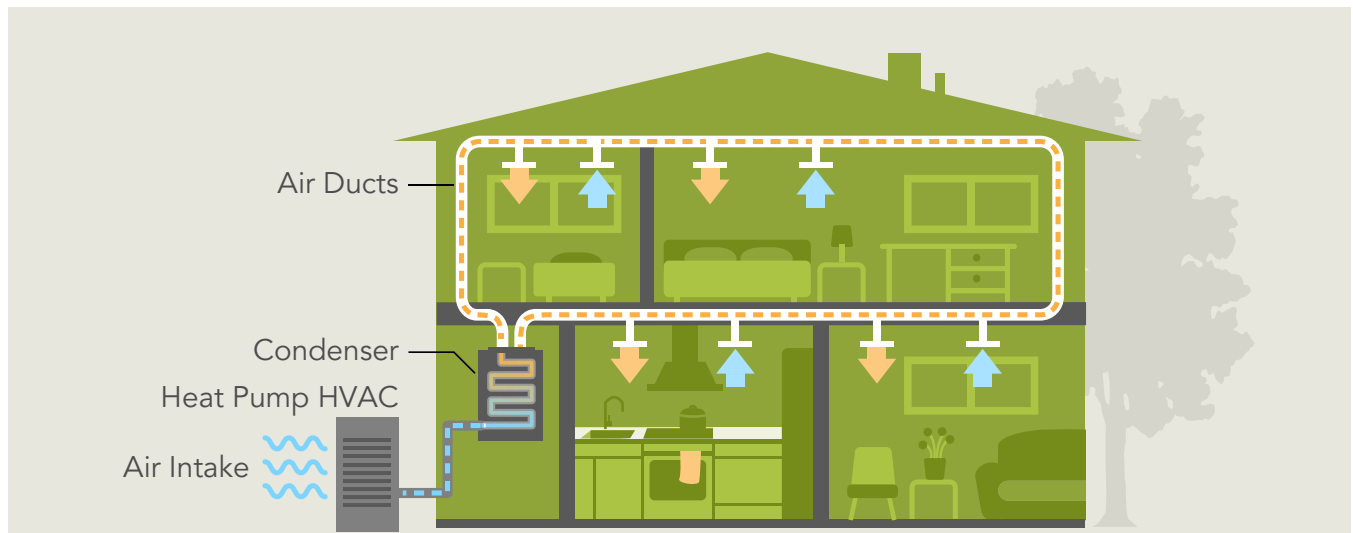
Given the high cost of upgrading provincial and local electricity grids, measures such as these can go a long way to maintaining competitive electricity rates and overall resiliency while a market-wide shift to zero emissions buildings takes place.





## Zero Emissions Heating and Cooling

In most cases, installing high-efficiency electric heating and cooling equipment will be the quickest, most economical, and most permanent way to achieve a zero emissions building. Of the various categories of high-efficiency electric technologies already available, heat pumps carry the most promise for achieving significant emissions reductions in homes and buildings.



### How do Heat Pumps Work?

Electric heat pumps provide both heating during the winter and cooling during the summer with the help of the air outside your home. A heat pump operates similarly to your refrigerator or air conditioner. In the winter, a heat pump extracts heat from the outside air (or ground, depending on the type) and brings it into your home. In the summer, it pulls heat from inside your home and moves it outside, effectively cooling the indoor space. By using refrigerants to help move the heat, heat pumps are by far the most energy efficient technology available for space heating and cooling and hot water heating. For every unit of energy it takes to run, a heat pump typically provides three to five units of heating or cooling, at temperatures above 0°C (in other words, they are 300-500% efficient). Low temperature heat pumps operate very well below 0°C, but efficiency gains get closer to conventional electric heating as temperatures drop. In contrast, an electric baseboard heater converts each unit of electrical energy into a single unit of heat energy (100% efficient), and a high performance natural gas furnace provides slightly less than a single unit of heat energy (about 95% efficient).

This very high efficiency means that electric heat pumps are not only a zero emissions solution for buildings, they also operate using less electricity while providing both heating and cooling to homes and other buildings.

In addition to being zero emissions, heat pumps provide air conditioning in the summer. This makes these buildings more resilient to the longer, hotter, drier summers that are predicted for the Metro Vancouver region as a result of climate change.

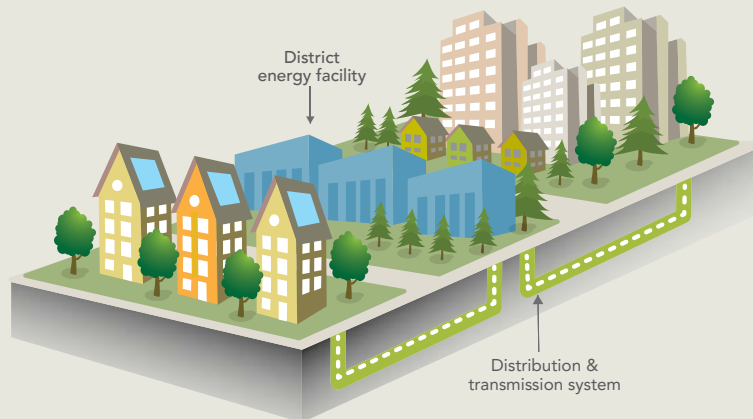
Heat pumps also help to filter indoor air, a feature that is especially important during wildfire smoke events that are becoming increasingly common during the summer months. During a wildfire smoke event it is also important that buildings remain cool and comfortable with the windows closed, because of the need to minimize the amount of unfiltered outdoor air that enters the building. Maintaining a comfortable indoor air temperature is easily achieved with a heat pump. Although a conventional air conditioning unit could provide similar services, it is often more straightforward and economical to have a single system that can do both the heating and cooling for a building.

## Managing Refrigerants to Reduce Greenhouse Gas Emissions

As heat pumps become more widely used in BC, it will be important to work with other government and industry partners to ensure that the refrigerants used in this equipment do not create unintended environmental harm. Many of the refrigerants permitted today have very high “global warming potential” – or GHG emissions equivalent. Releasing a single kilogram of these gases into the atmosphere can equal the impact of hundreds or thousands of kilograms of carbon dioxide, the most common greenhouse gas.

Fortunately, international efforts are underway to reduce the global warming potential of refrigerants, and the Government of Canada requires industry to participate in refrigerant management stewardship, but more needs to be done to further reduce releases of refrigerants from existing equipment. In the meantime, more and more models of heat pumps with low global warming potential refrigerants are becoming available.

### Example of how a district Energy System works



## District Energy Systems

Metro Vancouver is home to at least 18 different District Energy Systems. A District Energy System is a utility that provides heating services to buildings within a concentrated geographic area (e.g., university campus, hospital, downtown core, high-density neighbourhood). Pipes carry hot water or steam from a centralized heating plant to the system’s connected building network. Different renewable and non-renewable fuel sources are used by district energy systems, but the most common fuel used is natural gas. In order to achieve zero emissions for buildings connected to

district energy system, all new and existing systems will need to convert to clean and renewable sources of energy such as electricity and waste heat, heat from data centres, air conditioning, and Metro Vancouver’s sewer pipes. Once converted, all of the buildings connected to the district energy system will minimize their own emissions and will benefit from the emissions reductions at the plant. These systems present unique opportunities to decarbonize clusters of buildings throughout the region.



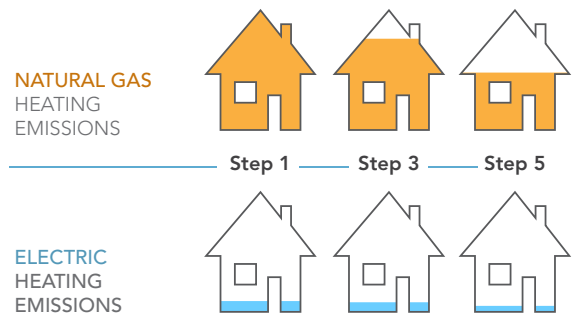
# Barriers and Opportunities

## New Construction

For new construction, most of the technologies to make new residential and commercial buildings zero emissions are already commercially available. Modern, high-efficiency building techniques and technologies also mean far less energy is needed to meet a building's space and water heating needs than in the past. Many of the region's local governments have adopted the BC Energy Step Code and have signaled their intention to continue to increase energy performance requirements, but challenges remain in the new buildings sector, including the following:

- **The Energy Step Code does not include GHG emission limits.** Local governments are not currently permitted to include GHG emissions limits that would restrict the use of fossil fuels in new buildings. As a result, many of the high-efficiency new homes built in the region are being built with natural gas heating systems that will emit higher levels of GHG emissions for the foreseeable future. As shown in the image below, even at Step 1, the lowest step, electric heating results in a more than 90% reduction in GHGs compared to natural gas heating, due to BC's clean, renewable hydroelectricity. The BC Government has signaled an intent to regulate the GHG performance of new buildings. Ensuring this happens is a critical step towards zero emissions buildings.

GREENHOUSE GAS EMISSIONS BY HEATING TYPE



- **Embodied emissions aren't being measured.** Embodied emissions are currently a blind spot for the building industry. The greenhouse gas emissions generated from the production and installation of building materials can have a significant impact on the overall emissions of the building. Government and the building industry needs to better understand the impact that building material choice has on the embodied emissions of a building and work to reduce it.
- **Building knowledge and capacity in skilled trades.** As bold policies are introduced for zero emission buildings, the real pace of change will be set by the people who build them. Knowledge building and training through schools and trade associations will help to ensure that everyone working in the sector has the skills they need to confidently make every new building zero emissions.



The BC Energy Step Code allows local governments to set increasingly stringent energy efficiency requirements for new construction, leading to net-zero energy ready buildings by 2032. There is a big opportunity for the Step Code to include GHG limits in new buildings.



## Existing Buildings

Although many of the solutions needed to convert existing buildings to zero emissions are readily available, the transition will be more gradual and challenging for existing buildings. Some of the main reasons for this are listed below:

- **Existing heating equipment is only replaced every 10 to 20 years.** One of the Building Roadmap's biggest logistical challenges is that the transition will require most existing natural gas space and/or water heating systems to be replaced with high-efficiency electric heat pumps. Most of these systems only get replaced once every 10 to 15 years for water heaters and 15 to 20 years for furnaces. Requiring these systems to be replaced more rapidly than this would place a financial burden on many building owners.
- **No limits on greenhouse gas emissions from buildings.** New buildings are constructed to the requirements in the Building Code, which locks in the greenhouse gas emissions and energy use of the building until it undergoes a major renovation. Other than the City of Vancouver, there are virtually no regulatory requirements in BC to encourage building owners to take action to reduce the greenhouse gas emissions in their building at the point of renovation.

### BC Retrofit Code

As of 2021, the BC Government is considering a code for alterations to existing buildings that would include energy efficiency, earthquake safety, and occupant health and safety, to be introduced in 2024. This code would follow and harmonize with the introduction of a Government of Canada model code for retrofits in 2022. Existing buildings are a much larger source of greenhouse gas emissions than new buildings. Placing greenhouse gas limits on retrofits is a game-changing opportunity to transition to zero emissions buildings.



- **Complexity and cost impede decision-making.** For many home and building owners, the steps needed to reduce the greenhouse gas emissions from their building can be time consuming and overwhelming, and can dissuade them from switching to clean, renewable energy. These issues are compounded for older buildings where additional steps may need to be taken to improve their overall efficiency (such as improved insulation, air leak sealing, high-efficiency windows, heat recovery, or converting a steam heating system to a lower temperature one) before an electric heat pump can be effectively used.
- **Availability of clean, renewable energy.** Electrification is a key decarbonization strategy for buildings to meet emission reduction targets, and provides co-benefits such as reduced emissions, improved air quality, cooling in homes and increased energy efficiency. Electricity in BC is currently abundant, but as more buildings electrify, there may be capacity constraints for electrical supply that need to be resolved. For some existing heating systems that are harder to electrify quickly, such as district energy and high-temperature water or steam boilers, a viable path to reduce greenhouse gas emissions will be to use renewable natural gas. The main challenge will be to ensure that there is a sufficient supply of cost-competitive renewable natural gas if it is to be used as a strategy to decarbonize large portions of the building sector. The provincial CleanBC Plan has set a goal for renewable gas to make up 15% of the province's natural gas supply by 2030. It currently makes up less than 0.5% of FortisBC's total gas supply. Given the scale of the challenge to decarbonize buildings, every available clean, renewable form of energy will play an important role.
- **Costs of retrofitting to zero emissions.** Similar to the new construction sector, many zero emissions solutions are available for most building types, but the cost of providing these solutions can be considerably higher when compared to simply replacing one fossil fuel system with another. Costs can be higher in a building with high heating demand, which is often older buildings. Affordability is exacerbated in rented or leased spaces. In these cases, a key cost reduction measure is to retrofit the building to reduce heating demand before replacing the heating systems. For many buildings in the region, incentives to support both the capital cost of retrofits as well as the ongoing energy costs will need to be explored.

## Low Awareness of the Benefits of Constructing and Renovating to Zero Emissions Standards

Across new and existing buildings, there is a low level of awareness about the benefits of electrification and other low and zero emissions building options. For example, most people are not aware that natural gas is responsible for almost all of the greenhouse gas emissions that come from buildings. Nor are they aware of the climate, health and resiliency benefits associated with high-efficiency electric heat pumps. Often the zero emissions and resiliency solutions for any new or existing building are hidden inside and behind the walls. A huge opportunity exists to amplify the benefits and success stories of zero emissions buildings.

Each of the barriers that have been raised here are addressed within the strategies and actions in the next section of this *Roadmap*.

# The Journey to Zero Emissions, Resilient Buildings

## Linkages to other Climate 2050 Roadmaps

There are many linkages between buildings and other issue areas. You can find additional information on some topics in the following:

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

**Land-use and Growth Management Roadmap** – ideas that shape the form and location of buildings in the region, which influences their emissions and resilience.

**Energy Roadmap** – availability of clean, renewable energy for use by buildings between now and 2050.

**Industry Roadmap** – emissions produced in the construction and demolition of buildings.

**Nature and Ecosystems Roadmap** – the importance of natural systems to reducing emissions from buildings, and increasing the resiliency of the built environment.

## Linkage to Metro Vancouver's Clean Air Plan

Zero Emissions Buildings Strategies 1-4 (and all the associated actions) appear in both the *Buildings 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.



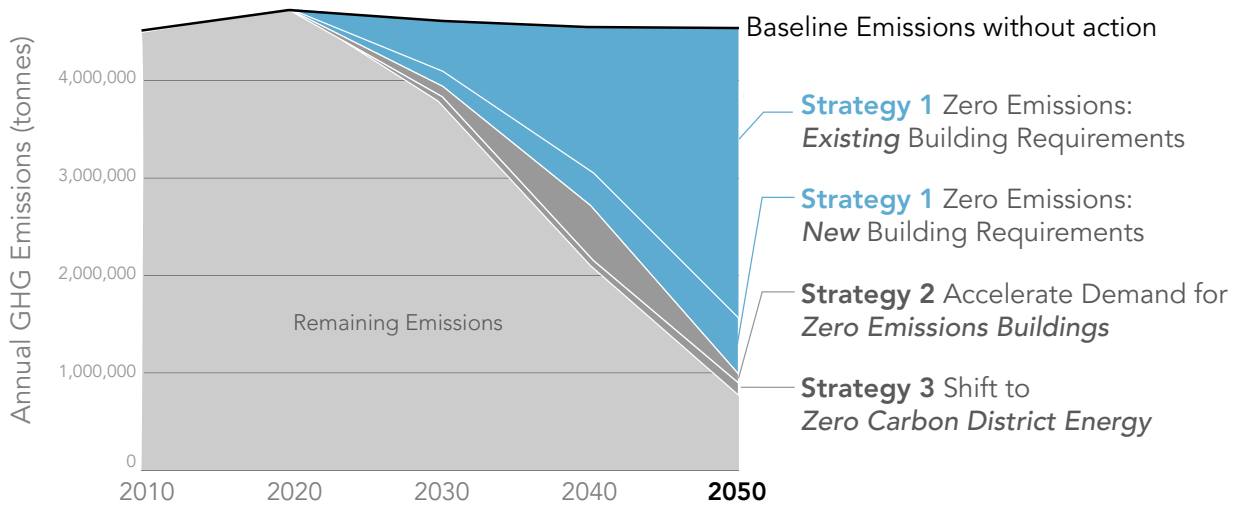


# Zero Emissions Buildings Strategies

## STRATEGY 1: Signal the Transition to Zero Emission Buildings through Requirements and Standards.

Space and water heating using natural gas contributes about 25% of the greenhouse gas emissions in the region. To meet our targets we must send clear and early signals about future requirements for buildings. The BC Energy Step Code and upcoming BC Retrofit Code will improve the energy performance of new and renovated buildings, and both should require that most heating and cooling uses clean, renewable electricity. Equipment efficiency standards and the climate impacts of refrigerants must also be addressed, along with a clear mandate for BC Hydro to support electrification of buildings, will accelerate the transition to zero emissions buildings.

### POTENTIAL IMPACT OF STRATEGY 1 ON GHG EMISSIONS



STRATEGY 1	Potential Impacts of Strategy	Key Partners
	Reduce annual greenhouse gases by up to <b>650,000</b> tonnes in 2030	<ul style="list-style-type: none"> <li>• Federal Government</li> <li>• BC Government</li> </ul>
	Reduce annual greenhouse gases by up to <b>3.5 million</b> tonnes in 2050	<ul style="list-style-type: none"> <li>• Member jurisdictions</li> <li>• BC Hydro</li> </ul>

### 1.1 Greenhouse Gas Performance Requirements for Existing Large Buildings.

Develop regulatory requirements for existing large buildings to meet greenhouse gas emission performance targets, which would reach zero carbon emissions before 2050. Requirements would apply to all existing large commercial and large residential buildings, and would include energy consumption benchmarking, reporting and performance requirements in coordination with BC Government regulatory requirements. These requirements would help to achieve Metro Vancouver's air quality objectives and align with emissions requirements for district energy systems. (see Strategy 2.4). Public sector organizations could play a leadership role by establishing zero emission targets for their own existing buildings earlier.

### 1.2 Greenhouse Gas Performance Requirements for Existing Houses and Townhomes.

Develop regulatory requirements for existing homes and townhomes to meet greenhouse gas emission performance targets, which would reach zero carbon emissions before 2050 in coordination with BC Government regulatory requirements. These requirements could be developed with member jurisdictions, and would also help with achieving Metro Vancouver's ambient air quality objectives.

### 1.3 New Buildings are Highly Efficient and Electric.

Work with the BC Government to establish greenhouse gas performance requirements for new buildings, through the BC Energy Step Code or other legislation, reaching zero emissions (i.e., electric heating and cooling) by 2030. These requirements should allow local governments to voluntarily establish zero emission targets earlier. These requirements would apply to new homes, townhomes, commercial buildings, and large residential buildings. Public

sector organizations should play a leadership role by establishing zero emission targets for their own new buildings in advance of provincial requirements.

### 1.4 Require Greenhouse Gas Reductions During Renovations.

Advocate to the BC Government to establish the BC Retrofit Code with increasingly stringent greenhouse gas performance requirements for buildings undergoing significant renovations.

### 1.5 Building Electrification Mandate for BC Hydro.

Advocate to the BC Government to direct BC Hydro and the BC Utilities Commission to promote and accelerate building electrification and to reduce emissions from buildings. A clear mandate could also support the development of electricity rates for residents who wish to switch to electricity.

### 1.6 Energy Labels for Homes and Buildings.

Work with the BC Government to require every building and home in the region to obtain an energy and greenhouse gas emissions label. The label must be disclosed publicly when a property is constructed or listed for sale, rental or lease. This should include outreach and training with real estate agents, property assessors, insurance providers and other related professions. Such labels would provide information to accelerate low carbon updates for buildings.

### 1.7 Manage Indoor Air Quality in Building Codes.

Work with the BC Government, health authorities and member jurisdictions to ensure that indoor air quality impacts of air tight buildings are safely managed in future updates to building codes.



### 1.8 High Performance Heating and Cooling Equipment Import and Sale Standards.

Advocate to the Government of Canada and the BC Government to establish energy efficiency standards for new and imported heating and cooling equipment. The standards should require a rated energy performance of 100% or more, and greenhouse gas requirements for refrigerants, both by 2030. The standards would help buildings conserve energy while reducing emissions.

### 1.9 Significantly Reduce Refrigerant Leaks in Building Equipment.

Advocate to the BC Government to improve compliance with the requirements of the *BC Ozone Depleting Substances and other Halocarbons Regulation*. This is expected to involve enhanced outreach to help safely reduce refrigerant leaks and ensure effective refrigerant management in heating and cooling systems in buildings.

### 1.10 Accurately Value Zero Emission and Resilient Buildings.

Work with the BC Government and the Government of Canada to establish guidelines for the valuation of low and zero emission, and resilient buildings. This would support lenders, appraisers and insurers in providing competitive products for low and zero emission, and resilient buildings, such as “Green Mortgages” and “Green Loans”.

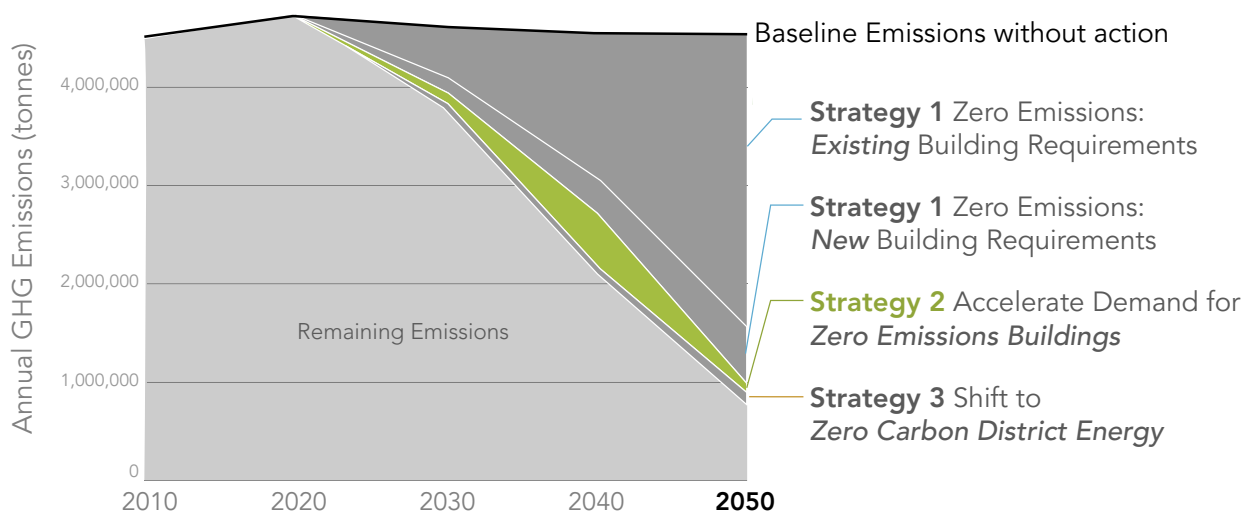




## STRATEGY 2: Accelerate Demand for Zero Emission Buildings through Incentives, Education and Research.

Many technologies, like heat pumps and heat recovery systems, exist today to electrify most buildings that currently use natural gas for heating. Current technical support programs and incentives help home and building owners to adopt these technologies, as well as to improve the energy performance of buildings. A regional Building Decarbonization Coalition will help significantly expand existing programs so more home and building owners can reduce their building emissions. These programs must work directly with community partners to identify the best ways to involve all communities in the region so everyone can benefit from zero emission buildings. Increased technical support and expanded incentives will underpin greenhouse gas requirements by supporting home and building owners to make informed decisions and reduce their emissions.

### POTENTIAL IMPACT OF STRATEGY 2 ON GHG EMISSIONS



STRATEGY 2	Potential Impacts of Strategy	Key Partners
	<p>Reduce annual greenhouse gases by up to <b>110,000</b> tonnes by 2030</p> <p>Reduce annual greenhouse gases by up to <b>90,000*</b> tonnes by 2050</p> <p>*annual reductions in 2050 are lower because the effectiveness of Strategy 2 peaks around 2040 (up to 540,000 tonnes) as shown in the graph above.</p>	<ul style="list-style-type: none"> <li>• Federal Government</li> <li>• BC Government</li> <li>• Member jurisdictions</li> <li>• BC Hydro</li> </ul>



### 2.1 Expand Low Carbon Upgrade Incentives.



Advocate to the BC Government and the Government of Canada to increase funding for fuel-switching and energy efficiency incentives, to the scale required to transition to zero emission buildings in the region and the province. The funding (e.g., incentives, tax credits) should support more building electrification solutions for older homes and buildings, and should complement financing tools under Action 2.5. Specific incentives should also support rental and non-market housing building owners to conduct low carbon upgrades while avoiding increased evictions or significant cost increases for renters

### 2.2 Online Decision Support Tools for Low Carbon Upgrades in Buildings.



Work with the BC Government, the Government of Canada and member jurisdictions to develop innovative online decision support tools to help significantly increase public awareness of low carbon solutions. These tools would help home and building owners choose these solutions by simplifying the planning, financing and execution of low carbon upgrades in buildings. These tools would be supported by energy advisor services under Action 2.3

### 2.3 New Financing Tools for Low Carbon Upgrades.

Work with member jurisdictions, BC Government, Government of Canada, energy utilities and other partners to develop strategic financing tools for home and building owners to accelerate low carbon building upgrades. These tools allow owners to spread the cost of a retrofit over a longer period, making the retrofits more affordable. Examples include Property Assessed Clean Energy (PACE) financing, on-bill financing and other related mechanisms. The tools should be available for homes, townhomes, and large commercial and residential buildings.

### 2.4 Building Decarbonization Coalition.

Work with governments, energy utilities, construction industry, academic institutions, non-governmental organizations and other regional partners to develop a Building Decarbonization Coalition. The Coalition would collaborate to address major barriers (e.g., supply constraints for zero emission building equipment) and create opportunities to accelerate the transition to zero emission homes and buildings. The Coalition would also align its work with the regional working group focused on reducing embodied emissions in new and existing buildings (see Action 4.4).



## 2.5 Energy Advisor Services for Homes and Large Buildings.

Work with the BC Government and the buildings industry to enhance energy advisor services for home and building owners energy advisor services for home and building owners. The expansion would help simplify the customer journey for home and building owners considering retrofits, so they can more easily access technical support and financial incentives.

## 2.6 Make Electricity Upgrades Faster and Cheaper.

Advocate to BC Hydro to work with member jurisdictions, trade associations and other regional partners to streamline electricity service upgrades, to reduce costs and installation timelines.

## 2.7 Increase Public Awareness of the Benefits of Zero Emissions and Resilient Buildings.

Work with member jurisdictions, the BC Government, health authorities, and other partners to deliver awareness and educational programs that encourage home and building owners to choose zero emissions and resilient buildings solutions. These programs would highlight how health is improved by reducing emissions of indoor aircontaminants; the benefits of using qualified installers; permitting requirements for heating, cooling and ventilation systems; and the consumer protections provided by municipal permits.

## 2.8 Training and Education in Zero Emissions and Resilient Buildings.

Work with industry stakeholders and other governments to ensure industry training and certification meets the growing market demand for zero emissions and resilient building design, technology, installation and operation, for both new builds and retrofits of existing buildings.

## 2.9 Share Lessons from Transitioning Metro Vancouver Corporate Buildings to Zero Emissions.

**Corporate LEADERSHIP**

Develop and promote case studies about low carbon upgrades completed at Metro Vancouver corporate buildings, including Metro Vancouver Housing buildings, to show the benefits and feasibility of electric and resilient buildings.

## 2.10 Test New Zero Emission Building Technologies.

**Corporate LEADERSHIP**

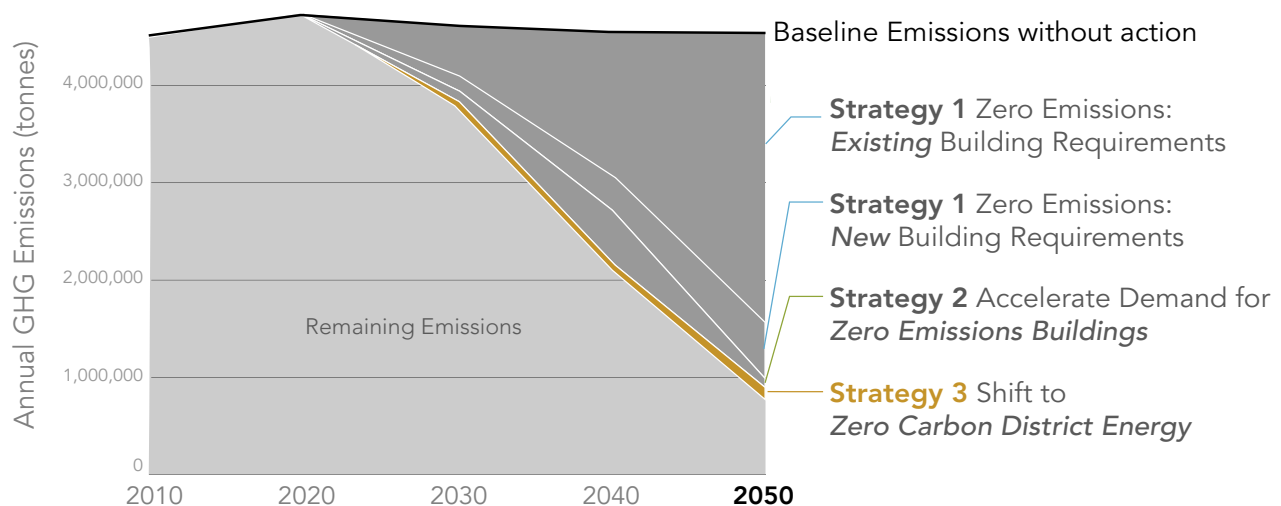
Test new zero emission building technologies in Metro Vancouver corporate buildings, including Metro Vancouver Housing buildings. These pilot projects would include the installation, use and monitoring of building technologies that are not yet widely used in the region.



## STRATEGY 3: Shift to Zero Carbon District Energy Systems.

District energy systems provide heating and cooling to a network of residential and commercial buildings more efficiently and generally with lower greenhouse gas emissions than individual building heating and cooling systems. There are currently 18 district energy systems in the region, running on natural gas, recovered heat and biomass, and more systems are under development. Developing a long-term emissions pathway to transition district energy systems to clean, renewable energy will set a path for entire district energy neighbourhoods to become zero emissions in the future. Metro Vancouver is currently exploring opportunities to provide clean, renewable energy to district energy systems.

### POTENTIAL IMPACT OF STRATEGY 3 ON GHG EMISSIONS



STRATEGY 3	Potential Impacts of Strategy	Key Partners
	<p>Reduce annual greenhouse gases by up to <b>80,000</b> tonnes by 2030</p> <p>Reduce annual greenhouse gases by up to <b>110,000</b> tonnes by 2050</p>	<ul style="list-style-type: none"> <li>• Member jurisdictions</li> <li>• Energy utilities</li> </ul>

#### 3.1 Emissions Requirements for District Energy Systems.



Develop a regulatory pathway to achieve zero carbon district energy systems by 2050, working with member jurisdictions, BC Government and energy utilities. Regulatory design will also support Metro Vancouver's air quality objectives. These requirements should align with Action 1.1 on large buildings.

#### 3.2 Low Carbon District Energy Policies.

Work with member jurisdictions with district energy systems to assess the feasibility of using sewer heat and biogas generation from Metro Vancouver and other member jurisdictions.

## STRATEGY 4: Accelerate the Transition to Lower Embodied Emissions in Buildings.

Embodied emissions are the greenhouse gas emissions associated with resource extraction, manufacturing and distribution of buildings products. Using construction materials with lower embodied emissions will reduce global emissions of greenhouse gases. Local governments in the region are establishing requirements for embodied emissions of construction materials. Establishing a regional embodied emissions working group, and setting requirements in the building code and for new public buildings, will help accelerate the transition to lower embodied emissions in buildings.

STRATEGY 4	Potential Impacts of Strategy	Key Partners
	To be developed as Strategy is implemented	<ul style="list-style-type: none"> <li>• Member jurisdictions</li> <li>• BC Government</li> <li>• Construction/ Renovation industry</li> </ul>

### 4.1 Incorporate Embodied Emissions into the BC Building Code.



Advocate to the BC Government that future BC Building Code and Retrofit Code updates should include stringent embodied emissions performance targets for new construction and retrofits, and would incentivize the use of materials with low embodied emissions through consideration of cost and material availability.

### 4.2 Use Building Materials with Low Embodied Emissions.

Work with the BC Government and member jurisdictions to update or create policies (e.g., procurement, design guidelines, zoning) to prioritize the use of building materials with low embodied emissions, including BC forest products. This should include development and maintenance of widely-supported standard calculations for the life cycle emissions of common building products.

### 4.3 New Public Buildings Set Embodied Emission Reduction Targets.

Advocate to public sector organizations in the region to establish embodied emission reduction targets for new construction projects, ahead of BC Building Code and Retrofit Code changes.

#### Buildings and the circular economy

The construction, retrofit and demolition of buildings creates a lot of unnecessary emissions and waste. In our current “take-make-dispose” economy, demolition material is too damaged to use in new construction. New approaches such as thinking of buildings as “material banks” could help the region transition to a circular economy that keeps building materials circulating at their highest potential value. Through circular design and circular business models we can decrease embodied emissions while increasing economic activity for deconstruction. A small building deconstruction economy is already starting in Metro Vancouver – by setting embodied emissions targets in buildings we can support further growth of the circular economy for the built environment in our region.





#### 4.4 Regional Working Group to Reduce Embodied Emissions in Buildings.

Work with member jurisdictions, BC Government, construction industry and other regional partners to develop a regional working group focused on reducing the embodied emissions in new construction and building retrofits. The working group should support accelerated policy development, establish a regional baseline for embodied emissions, and would also align with the Building Decarbonization Coalition (see Action 2.4).

#### 4.5 Strengthen Metro Vancouver's Corporate Sustainable Design Requirements.

**Corporate LEADERSHIP**

Update Metro Vancouver's Sustainable Infrastructure and Buildings Policy to include increasingly stringent embodied emissions requirements and greenhouse gas performance limits. These requirements should align with the corporate low carbon procurement policies in Action 4.2.



# Resilient Buildings Strategies

## STRATEGY 5: Support water conservation and non-potable water reuse to increase resilience to shifting precipitation patterns

As summers become hotter and drier in the future and water supply is impacted, the region will look to buildings to play a role in better water conservation practices. On-site non-potable water systems have a great deal of potential to reduce demand for potable water in Metro Vancouver. To make these systems more viable, however, there is a need to improve industry understanding on how to appropriately install and maintain them. Guides and resources aimed at key industry and stakeholder groups will support the training that will be required for successful implementation.

### 5.1 Apply Leading Water Efficiency Standards to Buildings.



Advocate for updates to the BC Building and Plumbing Code to require the highest efficiency standards for water use in buildings. Ongoing updates to strengthen standards for water efficiency in buildings should reflect the continuous improvement in technologies and practices for construction and plumbing.

### 5.2 Broaden Applications of Non-Potable Water Use in Buildings.

Advocate to member jurisdictions and other agencies for the development of standardized on-site non-potable water use (e.g., non-food green roof irrigation, toilets, make-up water for boiling and cooling systems), working towards a One Water approach. Metro Vancouver will support member jurisdictions to identify barriers and solutions for the application of these standards new and existing buildings.

### 5.3 Support Capacity Building of Non-Potable Water Use Applications on Building Sites.

Work with member jurisdictions, the BC Government, industry and other regional partners to develop educational resources for the public, building industry and trades that increase the capacity to install and maintain on-site non-potable systems, which have a high potential to reduce demand for potable water in Metro Vancouver. This work should be integrated with the industry training and education work in action 2.8, 6.6, and 7.2.

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

## **STRATEGY 6:** Support the uptake of building design and retrofit solutions to reduce the impact of heatwaves and wildfires

Metro Vancouver has already experienced the challenges of heatwaves and extended periods of poor air quality from wildfires, and this is expected to increase in the future. These events carry with them a host of health and safety risks (e.g., overheating, and aggravating existing respiratory diseases), especially for populations with pre-existing health conditions and limited access to resources. To reduce the impact that heat and wildfire smoke has on our residents, we need a network of publicly accessible buildings that can provide cool, clean indoor air, where people can seek shelter. At the same time, our new and existing buildings will need to meet higher standards for cooling, airtightness and filtration. Nature-based solutions are central to low carbon resiliency, including using green roofs that can dissipate heat and planting deciduous trees that can shade buildings in the summer, and let light through in the winter.

### **6.1 Require Cooling Measures in New Buildings and Major Retrofits.**

Advocate to BC Government to require cooling measures in new construction and significant retrofits to meet current and future cooling demands.



### **6.2 Apply Leading Standards for Ventilation and Filtration in New Buildings.**

Advocate to the BC Government to establish increasingly stringent code requirements for ventilation and filtration systems in new construction. These requirements will reduce the impacts of poor indoor air quality, including wildfire smoke events.



### **6.3 Expand the Network of Public Buildings that can serve as Cool, Clean Air Centres.**

Work with regional partners to conduct public outreach about buildings that our most vulnerable residents can rely on for cool and clean air during extreme heat events and periods of poor air quality, and identify facilities or other building site green spaces that could be feasibly improved to serve this function.

### **6.4 Understand Climate Risk and Resilience for Public Buildings Across the Region.**

Work with member jurisdictions, health authorities and other regional partners to conduct a regional vulnerability assessment for public buildings in Metro Vancouver to understand where risks are the highest and where adaptive capacity already exists.

#### **Cooler Buildings for a Hotter Future**

As the climate warms, enhanced cooling will be necessary to ensure thermal comfort for building occupants. Starting with passive design is key to simultaneously reducing cooling demand and energy costs, through strategies such as orientation, solar shading (e.g., window covers, tree canopy) and high-performance glazing. After maximizing passive measures, mechanical systems such as heat pumps can help to meet additional cooling needs. These measures should be applied in combination at new construction projects and major retrofits, with designs that account for both present and future conditions.

## STRATEGY 6 continued

### 6.5 Integrate Resiliency into Low Carbon Upgrade Solutions.

Work with member municipalities, BC Government and other regional partners to integrate resiliency solutions for existing buildings into the support services proposed in Strategy 2.

### 6.6 Provide Education on Retrofit Options that can Increase Resilience to Heatwaves and Wildfires

Work with member municipalities, BC Government and other regional partners to communicate to the public and industry the retrofit solutions that reduce the risks associated with severe heat and wildfire events. This work should be integrated with training and education work in actions 2.8, 5.3 and 7.2.

## STRATEGY 7: Encourage the uptake of design and retrofit solutions that increase resilience to severe storms and flooding in buildings

As our climate changes, severe storms with heavy precipitation and high winds will occur more frequently and with greater magnitude. It will be important to ensure that new buildings are designed to withstand the impact of these shock events, and to reduce damage and avoid financial burden. Metro Vancouver and its partners can serve as key actors in developing and disseminating information on these options to industry and other stakeholders.

### Different kinds of flooding in the region

Metro Vancouver is expected to see increased flooding in the future. There are three types of flooding that can impact buildings in our region:

**Coastal flooding** happens when strong winds push ocean waves beyond the natural tidal area. Low lying areas can be particularly vulnerable to coastal flooding.

**Riverine flooding** happens when water levels run over the natural or artificial banks of a stream or river, such as the Fraser.

**Urban flooding** happens when severe precipitation overwhelms the drainage system of a city or town and causes water to collect in the streets, causing damage to buildings and infrastructure.

### 7.1 Update Climate Projections to Future-Proof Buildings.

Work with the BC Government to update planning and design tools for building design, based on future climate modeling, to ensure buildings are capable of withstanding anticipated climate conditions, including heavy precipitation, flooding and increased wind speeds.

### 7.2 Provide Education on Retrofit Options that can Increase Resilience to Severe Storms and Flooding.

Work with member municipalities, BC Government and other regional partners to communicate to the public and industry the retrofit solutions that reduce the risks associated with severe storms and flooding. This work should be integrated with the industry training and education work in action 2.8, 5.3, and 6.6.





## Setting the Path Ahead

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

Zero emissions, efficient buildings are better for the environment and better for the people who work, live and play in them. There is strong potential and a critical need to achieve significant greenhouse gas emissions reductions in Metro Vancouver’s building sector over the next three decades. The first place to start is to ensure that all new buildings constructed are zero emissions.

By expediently addressing new construction, all levels of government, utilities, and industry can then focus on the longer-term task of decarbonizing the region’s existing building stock. Achieving this will require careful coordination between key stakeholders, and increased market awareness about the opportunities and benefits of efficient buildings powered by clean and renewable energy. Support for training and knowledge sharing will make it easier for building owners and building professionals to make this shift, backed by effective regulations to ensure that all buildings eventually participate.

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

# CLIMATE 2050 BUILDINGS ROADMAP ACTION TIMELINE

STRATEGY	2021-2023	2024-2029	2030-BEYOND
<b>STRATEGY 1</b> Signal the Transition to Zero Emission Buildings Through Requirements and Standards		<ul style="list-style-type: none"> <li>GHG Performance Requirements for Existing Large Buildings</li> <li>GHG Performance Requirements for Existing Houses &amp; Townhomes</li> </ul>	
		<ul style="list-style-type: none"> <li>New Buildings Efficient and Electric</li> </ul>	
		<ul style="list-style-type: none"> <li>Require Greenhouse Gas Reductions During Renovations</li> </ul>	
		<ul style="list-style-type: none"> <li>Building Electrification Mandate for BC Hydro</li> </ul>	
		<ul style="list-style-type: none"> <li>Energy Labels for Homes and Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>Manage Indoor Air Quality in Building Codes</li> </ul>	
			<ul style="list-style-type: none"> <li>High Perform. Heating and Cooling Equip.</li> </ul>
		<ul style="list-style-type: none"> <li>Significantly Reduce Refrigerant Leaks in Building Equipment</li> </ul>	
			<ul style="list-style-type: none"> <li>Accurately Value Zero Emissions and Resilient Buildings</li> </ul>
	<b>STRATEGY 2</b> Accelerate Demand for Zero Emissions Buildings through Research, Education & Funding		<ul style="list-style-type: none"> <li>Expand Incentives for Low Carbon Upgrades</li> </ul>
		<ul style="list-style-type: none"> <li>Online Decision Support Tools for Low Carbon Upgrades in Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>New Financing Tools for Low Carbon Upgrades</li> </ul>	
		<ul style="list-style-type: none"> <li>Building Decarbonization Coalition</li> </ul>	
		<ul style="list-style-type: none"> <li>Energy Advisor Services for Homes and Large Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>Make Electricity Upgrades Faster and Cheaper</li> </ul>	
		<ul style="list-style-type: none"> <li>Increase Public Awareness of the Benefits of Zero Emissions and Resilient Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>Training and Education in Zero Emissions and Resilient Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>Share Lessons from Transitioning Metro Vancouver Corporate Buildings to Zero Emissions</li> </ul>	
		<ul style="list-style-type: none"> <li>Test New Zero Emission Building Technologies</li> </ul>	
<b>STRATEGY 3</b> Shift to ZeroCarbon District EnergySystems		<ul style="list-style-type: none"> <li>Emissions Requirements for District Energy Systems</li> </ul>	
		<ul style="list-style-type: none"> <li>Low Carbon District Energy Policies</li> </ul>	
<b>STRATEGY 4</b> Accelerate the Transition to Lower Embodied Emissions in Buildings		<ul style="list-style-type: none"> <li>Incorporate Embodied Emissions into BC Building Code</li> </ul>	
		<ul style="list-style-type: none"> <li>New Public Buildings Set Embodied Emission Reduction Targets</li> </ul>	
		<ul style="list-style-type: none"> <li>Use Building Materials with Low Embodied Emissions</li> </ul>	
		<ul style="list-style-type: none"> <li>Regional Working Group to Reduce Embodied Emissions in Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>Strengthen Metro Vancouver's Corporate Sustainable Design Requirements</li> </ul>	
<b>STRATEGY 5</b> Water Conservation & Non-Potable Water Reuse		<ul style="list-style-type: none"> <li>Apply Leading Water Efficiency Standards to Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>Broaden Applications of Non-Potable Water Use in Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>Support Capacity Building of Non-Potable Water use Applications on Building Sites</li> </ul>	
<b>STRATEGY 6</b> Design & Retrofit Solutions for Heatwave and Wildfire Resiliency		<ul style="list-style-type: none"> <li>Require Cooling Measures in New Buildings and Major Retrofits</li> </ul>	
		<ul style="list-style-type: none"> <li>Apply Leading Standards for Ventilation and Filtration in New Buildings</li> </ul>	
		<ul style="list-style-type: none"> <li>Expand the Network of Public Buildings that can serve as Cool, Clean Air Centres</li> </ul>	
		<ul style="list-style-type: none"> <li>Understand Climate Risk and Resilience for Public Buildings Across the Region</li> </ul>	
<b>STRATEGY 7</b> Design & Retrofit Solutions for Storm and Flooding Resiliency		<ul style="list-style-type: none"> <li>Integrate Resiliency into Low Carbon Upgrade Solutions</li> </ul>	
		<ul style="list-style-type: none"> <li>Provide Education on Retrofit Options that can Increase Resilience to Heatwaves and Wildfires</li> </ul>	
		<ul style="list-style-type: none"> <li>Update Climate Projections to Future-Proof Buildings</li> </ul>	
	<ul style="list-style-type: none"> <li>Provide Education on Retrofit Options that can Increase Resilience to Severe Storms and Flooding</li> </ul>		

## Measuring our Progress

The table below lists examples of some of the performance indicators that could be used to help Metro Vancouver measure regional progress towards meeting the targets set out for this purpose. The performance indicators used will depend on the availability of this information from other organizations. Because the Buildings 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 zero emissions future. 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
Regional GHG impact	tCO <sub>2</sub> e attributed to the building sector	Regional GHG inventory	Yes
	tCO <sub>2</sub> e attributed to the building sector	Aggregated utility data for building energy sales	Yes
Zero Emissions Buildings Standards	Number of municipalities adopting minimum GHG performance requirements (medium term)	BC Government	No
	Number of retrofit code permits with energy/climate measures	Local Governments	No
Demand for Zero Emissions Buildings	Numbers of high-efficiency electric equipment sold in BC	HRAI & CIPH shipment data Technical Safety BC Municipal mechanical system permits	No
	New buildings with low-carbon energy systems	Local Government building permits	Yes
	Distribution of building level GHG intensity scores (medium term KPI)	Building Energy Benchmarking Home Energy Scores	No
	Number of incentives (number of incentives and total dollar value).	CleanBC, Utilities	Yes
	Number of self-reported heat pump systems and fuel switches	Residential End Use Survey & Commercial End Use Survey (medium term KPI)	Yes
	Number of installed heat pump systems	Local government and Technical Safety BC Installation Permits	Yes
	Number of builders and retrofit trades companies operating in BC	North American Industry Classification Systems (NAICS) company registry	Yes
	Number of CleanBC Program Registered Contractors in different regions of BC	Utilities, Home Performance Stakeholder Council (HPSC)	Yes
	Number and sector distribution of Building Electrification Coalition members	Coalition	Yes
	Number of products, efficiency ratings and purchase cost	Shelf/industry survey	Yes
	Net present value of newly installed high-efficiency electric systems in buildings	Various	No



ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Demand for Zero Emissions Buildings (cont.)	Number of new products – year over year	Shelf/industry survey	No
	Number and types of products going through certification process	Canadian Standards Association (CSA)	No
Zero Carbon District Energy Systems	tCO <sub>2</sub> e attributed to district energy systems	Metro Vancouver District Energy Reporting Data	Yes
Lower Embodied Emissions	TBD	TBD	TBD
Water Conservation & Reuse	TBD	TBD	TBD
Heatwave & Wildfire Resilience	Numbers of high-efficiency electric equipment sold in BC	HRAI & CIPH shipment data Technical Safety BC Municipal mechanical system permits	No
	Number of new buildings with low-carbon energy systems	Local Government building permits	Yes
	Percentage of buildings self-reporting heat pump systems and fuel switches	Residential End Use Survey & Commercial End Use Survey (medium term KPI)	Yes
	Percentage of buildings self-reporting mechanical air filtration systems	Residential End Use Survey & Commercial End Use Survey (medium term KPI)	No
	Number of installed heat pump systems	Local government and Technical Safety BC Installation Permits	Yes
Storm and Flooding Resilience	TBD	TBD	TBD

# Glossary

**Carbon dioxide (CO<sub>2</sub>)** 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 emissions reductions possible across all economic sectors, and any remaining emissions are balanced out by the carbon dioxide that the plants, trees, and soil of the region remove from the atmosphere, or potentially through technological means

**Carbon 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 or solar.

**Climate resilience** describes the capacity of ecosystems, infrastructure, economies, and communities to absorb the impacts of climate change while maintaining essential services and functions needed to support health and well-being. In some cases, climate resilience involves changing services and functions so they are more sustainable.

**Common air contaminants** are air contaminants that can harm public health and reduce residents' quality of life and life expectancy by causing heart and lung diseases, cancer, asthma, and other impacts. Some air contaminants have odorous characteristics. Common air contaminants include fine and coarse particulate matter, ground-level ozone, nitrogen dioxide, sulphur dioxide, and ammonia.

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

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.

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

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

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

**Low carbon building upgrades** include upgrading building insulation and windows, sealing out drafts and switching to electric heating and cooling. These upgrades can significantly reduce energy consumption and emissions.

**Nitrogen oxides (NOx)** are a group of gases, which includes nitrogen dioxide, that are produced during high-temperature fuel combustion, and can contribute to the formation of ground-level ozone and fine particulate matter.

**Renewable natural gas** is a renewable form of natural gas with a low carbon intensity. Sources of renewable natural gas include landfill gas and organic waste.

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

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

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

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







