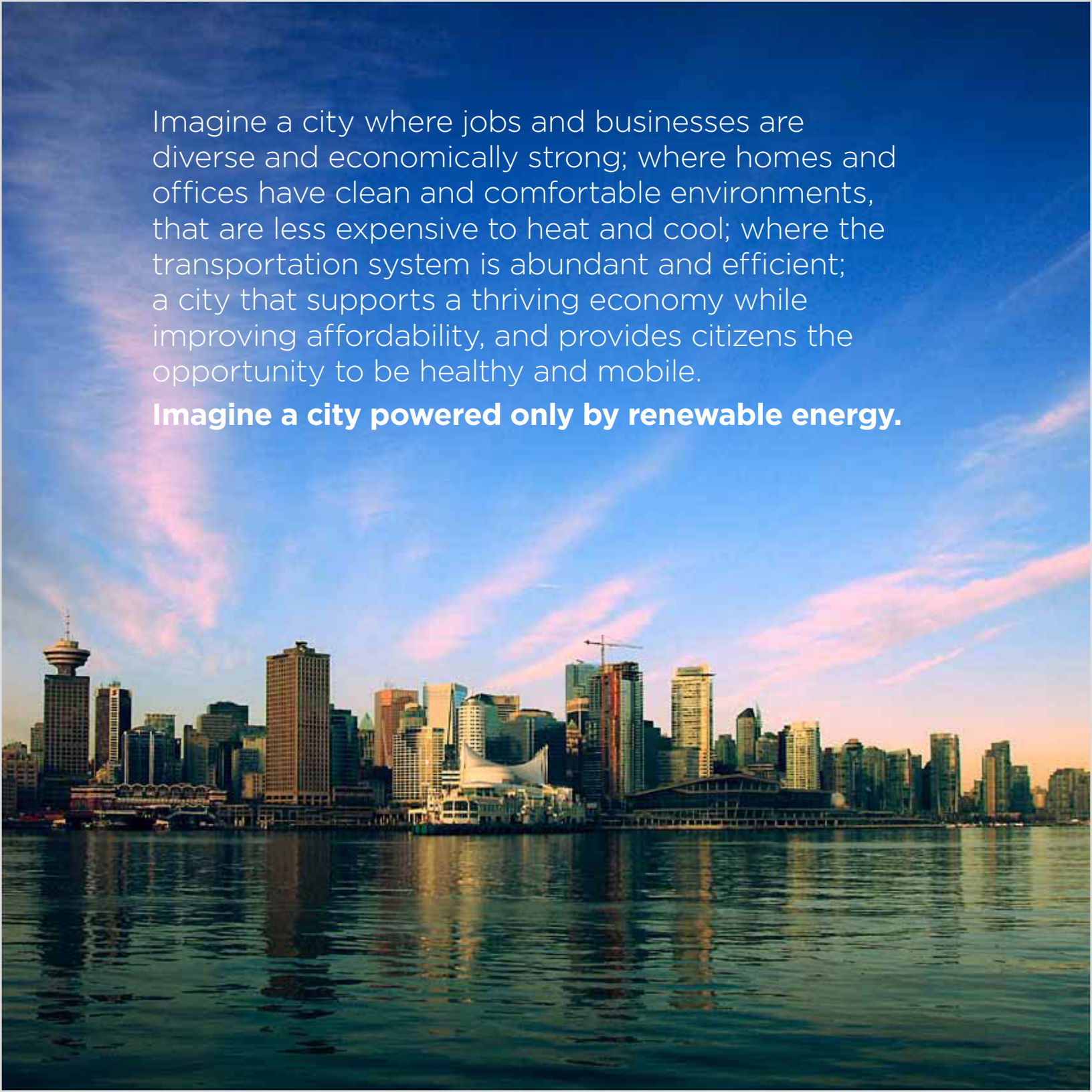
CITY OF VANCOUVER

RENEWABLE CITY STRATEGY

2015-2050



Imagine a city where jobs and businesses are diverse and economically strong; where homes and offices have clean and comfortable environments, that are less expensive to heat and cool; where the transportation system is abundant and efficient; a city that supports a thriving economy while improving affordability, and provides citizens the opportunity to be healthy and mobile.

Imagine a city powered only by renewable energy.

RENEWABLE CITY STRATEGY

For more details, visit vancouver.ca/renewablecity for the full Renewable City Strategy.

RENEWABLE CITY STRATEGY

A MESSAGE FROM THE MAYOR

Vancouver is inspired to lead the major cities of the Americas, first with a commitment to derive 100% of our energy from renewable sources, and now with a *Renewable City Strategy* to outline how we do that before 2050.

The world is rallying to respond to the accelerating rate of climate change and its devastating impacts; taking action to dramatically reduce climate pollution is essential to our viable future.

Cities are leading the way and are now joined by governments, businesses and communities the world over. In response, energy systems are rapidly shifting and since 2012 renewable energy is attracting more capital investment than fossil fuels, signalling a profound economic transformation.

In our commitment to use 100% renewable energy, Vancouver is primed for success. We are building on 25 years of positive action on climate: we are a world leader in the development of complete, compact and livable communities, we are economically diverse and strong, and are blessed with abundant renewable electricity. Vancouver has the opportunity to thrive in a renewably-powered future.

Our *Renewable City Strategy* focuses on Vancouver's two biggest users of energy—buildings and transportation—which accounted for over 90% of our emissions in 2014.

Currently more than half the journeys in Vancouver are made by walking, biking or using transit. Our building code is considered the greenest in North America. Since 1990 our population grew 34% and jobs increased by 30%, but we cut our greenhouse gas emissions by 7%. We have clearly shown that cutting emissions is good for our economy, but with 69% of our current energy coming from fossil fuels, we still have significant work to do.

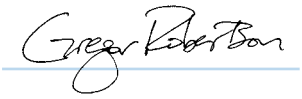
To become a 100% Renewable City we need to deepen partnerships between all levels of government, utilities, businesses, non-profits, neighbourhoods and the citizens of our local and global communities.

This strategy was developed through extensive consultation with our local community, industry experts, local and international thought-leaders and by looking to some of the world's other leading cities.

Our *Renewable City Strategy* sets the stage for Vancouver to accelerate our success. We are building an economy that is more diverse and resilient, has inclusive employment opportunities, and which further establishes Vancouver as a global green capital.

Embracing renewable energy is crucial to restoring our climate and environment, and generates remarkable economic opportunities. It's also about improving quality of life, health and affordability—now and for future generations.

I look forward to working with you all in the coming months and years to quicken the pace. We must focus our ambition, ingenuity and teamwork to transform Vancouver and all of the world's cities and communities to 100% Renewable. For the good of our world and all who live here.



Mayor Gregor Robertson

SETTING THE STAGE

TARGET 1:
Derive 100% of the energy used in Vancouver from renewable sources before 2050

TARGET 2:
Reduce greenhouse gas emissions by at least 80% below 2007 levels before 2050

RENEWABLE ENERGY IS ENERGY THAT IS NATURALLY REPLENISHED AS IT IS USED.

Vancouver has what is needed to successfully derive 100% of its energy from renewable sources before 2050. Vancouver is building on 25 years of action and success tackling climate change. Vancouver is already a world leader in the development of complete, compact, and livable communities with greenhouse gas emissions per person amongst the lowest in the developed world. Serviced by a clean and reliable electrical system, which also powers much of the city's transit system, Vancouver is primed to capitalize on the electrification of both its buildings and its transportation system.

The technological and business transformation of energy efficiency, conservation, and management coupled with new renewable energy generation is set to define the economy of the future. The *Renewable City Strategy* positions Vancouver to further increase its economic diversity for a stronger, more resilient economy. A healthy environment is essential to attracting and retaining the very best minds, establishing Vancouver as an innovation hub with high and inclusive employment—positioning Vancouver in the vanguard of long-term economic stability and success.

The City of Vancouver can be the catalyst for change through its own operations, as well as through public pilots and demonstrations. Ensuring that the city's neighbourhoods, communities, buildings, and transportation system embrace renewable energy will mean a better, healthier quality of life for residents of Vancouver today and into the future.

Vancouver has grown a lot since it was founded in 1886 and now uses over 59 million gigajoules (GJ) of energy a year—that's enough energy to get to the moon and back 6,500 times—and releases 2.8 million tonnes of CO_2e as a result.

Vancouver's energy supply is currently 31% renewable, with the remaining fossil fuel portion dominated by natural gas for space heat and hot water, and gasoline for personal and light-duty vehicle use. Vancouver's energy use and resulting greenhouse gas emissions are dominated by buildings and transportation. These two sectors are the focus of the *Renewable City Strategy*.

IMPLEMENTATION

The *Renewable City Strategy* sets the direction for Vancouver to achieve its 100% renewable energy goal. It is not intended to be a detailed roadmap or technology guide, but instead is a foundation for more detailed planning and budgeting. Project and technology support that result from the *Renewable City Strategy* will be assessed to ensure that the route followed is technically, economically and socially responsible. The *Renewable City Strategy* proposes a viable route to using 100% renewable energy—it is not the *only* route to that success.

The City of Vancouver will partner with the business community, academia, non-profit organizations, schools, labour unions, neighbourhoods, faith groups, surrounding municipalities, other levels of government, public agencies, and the public at large to ensure the success of the *Renewable City Strategy*.

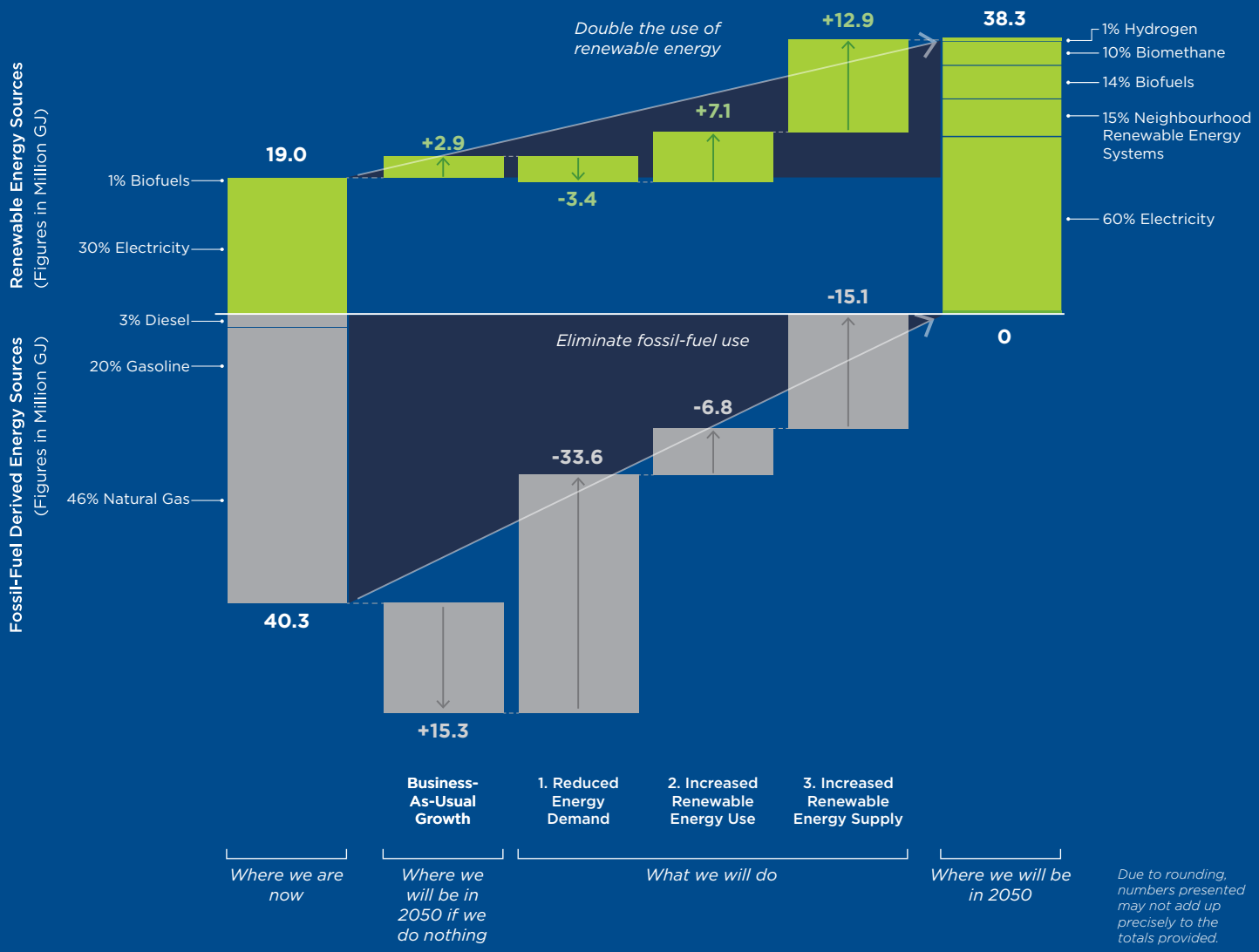
The City will ensure that the public is widely engaged and consulted as the *Strategy* moves into implementation. Empowering Vancouver's citizens and communities to participate in the energy revolution will be a critical success factor. Vancouver residents and businesses must be mobilized to become the agents for, and investors in, the changes that will come with a renewable city. Vancouver has the capacity to be a world-leading innovation hub for renewable energy and technology. At its heart, a renewable energy strategy is not just about energy: it is about quality of life, health, affordability, and a strong and sustainable economy for generations to come.

HOW VANCOUVER WILL GET TO 100% RENEWABLE ENERGY BY 2050

2014
Total Energy Use
59.3 Million GJ

BUILDINGS AND TRANSPORTATION

2050
Total Energy Use
38.3 Million GJ



Due to rounding, numbers presented may not add up precisely to the totals provided.

GOALS FOR A RENEWABLE CITY

BECOMING A RENEWABLE CITY

The goal of the *Renewable City Strategy* is that Vancouver will become a city that uses only renewable sources of energy while respecting the principles of sustainability. The *Strategy* will target two major energy consumers: buildings and transportation. There are many other sources of greenhouse gas emissions that the City will continue to address in partnership with residents and businesses.

Renewable energy technologies are maturing and becoming cost competitive, with many more new technologies are under development or yet to be realized. As long as they meet the definition for renewable, new innovations will be considered as the *Renewable City Strategy* is updated and refined.

- **Buildings:** Renewable energy sources for buildings must typically provide electrical power or heating and cooling. Electrical needs can be met by both large and small hydro projects, solar panels, and wind. Space heat can be met with biomethane, heat pumps, or resistance heating using renewable electricity or renewable waste streams such as biomethane, waste wood, and sewer heat, with geoexchange systems able to provide renewable heating and cooling.
- **Transportation:** Renewable energy sources for transportation include responsibly sourced and processed biofuels, hydrogen from the electrolysis of water using renewable electricity, biomethane (also called 'renewable natural gas' or 'biogas'), and renewable electricity.

CITY CONTEXT

The City of Vancouver's mission statement is "to create a great city of communities that cares about its people, its environment, and the opportunities to live, work, and prosper." Striving to use 100% renewable energy provides an opportunity to enhance each of these pillars.

- **People:** Vancouver is defined by its residents and their diversity, ability to adapt, visionary outlook, and desire to be involved in shaping their city. Becoming a 100% renewable city provides the opportunity for communities to be more vibrant, integrated, and considerate of their impacts. The energy used in daily life through transportation choices, heating and cooling homes, are integral to delivering the communities Vancouverites want.
- **Economy:** The transition to renewable energy also provides the opportunity for innovation and the development of new business models, products, and technologies. Local innovation can be shared internationally, reinforcing Vancouver's leadership in environmental responsibility.
- **Environment:** Evolving to a renewable energy future will reduce greenhouse gas emissions and lead to better air quality, a healthier lifestyle, enhanced natural habitat, reduced pollution risk from fuel leaks and spills, as well as help to prepare for the anticipated impacts of a changing climate such as extreme weather events.

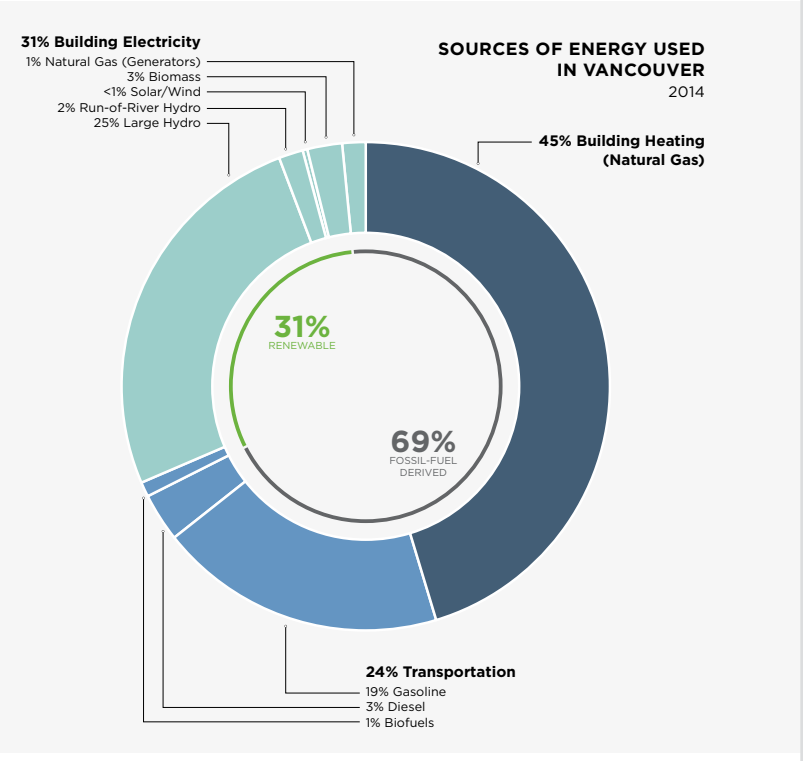
STRATEGIC APPROACH TO THE RENEWABLE ENERGY TRANSITION

Energy efficiency and conservation measures have the largest long-term impact and are the most cost effective way to move towards using only renewable energy, while increasing the use of existing renewable energy resources is more cost effective than building new.

1. **Reduce energy use.**
   Advance energy conservation and efficiency programs which are the most cost-effective way to a renewable energy future.
   e.g., increase building insulation requirements or improve bike network

2. **Increase the use of renewable energy.**
   Switch to renewable forms of energy that are already available, and make improvements to our existing infrastructure to use it to its fullest potential.
   e.g., switch to an electric vehicle or expand the number of buildings connected to the Southeast False Creek Neighbourhood Energy Utility

3. **Increase the supply of renewable energy.**
   Increase the supply of renewable energy and build new renewable energy infrastructure.
   e.g., increase the amount of rooftop solar power generation or supply more biofuels for transportation



RENEWABLE CITY: A STRATEGY IN CONTEXT

STRATEGIC CITY PLANS

The *Renewable City Strategy* is the natural continuation of the *Greenest City 2020 Action Plan* that establishes the City's environmental targets to 2020, and compliments the City's existing approach to the three pillars of sustainability: social (*Healthy City Strategy)*, economic, (*Vancouver Economic Action Strategy*) and environmental (*Greenest City 2020 Action Plan*).

Regional Planning

The City of Vancouver cannot act in isolation when transitioning to using 100% renewable energy. Metro Vancouver's most important strategies to respond to regional growth and support the use of renewable energy are the *Regional Growth Strategy*, the *Integrated Air Quality & Greenhouse Gas Management Plan*, and the *Integrated Solid Waste & Resource Recovery Management Plan*.

Provincial Policy

The Provincial Government of BC has a number of plans that support the development of 100% renewable energy resources. These include the *BC Climate Action Plan* (successor under development), *BC Energy Plan*, *BC Bioenergy Strategy*, and the *BC Air Action Plan*. The City of Vancouver encourages the Provincial Government to continue with these commitments, devote additional resources to the transition, and accelerate the pace of change.

Federal Policy

The Federal Government's most relevant policies related to renewable energy are currently limited to infrastructure planning and funding. There is need for more explicit federal policies and programs to support renewable energy, energy efficiency improvements, and the pricing of carbon pollution.

For a complete list of related plans, visit vancouver.ca/renewablecity for the full Renewable City Strategy.

RENEWABLES AND EQUITY

The consequences of inaction to reduce fossil fuel use, such as climate change, poor air quality and detrimental health impacts, can be avoided through the adoption of renewable energy, while increasing social equity. Buildings that use less energy means lower energy bills for renters and owners alike. A move towards electrification and the use of renewables to produce that electricity, with BC's regulated utilities, provides more certainty in long-term energy costs compared to the variability of fossil fuel prices. Renewable energy technologies, such as solar panels, also allow residents or neighbourhoods to produce their own electricity, and sell any excess they don't use. Communities that prioritize active transportation and that are well served by transit can improve affordability by reducing the need for residents to maintain and buy fuel for personal vehicles, increase access to jobs and economic opportunity, as well as increase health through greater physical activity.

RISING TO THE CHALLENGE

THE CONSEQUENCES OF CONTINUING TO USE FOSSIL FUELS

The effects of climate change are already being felt. 2014 was the hottest year on record. Burning fossil fuels worsens air quality, directly impacts human health, accelerates the loss of natural habitats, and affects agricultural production, among other things. The release of carbon dioxide through fossil fuel use is affecting Vancouver and its surroundings through sea level rise, more frequent and more severe heat waves, increased frequency and severity of storms, increased winter rainfall, summer droughts, and less snow. These changes will continue to worsen in the foreseeable future. There is a need to not only take action to prevent this (climate mitigation), but also prepare for it (climate adaptation).

POPULATION AND URBAN GROWTH

The world's population continues to increase, with most of that growth taking place in urban environments. Cities are the engines of the global economy and are responsible for about 70% of the world's greenhouse gas emissions. The benefits that fossil fuels have brought over the past 100 years can no longer be relied upon to continue into the future—in fact, to continue to improve the standard of living for everyone in Vancouver, the city must transform so that it derives 100% of its energy from renewable sources.

THE TIME TO ACT IS NOW

There is consensus among world leaders, scientists, and businesses that climate change must be addressed quickly and effectively in order to avoid devastating social and economic upheaval worldwide. In April 2015, more than 40 CEOs from some of the world's largest companies, representing 20 economic sectors and operations in more than 150 countries, called for bold action on climate while committing to reduce their own corporate emissions. In May 2015, Pope Francis released his encyclical that warned there would be serious consequences for all of humanity if we fail to take action on climate change. The world conversation on climate change is wholly focused on action. The *Renewable City Strategy* is an affirmation of Vancouver's commitment to continue to take action now and into the future.

United Nations Climate Conference 2015

The United Nations Framework Convention on Climate Change (UNFCCC) will hold its 21st Conference of the Parties (COP21) in Paris in December 2015. The objective of COP21 is to establish a legally binding universal agreement on climate action, with the intent to limit world greenhouse gas emissions to hold the increase in global average temperature below two degrees celsius—the generally accepted limit to avoid irreparable ecosystem damage. In 1997, 35 countries, producing 14% of global emissions, signed the Kyoto Agreement, the first and now expired global climate agreement. Today, 149 countries, accounting for 90% of current global emissions, have submitted commitments to the UNFCCC. The world is moving to take action.

Action from the World's Big Carbon Emitters

The world's two biggest economies, China and the United States, were responsible for over 38% of global greenhouse gas emissions in 2010. In November 2014, China and the US signed a joint announcement on climate change and clean energy cooperation that committed the US to cut its emissions by 26 to 28% below 2005 levels by 2025 and mandated China's greenhouse gas emissions to peak in 2030. With the world's largest economies supporting climate action and clean energy, the stage is set for changes in how the world derives its energy.

LOCAL GOVERNMENT LEADERSHIP ON CLIMATE ACTION

Urban areas are home to the majority of the world's population and are on the front line of climate change impacts. Cities and their mayors are leading the changes needed to avert the worst effects of climate change. Some are acting in the absence of national leadership and are primed to make even more progress with better harmonized national policy. In 2014, the United Nations launched the Compact of Mayors, a global initiative for cities to commit to action on climate change and report their progress. As of October 2015, the Compact of Mayors had 197 members from 53 countries, including Vancouver.

PRICING CARBON POLLUTION

Carbon pollution has social costs that are not reflected in the price of fossel fuels: 'externalities,' as they are called by economists, that include human health impacts, sea level rise, lost agricultural productivity, and habitat loss. To illuminate and mitigate the full impacts of burning fossil fuels, it is important to price those externalities. That price may take the form of a tax on those who emit the carbon, like there is in BC, or it may take the form of a cap-and-trade system in which carbon emissions become a commodity like any other, and that can be traded. Programs like this exist in Ontario, Quebec, California, and Europe.

FOSSIL FUEL DIVESTMENT AND RENEWABLE ENERGY INVESTMENT

The movement by pension funds, private equity, academia, and some governments to withdraw investments in companies that extract fossil fuels is one of the fastest divestment movements in history. Some are removing finance from fossil fuel extraction companies on moral grounds, while for others it is seen as the prudent long-term investment decision. Investment in renewable energy projects (excluding large hydro) jumped by nearly 17% in 2014 compared to 2013; 2014 also saw an all-time high in the capacity of wind and solar power installations: 20% higher than in 2013.

CHANGE IS INEVITABLE

The world is moving away from fossil fuels, and Vancouver can either postpone action and play catch-up at a later date, or continue to take advantage of emerging social and economic opportunities. The transition is not about austerity or making sacrifices; it is about growing a city that better meets our needs. A renewable future will enrich society with new opportunities in many areas of our lives, and our children will look back and ask, "What took you so long?"

VANCOUVER IN 2015

Vancouver, known for its mild coastal climate and mountain views, is the largest city in British Columbia and the eighth-largest city in Canada. Vancouver has an ethnically and linguistically diverse community: half its residents speak a first language other than English, and its economy is the second most diversified in Canada. At the time of first European contact in the late 18th century, the Musqueam, Squamish, and Tsleil-Waututh peoples lived in the area that is now Vancouver. All are Coast Salish First Nations, sharing cultural and language traits with people in the Fraser Valley and Northern Washington State, and the City of Vancouver acknowledges their unceded traditional territories.

Photo by Steve Chou

CITY PROFILE

In 2011 there were over 605,000 people in the city's 115 sq. km area. The city is made up of large areas of residential property, many commercial buildings, and a growing number of mixed-use buildings. Vancouver is the regional center for economic and educational activity. As such, close to 400,000 additional people travel to or through the city each day. Vancouver has only three large industrial facilities, a handful of medium-sized industries, and a myriad of light-industrial and small and medium enterprises.

METRO VANCOUVER

The City of Vancouver is part of Metro Vancouver, a region made up of 21 municipalities, one treaty First Nation and one electoral area, which together have an area of nearly 2,900 sq. km and in 2011 a population of 2.5 million people.

POPULATION AND JOB INCREASES

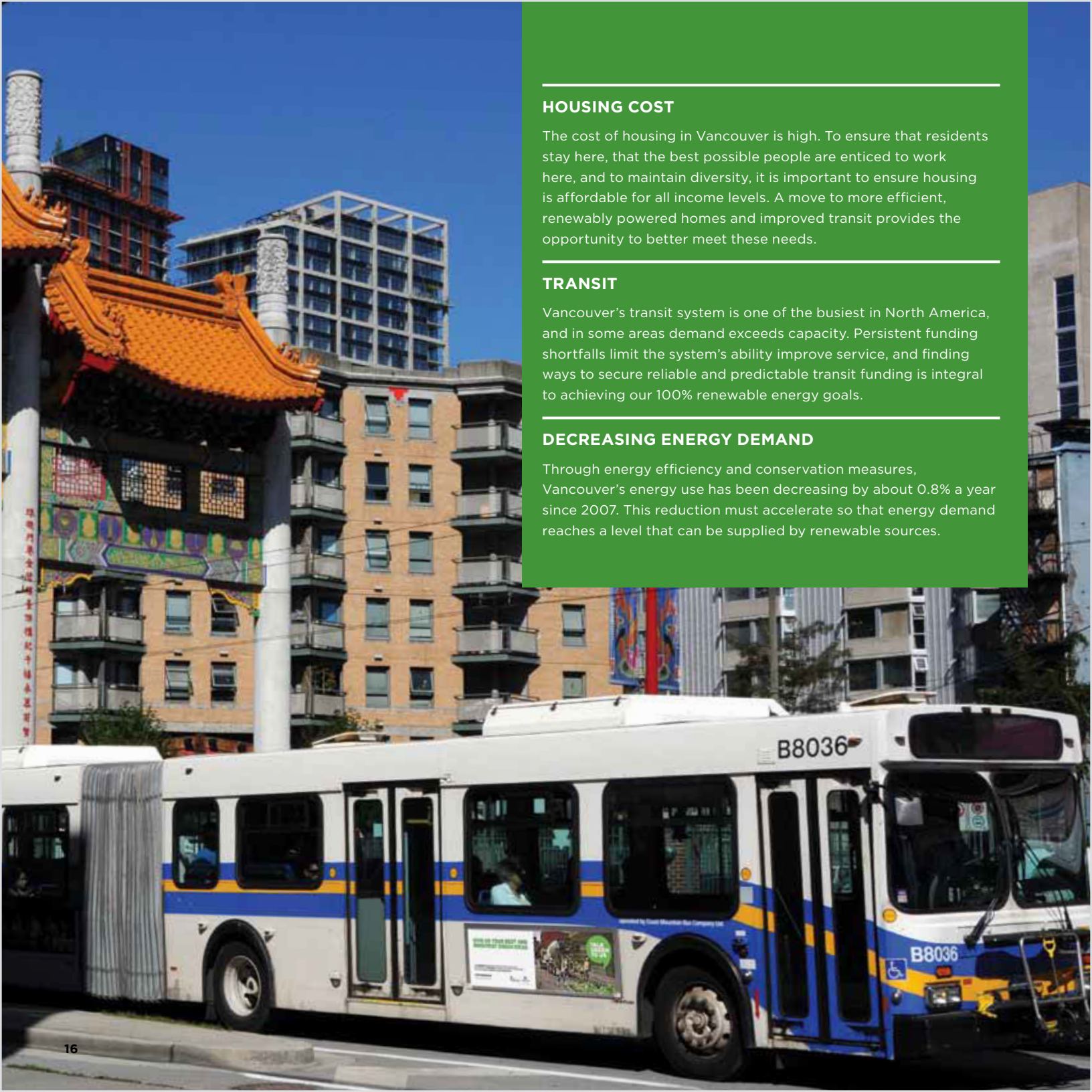
In the past 25 years, Vancouver's population has grown by 34%, with jobs increasing by 30%. Over the same time, Vancouver's carbon emissions saw a net reduction of 7% and are expected to keep falling, showing that the city can continue to grow and be economically strong while removing the burden of carbon pollution. Over the next 35 years, the city's population is expected to grow by about 30%—that's another 170,000 people—adding 32% more jobs.

BUSINESS PROFILE

Vancouver's business and industrial foundation is made up of small and medium enterprises. Over 90% of Vancouver businesses have fewer than 50 employees, and over 70% have 10 employees or fewer. This gives the economy strength through diversity, and with so many individual stakeholders, cooperation and participation from the whole business community are key.

VANCOUVER'S BRAND

Vancouver's brand, valued at US$31 billion in 2015 when measured by investment, reputation, and performance, has shown that sustainability is integral to Vancouver's success. Vancouver is recognized globally for its reputation in sustainability, green technology, and environmental protection. This brand encourages businesses to move and invest here, attracts talented workers, encourages outstanding students and researchers to study here, and underpins our long-term economic stability.



HOUSING COST

The cost of housing in Vancouver is high. To ensure that residents stay here, that the best possible people are enticed to work here, and to maintain diversity, it is important to ensure housing is affordable for all income levels. A move to more efficient, renewably powered homes and improved transit provides the opportunity to better meet these needs.

TRANSIT

Vancouver's transit system is one of the busiest in North America, and in some areas demand exceeds capacity. Persistent funding shortfalls limit the system's ability improve service, and finding ways to secure reliable and predictable transit funding is integral to achieving our 100% renewable energy goals.

DECREASING ENERGY DEMAND

Through energy efficiency and conservation measures, Vancouver's energy use has been decreasing by about 0.8% a year since 2007. This reduction must accelerate so that energy demand reaches a level that can be supplied by renewable sources.

LOW-COST NATURAL GAS

Just a decade ago, natural gas prices were double what they are today and were rising. Limited supplies meant that natural gas could command a price premium. The discovery in North America of large quantities of shale gas has now caused the price to crash, and this low cost is expected to remain for years to come. What is not included in this price are the health and environmental damages caused by climate impacts from burning large amounts of natural gas.

TRANSPORTATION FUEL SUPPLY AND PRICES

Much of Vancouver's transportation fuel comes from within Canada, but its price is still affected by world trends. Gasoline and diesel prices have risen over the past decade and in the medium-to-long term are expected to continue in the same direction. These prices are volatile, making it difficult for people to plan their spending on fuel.

RENEWABLE ELECTRICITY

Vancouver is fortunate to have electrical power which comes mostly from large hydroelectric dams, with small amounts of small-hydro generation, wind, biomass, and natural gas. As the sole electrical utility supplying Vancouver, BC Hydro is mandated to produce as much power as BC needs from facilities within the province and is regulated to do so with 93% of the total generation met by clean sources.

BRITISH COLUMBIA'S CARBON TAX

The Province of BC levies a carbon tax of $30 per metric tonne of carbon dioxide on about 70% of BC greenhouse gas emission sources, including the most common fuels like gasoline, diesel, propane, and natural gas. The tax, launched in 2008, is revenue neutral, having been balanced by reductions in personal income and corporation tax rates. Provisions are made to reduce the tax collected from low-income families and those in northern BC that have greater heating needs.

PORT METRO VANCOUVER

Port Metro Vancouver is Canada's largest port, shipping goods valued at over $500 million a day. Port Metro Vancouver acts as Canada's primary gateway to Asia-Pacific economies and anticipates a 70% increase in container volumes by 2030 for the two terminals it operates in Vancouver, with significant growth also expected in bulk shipping of agricultural products like grain.

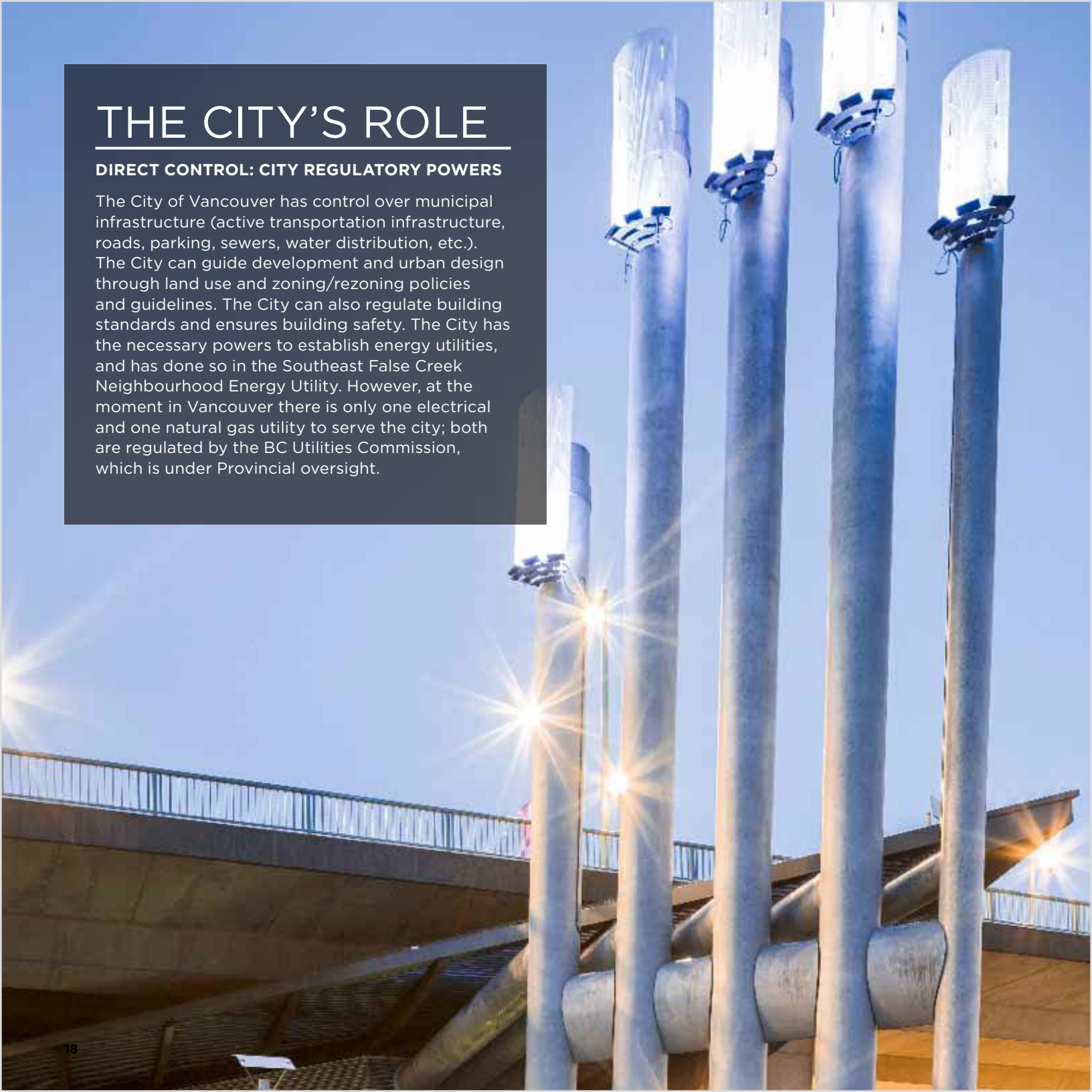
INFRASTRUCTURE

Vancouver's infrastructure is in good condition compared to many cities worldwide. This infrastructure allows the city to operate smoothly and effectively; however, maintaining our infrastructure is critical. In some cases, no reasonable amount of investment can keep pace with demand. The road space in Vancouver, for example, is at its maximum and we must learn how to use our road space differently when creating a vibrant urban landscape.

THE CITY'S ROLE

DIRECT CONTROL: CITY REGULATORY POWERS

The City of Vancouver has control over municipal infrastructure (active transportation infrastructure, roads, parking, sewers, water distribution, etc.). The City can guide development and urban design through land use and zoning/rezoning policies and guidelines. The City can also regulate building standards and ensures building safety. The City has the necessary powers to establish energy utilities, and has done so in the Southeast False Creek Neighbourhood Energy Utility. However, at the moment in Vancouver there is only one electrical and one natural gas utility to serve the city; both are regulated by the BC Utilities Commission, which is under Provincial oversight.



PARTIAL CONTROL: TRANSPORTATION

While the City of Vancouver has little control over vehicle choice, it has a strong influence on travel behaviour through land use and transportation planning, including signal operation, how streets are designed and space allocated, and where services and amenities are located. Public transportation infrastructure, including bridges and the Major Roads Network, is the shared responsibility of the City and TransLink, the local transit authority.

TransLink is required to provide a regional transportation system that supports Metro Vancouver's *Regional Growth Strategy*, air quality and greenhouse gas reduction objectives, and the economic development of the region. Vehicle fuel efficiency and pollution standards for new vehicles are set by the Federal Government.

PARTIAL CONTROL: WASTE

Vancouver is part of a regional waste system managed by Metro Vancouver, under Provincial oversight that combines private and public haulage and disposal. Residential waste collection and disposal in Vancouver is managed in part by the City through its own collections and the Vancouver Landfill in Delta, with private haulers playing an important role in waste collection and ultimate disposal.

LIMITED DIRECT CONTROL: PROVINCIAL AND FEDERAL LANDS

Large transportation infrastructure like rail lines and the container and shipping facilities at Port Metro Vancouver are under federal jurisdiction. There are some First Nations Reserves within the city's boundaries, over which the City has no direct control but does have service agreements with. For all lands subject to Provincial or Federal jurisdiction, the City will advocate for action to support the use of renewable energy.

STRATEGY SCOPE

Geographic Scope: The geographic scope of the *Renewable City Strategy* covers the area within the City limits, and any facilities owned or operated by the City of Vancouver outside those limits.

Emissions Scope: The *Renewable City Strategy* will track emissions in accordance with the most stringent international reporting standards (currently the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories*).

Almost all aspects of our daily lives require some form of fossil fuel-derived energy, which generates carbon pollution: energy to heat our homes and workplaces, energy to produce the food and products we consume, and fuel to transport people and goods. Much of this energy produces carbon dioxide—the most significant greenhouse gas because it is released in such large quantities.

The *Renewable City Strategy*'s target, to reduce emissions by 80%, ensures that a focus on renewable energy sources does not overlook greenhouse gas emission reductions. The *Strategy*'s dual targets ensure that the city's waste management system, responsible for about 8% of Vancouver's community emissions in 2014, is truly integrated into our energy system.

The *Renewable City Strategy* focuses on actions that can be taken to reduce emissions from the direct use of energy, like burning gasoline in cars or using natural gas to heat buildings; the City will also continue to support reductions in energy use that results from consumption like the energy used to produce food or make the products we buy.

For more details on the scope of the Renewable City Strategy, *visit vancouver.ca/renewablecity for the full* Strategy.

CONSULTATION AND PLAN DEVELOPMENT

The *Renewable City Strategy* is based upon best practices from around the world as well as local expertise and public input. Key inputs include:

- The Renewable City Action Team, made up of representatives from environmental and civil society non-profit organizations, academia, regional and provincial government, the business community, and local utilities. (see page 58)
- International thought leaders and peer organizations such as the City of Stockholm's *Roadmap for a Fossil Fuel–Free Stockholm 2050* and the City of Copenhagen's *CPH 2025 Climate Plan*.
- Members of the *Carbon Neutral Cities Alliance* (an organization that comprises the world's 17 leading cities taking action on climate change), who reviewed and provided feedback on initial drafts of the *Strategy*.
- Delegates from international organizations in attendance at the *Renewable Cities Global Learning Forum* held in May 2015.
- In 2015, the City held the *Bright Green Summer*, a series of events and engagements. Outreach included public presence at Pacific National Exhibition showground, Doors Open Vancouver, Pop-up City Hall, downtown block parties, and Vancouver Public Library summer reading events; a micro-conference; and a survey through the City's *Talk Vancouver* platform, which collected feedback on renewables from 850 people, 76% of whom supported the direction the City is taking in its climate action work.
- The City also retained a world-leading energy system consultancy to investigate and analyze the technological, financial and behavioural feasibility of adopting renewable energy technologies.

> "Between 2010 and 2014 $31 billion was invested in Canadian renewable electricity projects."
>
> - Clean Energy Canada, 2015

Photo by Limes Lemons

FOSTERING CHANGE THROUGH INFLUENCE AND ADVOCACY

By actively pursuing renewable energy in all areas where the City exercises some control, and through advocacy and partnership with agencies in the areas where the City has little or no control, the City of Vancouver will create an environment that fosters inclusiveness and innovation.

To achieve a 100% renewably powered future, the City of Vancouver will have to further build on its already strong organizational capacity, not only for the City's own operations but to lead and guide the wider public and business communities. There is also the need to ensure that renewable, clean, green, and emergent technologies are readily available and that people have what they need to implement them. The City can educate and empower people and businesses to directly engage in energy production and conservation, while itself leading both locally and internationally.

Vancouver has a long history of supporting climate action, from the *Clouds of Change* reports in 1990 to the *Community Climate Change Action Plan* in 2005 and the *Greenest City 2020 Action Plan* in 2011, and now the *Renewable City Strategy*. These plans were built with strong support from the public, businesses, and governments, as well as partnerships with local utilities, the development community, academic institutions, and non-profit organizations.

CONTROL

- STATIONARY ENERGY -

Building Standards and Land Use

Civic and City Buildings

- WASTE -

Vancouver Landfill
Biomethane Gas Capture

- TRANSPORTATION (ON-ROAD) -

Road Network and Traffic Planning

- ALL -

Pilot and Demonstration Programs

PARTNERSHIP

- TRANSPORTATION (ON-ROAD) -

Public Infrastructure
(Major Roads Network and Bridges)

- WASTE -

Haulage and Disposal

- ALL -

Capital/Operational Grants and Leases
(Non-Profit Organizations)

ADVOCACY

- STATIONARY ENERGY -

Power Generation and Distribution

Energy Efficiency Funding

First Nations Land

- ALL -

Carbon Pricing

Public Engagement

- TRANSPORTATION (ALL) -

Vehicle Efficiency and Pollution Standards

- TRANSPORTATION (NON-ROAD) -

Railways, Aviation, Waterborne Navigation


VANCOUVER
ARTSCLUB

THE ECONOMIC OPPORTUNITY

ECONOMIC OPPORTUNITY PRIORITIES

E.1 Support innovators through business and technology research, incubation, acceleration, and demonstration

E.2 Actively work with businesses to increase the use of renewable energy

E.3 Target key events and organizations that represent clean tech and renewable energy to strengthen Vancouver's economy

E.4 Attract 'green capital' and enable more innovative financing mechanisms for clean and renewable businesses

Imagine a city where jobs and businesses are diverse and economically strong, where businesses both big and small invest in the city, and where businesses thrive using only renewable energy.

OVERVIEW

Vancouver has long been a place of innovation, home to world-changing ideas and businesses. The extent to which Vancouver remains competitive and resilient and generates opportunity for our citizens will be defined by our efforts to reduce and adapt to climate change, as well as our efforts to future-proof our economy. As a city, we must continue to build a resilient economy, one that can avoid the boom and bust cycles that are amplified when economies hang their success on just a handful of industries. Investment now in a renewably powered economy is an investment with lasting returns.

Within the next fifteen years, global investment in clean energy is expected to constitute almost three quarters of total global energy investment; in fact, Canada already has more jobs in clean energy than in oil and gas. Renewable energy technologies like wind and solar generation and home battery storage are rapidly dropping in price at both the industrial and home scales. This is creating new business models where individuals and neighbourhoods are no longer passive consumers, but are actively producing, using, and selling their products and services, including the energy they generate.

QUICK STARTS

Underway Now: Expand and accelerate the Green & Digital Demonstration Program

The Vancouver Economic Commission's Green and Digital Demonstration Program*, which leverages City assets and infrastructure to pilot, demonstrate, and accelerate the commercialization of clean tech and digital innovations, has raised the profile of emerging businesses and fast-tracked their growth. As this program develops further, the Vancouver Economic Commission will emphasize clean energy pilots and demonstrations to ensure that Vancouver entrepreneurs know the business environment is ready for clean energy technologies and the digital technologies that support them.*

Business Emissions Quick Start: Use the *Vancouver Business Energy and Emissions Profile* to develop a targeted business energy use reduction and fuel-switching strategy

The Vancouver Business Energy and Emissions Profile *provides data on energy cost drivers for different business types within the city, and provides a window into where strategies to take action could be most effective in both cost and energy use reduction.*

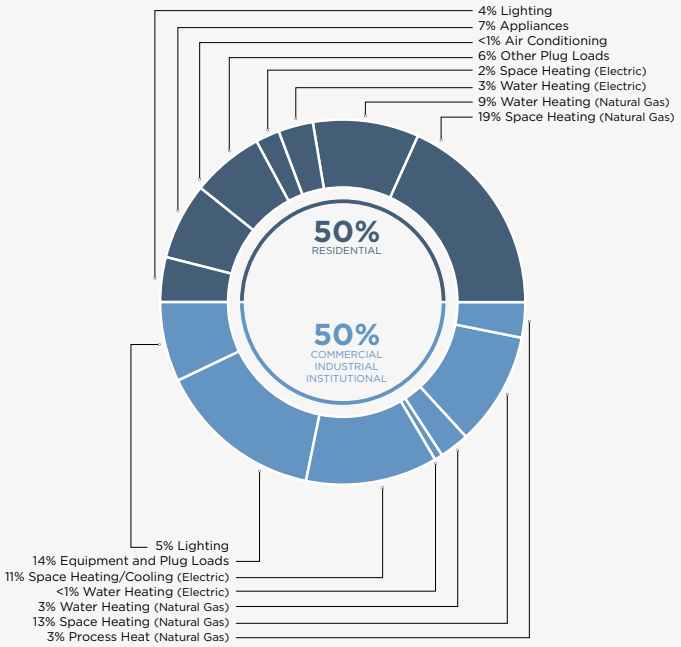
RENEWABLE BUILDING ENERGY USE

Imagine a city where homes and offices have clean and comfortable environments that are less expensive to heat and cool, and use only renewable sources of energy.

OVERVIEW

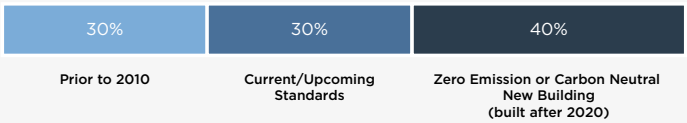
When taken together, residential, commercial, industrial, and institutional buildings are the largest single source of emissions in Vancouver, constituting 56% of the city's total in 2014. The City of Vancouver is tackling building energy use according to where it can have the largest carbon reduction impact—primarily in space heating and hot water.

BUILDING ENERGY USED IN VANCOUVER
2014



Vancouver has an active property development market compared to many cities. If historical trends continue, by 2050 about 40% of total floor space in Vancouver will have been built after 2020 and be carbon neutral or zero-emission; about 30% of the floor space will have been built to current or upcoming building standards, while the remaining 30% will have been built prior to 2010. The implication is that a large portion of the floor space in Vancouver will be new zero-emission buildings, while the portion remaining will have undergone a retrofit to bring them up to a similar standard.

AGE OF VANCOUVER FLOOR SPACE BY 2050



Of the total building floor area in 2050 about 10% might use baseboards and about 20% will be serviced by neighbourhood renewable energy systems. The remaining portion will have heat and hot water provided through heat-pump technologies, with the system design determined by site and building specifics.

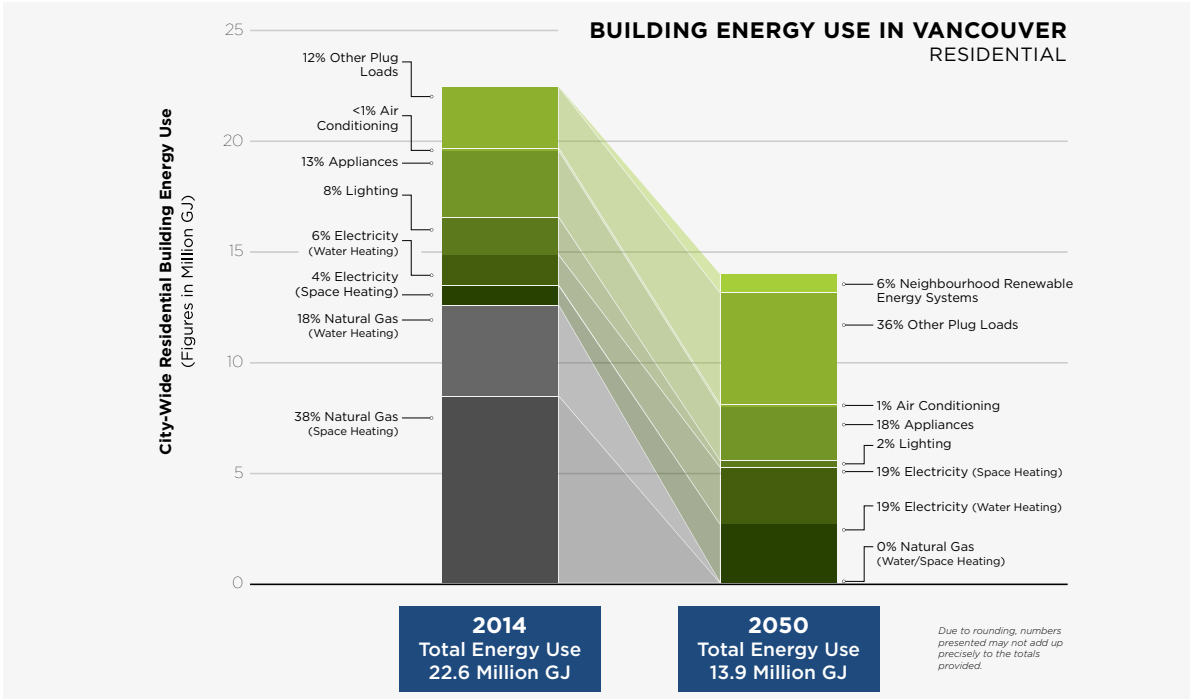
City-wide building energy demand could be reduced by about one-third over 2014 levels by adopting zero-emission buildings, requiring buildings that undergo retrofit to attain a similar level of performance, and connecting buildings to neighbourhood renewable energy systems. Of that energy demand in 2050, about 70% can be met through renewable electricity (both on-site and grid supplied) which constitutes about a 15% increase in building related electrical demand compared to today; about 10% of building engery needs will be met through biomethane and 20% through neighbourhood renewable energy systems.

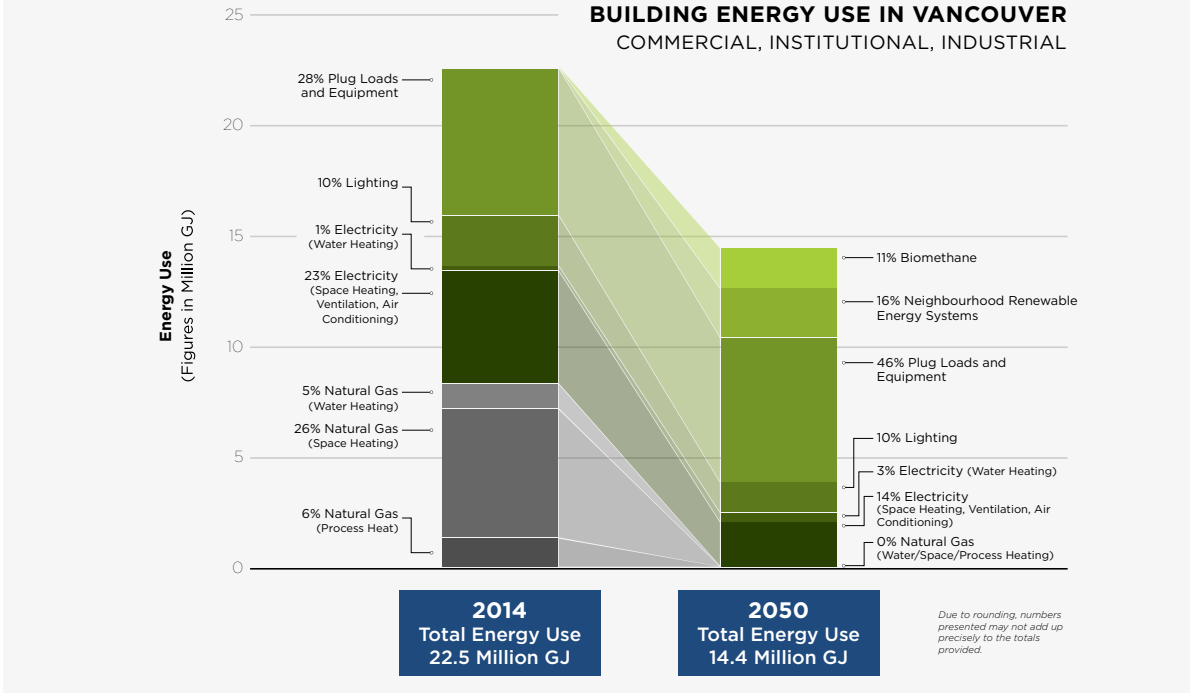
The need to charge electric vehicles will represent a 'new' electrical demand for buildings, but the scale of the increase will be relatively small: only about 5% of total city-wide building energy demand. This estimate may at first seem low, but given that a full battery charge currently allows a vehicle to travel about 150km, and typical daily commutes are only 10-30km, the energy needed to fully recharge the battery each day is small.

The most significant energy savings in industrial, commercial and institutional buildings can be expected from their heating and cooling systems that will, in aggregate by 2050, use about half the energy than they did in 2014. Non-residential connections to neighbourhood renewable energy systems will displace significant amounts of space heat and hot water needs that would otherwise need to be met through the use of biomethane. Direct biomethane use is expected to account for about 10% of industrial energy use, while neighbourhood renewable energy systems may also use biomethane to produce heat. In total, industrial, institutional and commercial buildings, systems and equipment improvements can be expected to cut city-wide energy use for the sector by about 35%.

Biomethane is currently a limited resource, and is likely to remain so as demand increases. With its high energy content and ease of transport, it is particularly useful as a vehicle fuel, especially in the commercial freight sector. While some buildings will have their heating needs met through biomethane, this is not the best long-term use for it. However, in the short-to-medium term, biomethane provides a ready opportunity to decarbonize space heat and hot water in buildings that currently use natural gas.

For more details, visit vancouver.ca/renewablecity for the full Renewable City Strategy.


BUILDING ENERGY USE IN VANCOUVER
RESIDENTIAL
City-Wide Residential Building Energy Use
(Figures in Million GJ)
25
20
15
10
5
0
12% Other Plug Loads
<1% Air Conditioning
13% Appliances
8% Lighting
6% Electricity (Water Heating)
4% Electricity (Space Heating)
18% Natural Gas (Water Heating)
38% Natural Gas (Space Heating)
6% Neighbourhood Renewable Energy Systems
36% Other Plug Loads
1% Air Conditioning
18% Appliances
2% Lighting
19% Electricity (Space Heating)
19% Electricity (Water Heating)
0% Natural Gas (Water/Space Heating)
2014
Total Energy Use
22.6 Million GJ
2050
Total Energy Use
13.9 Million GJ
Due to rounding, numbers presented may not add up precisely to the totals provided.


BUILDING ENERGY USE IN VANCOUVER
COMMERCIAL, INSTITUTIONAL, INDUSTRIAL
Energy Use
(Figures in Million GJ)
25
20
15
10
5
0
28% Plug Loads and Equipment
10% Lighting
1% Electricity (Water Heating)
23% Electricity (Space Heating, Ventilation, Air Conditioning)
5% Natural Gas (Water Heating)
26% Natural Gas (Space Heating)
6% Natural Gas (Process Heat)
11% Biomethane
16% Neighbourhood Renewable Energy Systems
46% Plug Loads and Equipment
10% Lighting
3% Electricity (Water Heating)
14% Electricity (Space Heating, Ventilation, Air Conditioning)
0% Natural Gas (Water/Space/Process Heating)
2014
Total Energy Use
22.5 Million GJ
2050
Total Energy Use
14.4 Million GJ
Due to rounding, numbers presented may not add up precisely to the totals provided.

ZERO-EMISSION BUILDING PRIORITIES

B.1 New buildings to be zero-emission by 2030

B.1.1 Adopt and demonstrate zero-emission standards in new City of Vancouver building construction

B.1.2 Ensure rezoning policy leads the transition to zero-emission buildings

B.1.3 Incentivize and streamline the development of exemplary buildings

B.1.4 Establish and enforce specific greenhouse gas intensity limits for new developments

B.1.5 Develop innovative financing tools to help fund new zero-emission buildings

B.1.6 Establish partnerships to build industry capacity

B.1.7 Mandate building energy benchmarking and labelling requirements

B.2 Retrofit existing buildings to perform like new construction

In 2014, Vancouver City Council approved the *Building Retrofit Strategy* that is now being implemented and enhanced.

B.2.1 Use the *Zero-Emission New Building Strategy* to reduce the need for building retrofits

B.2.2 Mandate energy efficiency improvements for existing buildings

B.2.3 Provide flexibility to achieve energy efficiency requirements through the support of on-site generation or neighbourhood renewable energy system connection

B.2.4 Facilitate modest retrofits through incentives and financial support mechanisms

B.2.5 Increase renewable energy use by large energy consumers

B.3 Expand existing and develop new neighbourhood renewable energy systems

In 2012, Vancouver City Council approved the *Neighbourhood Energy Strategy and Energy Centre Guidelines* that are now being used to guide the development of neighbourhood renewable energy systems in the city.

B.3.1 Expand existing neighbourhood renewable energy systems

B.3.2 Enable the conversion of the Downtown and Hospital steam systems from natural gas to renewable energy

B.3.3 Enable the development of new neighbourhood renewable energy systems for Downtown and the Cambie corridor

B.3.4 Continue to enforce and update as required, building and renewable energy supply policies that support neighbourhood renewable energy systems

B.4 Ensure grid supplied electricity is 100% renewable

B.4.1 Partner with utilities to increase the supply of renewable energy

B.4.2 Partner with utilities to implement a smart grid that meets Vancouver's energy needs

RENEWABLE ENERGY OPTIONS FOR BUILDINGS AND NEIGHBOURHOODS

Photovoltaic (PV) Systems: A residential solar energy system uses solar modules, made up of photovoltaic cells, to harvest the sun's energy and convert it to electricity.

Solar Hot Water Systems: Solar thermal collectors circulate a fluid which is heated by the sun's radiant energy. The heated fluid can then provide space heating, although it is more common to use these systems for hot water.

Wind: Small wind turbines can produce enough energy to partially meet the electricity needs of a home.

Heat Pumps and Geoexchange: Heat pumps can take heat from the air or ground and use it to provide space heat or hot water. Geoexchange systems, sometimes also called geothermal heat pumps or ground-source heat pumps, use the heating or cooling properties of the ground that make a basement warmer in the winter and cooler in the summer to heat or cool a building as required.

Neighbourhood Renewable Energy Systems: In neighbourhood renewable energy systems, a neighbourhood energy centre generates heat that is piped to local buildings for space heat, hot water, and, in some cases, cooling. This eliminates the need for each individual building to have its own boiler, hot water heating, and in some cases cooling equipment, and is more efficient.

Waste as an Energy Resource: Some waste streams, such as wood and food scraps can be used to generate energy. Anaerobic digesters produce biomethane from food scraps and clean wood combustion systems produce heat. Liquid waste can also provide a renewable source of energy. The City already uses sewage heat recovery in its Southeast False Creek Neighbourhood Energy Utility to provide heat and hot water to buildings in and around the Olympic Village. Non-renewable materials and mixed solid waste streams will continue to be actively managed for the most responsible outcomes, but they will not be considered as inputs to the long-term renewable energy system of our future.

Building Envelope: The building envelope is the fabric of the building: its walls, roof, windows, doors, etc. The envelope keeps weather out and manages heat and airflow, maintaining a comfortable internal environment. Advances in both materials and building design are contributing to the development of new windows, insulation, and roofing that can significantly reduce heat loss, as can design changes that limit energy-inefficient features such as expansive windows.

Building Systems: Building systems include heating, ventilation, air conditioning systems, and hot water equipment. Building electrical systems support appliances and devices that use electricity, like TVs, smartphones, and computers (known as plug loads). Some buildings also have more specialist systems like elevators, loading equipment, and server rooms. Home energy storage (batteries) will become an important component of future building systems.

REDUCING BUILDING ENERGY DEMAND

NEW BUILDING ENVELOPE PERFORMANCE

Reducing building heating demands is the foundation to achieving the City's 100% renewable energy target.

Once constructed, building envelopes last a long time before they need significant updates or retrofitting. While lighting and appliances can reasonably be expected to change every 10 years or so, buildings do not have their windows changed or walls re-insulated nearly as often. Ensuring that buildings meet zero-emission standards from the time they are built is the most effective way to ensure that buildings use as little energy as possible.

A zero-emission building, one that emits no greenhouse gases from the energy it uses, is only viable if it is very energy efficient. With energy use substantially reduced, a zero-emission building can meet its energy needs through either on-site generation or connection to an off-site renewable energy source like a neighbourhood renewable energy system or the electrical grid.

Electrical power in BC is regulated to be 93% clean or renewable (and in recent years has been as much as 97% to 98% clean); however, using electricity for space heat and hot water is expensive when compared to natural gas, which has halved in price over the last five years. Ultra energy-efficient buildings afford owners and occupants much lower electrical bills, avoid fossil fuel bills altogether, and do not overly burden the electrical grid. The use of electrical (resistance) heat only makes sense when buildings meet ultra-efficient standards, and in most circumstances, heat pumps provide a better alternative to resistance heat.

As new and retrofitted buildings start to incorporate more effective energy conservation principles—such as solar shading and solar orientation considerations—and the ability to generate their own power, the urban landscape will change. Building and neighbourhood design has never been static, and new designs will have to manage aesthetic appeal while incorporating design principles that support reduced energy use and increased energy generation, allowing buildings and neighbourhoods to cope better with a changing environment.

BUILDING ENVELOPE PERFORMANCE RETROFITS

Buildings not originally built to zero-emission standards will undergo some form of retrofit before 2050. Retrofits are likely to take place for one of two reasons:

1. Part of the building has reached the end of its useful life (such as the lighting, the heating system, or the roof).
2. The building owner feels that the building is in need of an update to be more appealing to buy or rent, reduce occupant energy bills, etc.

In the first case, lighting, appliances, and similar components are replaced much more often than major components like walls, roofs, or windows. For components that are replaced sooner, larger market forces outside those specific to Vancouver, or even BC, are shaping efficiency improvements. The technology is improving rapidly and is easy to update—all you have to do is plug it in! Lighting, although not as easy to replace as appliances, is relatively simple to upgrade, and with advances in LED technology, LEDs can be expected to meet almost all lighting needs by 2050.

For major components that have reached the end of their useful life and which are replaced less frequently, it is possible to use natural building renewal cycles to meet zero-emission standards more quickly. When a building undergoes a major retrofit, the elements being replaced will have to meet the standards required of a new building.

When building retrofitting is desirable rather than essential, the City will foster voluntary retrofitting or mandate only modest retrofit requirements to encourage building owners to undertake retrofits that achieve energy reductions. In the case of existing buildings, a retrofit would require connection to a neighbourhood renewable energy systems in high-density neighbourhoods, or use of a heat pump or on-site renewable energy generation for low-density areas.

BUILDING EQUIPMENT PERFORMANCE REQUIREMENTS

As with building envelopes, developers should install the most efficient building equipment available at the time of construction or upgrade to that standard at the time of retrofit—acting in the timeliest fashion secures the most improvement. However, envelope upgrades are a higher priority than building equipment upgrades, since equipment upgrades are less enduring and realize smaller gains in overall energy performance.

QUICK START

Civic Passive House Quick Start: The City will support a Passive House or ultra-low thermal demand design philosophy for City buildings

The City can help catalyze a change in building design through its consideration of Passive House or a low thermal demand approach as the default option for new City facilities. The City will investigate when the Passive House design philosophy and implementation is appropriate for City buildings and under which circumstances the approach does not currently deliver the best energy, greenhouse gas, occupant, and functional outcomes.

The City is about to trial the use of Passive House principles for one of its new fire halls. This will allow the City to better understand the opportunities Passive House can provide as well as increase the City's understanding of the design philosophy to better evaluate and introduce Passive House principles into the City's requirements for its own buildings.

INCREASE BUILDING RENEWABLE ENERGY USE

EXPAND EXISTING NEIGHBOURHOOD RENEWABLE ENERGY SYSTEMS

Energy efficiency improvements alone are not enough to achieve a renewable energy future; buildings must switch the sources of energy they rely on from fossil fuels to renewable sources. As such, the existing Southeast False Creek Neighbourhood Energy Utility system will be expanded to serve more buildings in the Southeast False Creek area and the False Creek Flats. The existing system uses waste heat from sewage to provide space heat and hot water to 4.2 million sq. ft. of buildings, with the system expected to expand to 7.8 million sq. ft. by 2022.

INDUSTRIAL FACILITIES TRANSITION TO RENEWABLE ENERGY

The City will continue to preserve its industrial lands to secure the long-term economic strength of Vancouver. Because of their significant roof space and underutilized land, such lands also have the opportunity to become significant renewable energy hubs through local and on-site generation. The price of land, and its prominence on a business' balance sheet, is an important factor in moving Vancouver businesses to be more renewable.

Vancouver cannot geographically expand any further—it is bound on all sides. With land at such a premium, land values have been rising for the past decade and this trend is unlikely to change. Vancouver currently has little large or heavy industry, but that which does exist serves regional, national, and international markets. Changing transportation patterns coupled with less favourable land economics are likely to mean that these heavy industries will have relocated outside the city by 2050.

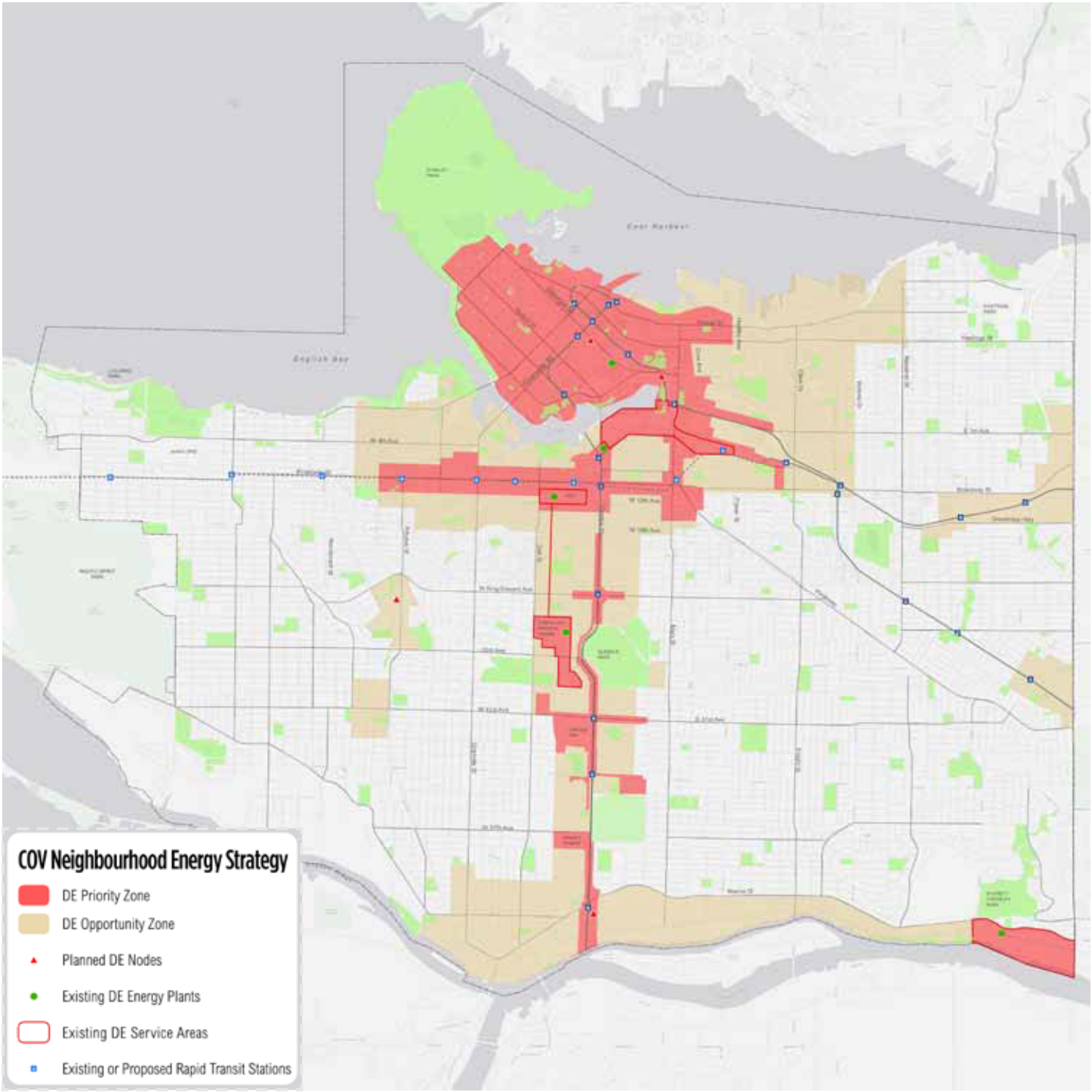
The use and generation of goods and energy for the industrial sector in Vancouver is driven by the large number of light to medium industrial enterprises that service the city, for which there is an incentive to remain close to their customers and not relocate out of the city. These businesses are the focus of preserving industrial lands within the city. Light to medium industry tends to own or lease its equipment, which is the primary driver of energy bills, as well as owning or having signed long-term leases for their premises. These businesses will become more energy aware as the cost of fossil fuels rises and that of renewable energy drops; and as they start to identify new business models driven by energy efficiency and renewable energy opportunities.

INCREASE BUILDING RENEWABLE ENERGY SUPPLY

NEW NEIGHBOURHOOD RENEWABLE ENERGY SYSTEMS

The City's *Neighbourhood Energy Strategy and Energy Centre Guidelines* set the long-term vision for the development of neighbourhood renewable energy systems in Vancouver with a focus on the following areas of opportunity:

- Conversion of the existing Downtown and Hospital campus steam heat systems from fossil fuels to renewable energy sources.
- Establishment and expansion of systems to serve high-density areas in the Downtown, Cambie Corridor, River District, and Central Broadway areas that are undergoing rapid development.
- Expansion of neighbourhood energy to replace the boiler equipment in existing gas-heated buildings.


COV Neighbourhood Energy Strategy
DE Priority Zone
DE Opportunity Zone
Planned DE Nodes
Existing DE Energy Plants
Existing DE Service Areas
Existing or Proposed Rapid Transit Stations

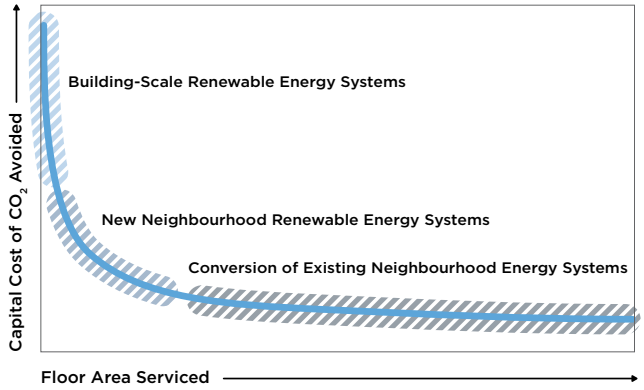
ON-SITE RENEWABLE ENERGY GENERATION

Areas with low population density—those with a lot of single-family homes or low-rise condos and apartments—do not require enough energy to merit being connected to a neighbourhood energy system. As such, low-density development must have its heating needs (for both space and hot water) met by renewable electricity from the grid or from on-site renewable energy generation.

On-site renewable energy generation is more applicable in low density circumstances since there is space available within the property to generate enough electricity and/or heat to meet the demand of a zero-emission building. On-site renewable energy generation can come from solar power or solar thermal, heat pumps (that would likely use grid-supplied electricity), or perhaps in some cases on-site wind generation.

With the anticipated improvements in building efficiency and an already effective and clean electrical grid, the need for on-site rooftop solar power generation will likely be determined by the market price of the technology, the cost to produce electricity, and the larger system needs of the electrical grid. The widespread use of solar panels is not necessary to meeting the City's renewable energy goals, but can give the public and businesses the opportunity to meet their own energy needs, earn income through the sale of excess power, and contribute to the move towards a renewably powered future. On-site generation can also allow buildings and neighbourhoods to be more resilient to disruption and outages, particularly during extreme weather events.

SIZING NEIGHBOURHOOD RENEWABLE ENERGY SYSTEMS



INCREASING RENEWABLE GRID ELECTRICITY SUPPLY

With current building practices, Vancouver's demand for electricity would be about 10% higher in 2050 than it is today, with a 25% increase in fossil fuel also expected. However, through energy efficiency and conservation efforts, the direction outlined in the *Renewable City Strategy* allows Vancouver to make much wider use of renewable electricity to eliminate fossil-fuel use completely while only increasing electricity demand by about 20% over current levels.

Across the province there is a need to increase grid-scale renewable electricity generation, not just for Vancouver. BC Hydro—the sole electrical utility supplying Vancouver—is legally required to develop an *Integrated Resource Plan* to detail its plans for meeting customer demand over the coming 20 to 30 years. The City's goal to move to 100% renewable energy is consistent with many aspects of the *Clean Energy Strategy* section of *BC Hydro's 2013 Integrated Resource Plan*.

New market-ready, utility-scale wind and solar technologies can compete on cost with large-hydro power. Grid-scale renewable electricity generation of the future should be brought into service as it is needed, to enhance system reliability, particularly in light of a changing climate, while also maintaining affordability.

Current regulation allows for up to 7% of the electricity used in Vancouver to come from non-renewable sources. The City will work with its utility partners to find ways to address that non-renewable portion, but in the event that the electricity supplied to Vancouver is not 100% renewable, the City of Vancouver will investigate how to secure renewable electricity from other sources.

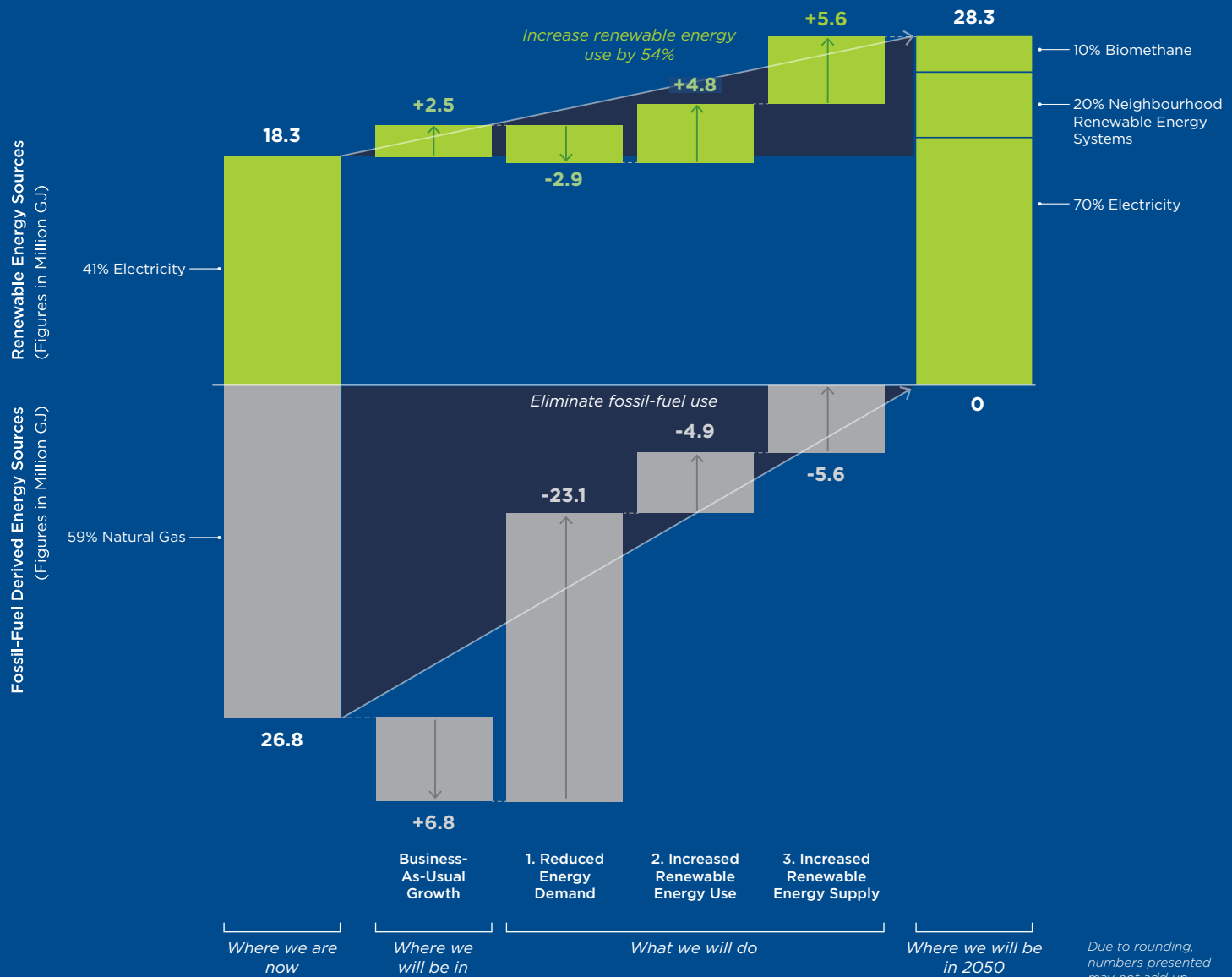
As there are increases in both on-site electricity generation and new grid-scale generation, the electrical grid will have to adapt; the electrical grid will need to become 'smart' to manage these new ways of generating and distributing electricity. The smart grid will not only better meet customer needs, but is also imperative to managing emerging technologies like energy storage, electric cars, the 'home ecosystem', and on-site power generation distributed throughout the city. A smart grid is more reliable, more resilient when things do go wrong, and more adaptable to the future demands on the electrical system.

HOW VANCOUVER WILL GET TO 100% RENEWABLE ENERGY BY 2050

2014
Total Energy Use
45.1 Million GJ

BUILDINGS

2050
Total Energy Use
28.3 Million GJ



Due to rounding, numbers presented may not add up precisely to the totals provided.

OWNERSHIP AND FINANCING

The business case for significantly reducing energy demand and moving to renewable energy sources is good when the total cost of ownership, including purchase, maintenance and operation is considered. However, a 'split incentive' occurs when the person or business constructing the building is not the one who owns and operates the building. This gives the developer little incentive to spend the extra money up front to improve the building performance, since the developer is not paying the energy bills once the building is occupied.

In some circumstances the builder and occupier are the same entity; this is often true for institutional buildings like schools, hospitals, libraries and community centres as well as commercial, rental and non-market housing developments. In these cases it is important to accelerate the pace at which building energy performance improvements are made, in order to help make energy efficiency improvements common practice and more affordable. In these same cases the owner/operator is often more tolerant of longer payback periods for their initial investment, which helps further support the upfront costs.

In cases where the split incentive persists, there is a need to develop new financing tools and energy equipment ownership models that support longer payback periods or reduce the need for owner financing. There is also a need to develop business models that transfer the cost savings from efficiency improvements back to the person or business that financed the improvements.

QUICK STARTS

Civic Renewable Generation Quick Start: The City will support new renewable energy technologies for City buildings

The City will actively consider new technologies, materials, and approaches that support the strategic approach of the Renewable City Strategy. *For civic facilities that need retrofit or that are to be newly built, the City will consider new and appropriate technologies that will enhance building performance, improve conditions for occupants, and increase the use and/or generation of renewable energy.*

Solar Quick Start: The City will streamline the process for the installation of rooftop solar systems

The City will streamline the process to install rooftop solar systems to allow solar technologies to be implemented quickly as demand grows. The generation of on-site power and heat will play an important role in achieving the use of renewable energy. Ensuring that renewable energy technologies can easily be implemented will be important in ensuring that market forces decide the most cost-effective way to supply renewable heat and power.

OVERVIEW

Our transportation choices impact our health and well-being as well as the quality of our air. Vancouver is a multimodal city where residents use a combination of walking, cycling, transit, and motor vehicles to get around and meet their needs. However, our transportation system moves more than just people—it also moves goods and services that are essential to a thriving local economy and high quality of life, requiring efficient local networks and connections to the larger road, rail, air, and marine networks.

RENEWABLE TRANSPORTATION

Imagine a city where the transportation system is efficient, supports a thriving economy while improving affordability, and provides citizens the opportunity to be healthy and mobile; a system that is powered by renewable energy.

Transportation and land use are inextricably linked—how we design our communities affects our journey choices and how much we travel. Those travel needs in turn influence how we use land. *Transportation 2040*, the City's strategic transportation plan, establishes a clear hierarchy of transportation modes that are consistent with the strategic approach of reducing the need for motorized transport and prioritizing walking, cycling, and transit.

Automobiles, while declining in terms of total proportion of journeys, will continue to play an important role in our transportation system for the foreseeable future, and must be planned for. Autonomous vehicles in particular could radically change how we get around, and at the moment their future impact, both positive and negative, is unclear. To meet our long-term air quality and emissions targets, it is important to support the shift to renewably powered vehicles.

Road transport accounted for about 37% of Vancouver's total emissions in 2014. That car-centric mindset is slowly changing but not without challenges. Many key actions—to improve the pedestrian realm, build a complete and attractive cycling network, improve transit capacity and reliability, and create vibrant public spaces—will require further road space reallocation from the private automobile.

The emergence of information technology and systems to manage our journeys has already begun, and can be expected to grow even more. The actions laid out in *Transportation 2040* and the direction set by the *Renewable City Strategy* outline the steps needed to ensure a smooth transition away from automobile dependency.

Vancouver has, through a clear transportation vision, been successful to date in ensuring that people, goods, and services can travel efficiently. The City's success has come from comprehensive partnerships, regional planning, and close cooperation between different municipal departments. Reimagining what road space is used for has led to the development of 'complete streets' that provide mobility and public space options for a wide variety of street users, changing how we move, alleviating congestion, and allowing Vancouverites to take important steps to improve their health. The transportation system that Vancouver is aiming for is not one where freedoms are given up at the expense of environmental benefit, but one where people make sustainable choices because they are the most rational, comfortable, convenient, safe, and enjoyable ways of getting around.

For more details, visit vancouver.ca/renewablecity for the full Renewable City Strategy.

QUICK START

Preferential Parking Quick Start: Support the uptake of renewably powered vehicles through preferential parking provision

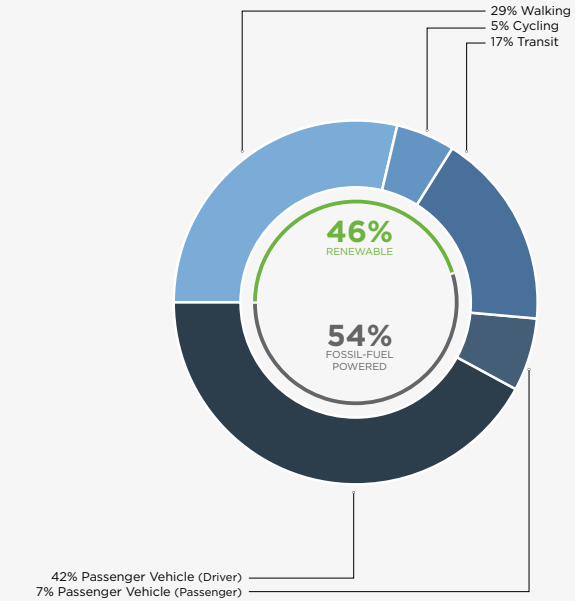
Parking provision and management is an important determinant of how we use our vehicles. Through the provision of preferential parking for clean vehicles it is possible to catalyze the uptake of clean vehicles as people see tangible benefits to ownership. As the transition becomes more complete there will be a need to reassess how preferential parking is managed.

Underway Now: *Replace the Georgia and Dunsmuir viaducts for better at-grade services and public space.*

Underway Now: *Improve the False Creek bridges to support active transport.*

Underway Now: *Implement a public bike-share system.*

PERSONAL TRIPS MADE IN VANCOUVER
2014



RENEWABLY POWERED TRANSPORTATION PRIORITIES

T.1 Use land-use and zoning policies to develop complete compact communities and complete streets that encourage active transportation and transit

T.1.1 Foster land-use as a tool to improve transportation consistent with the direction established in *Transportation 2040*

T.1.2 Enhance and accelerate the development of complete streets and green infrastructure

T.1.3 Enhance the pedestrian network according to the direction established in *Transportation 2040*

T.1.4 Enhance cycling infrastructure and encourage more bike trips according to the direction set in *Transportation 2040*

T.1.5 Use parking policies to support sustainable transportation choices and efficient use of our street network

T.1.6 Optimize the road network to manage congestion, improve safety, and prioritize green transportation

T.2 Improve transit services as set out in *Transportation 2040*

T.2.1 Extend the Millennium Line in a tunnel under Broadway

T.2.2 Improve frequency, reliability, and capacity across the transit network

T.2.3 Develop a transit supportive public realm with improved multimodal integration and comfortable waiting areas

T.2.4 Work with the transit authority and other partners to transition fossil fuel powered transit vehicles to renewable energy

T.3 Transition light-duty vehicles (cars and light trucks) to be predominantly electric, plug-in hybrid or sustainable biofuel powered

T.3.1 Develop vehicle and fuel standards to support renewably powered vehicles

- Advocate for a low- and zero-emission vehicle standard.
- Advocate for continued strengthening the Renewable and Low Carbon Fuel Requirements Regulation.
- Advocate for increased commercial vehicle efficiency and transition to renewable fuels.
- Advocate for the development of financial incentives to support the growth of renewably fuelled vehicles.

T.3.2 Develop supporting infrastructure that meets the needs of renewably powered vehicles

- Support the expansion of renewable fuel infrastructure for personal vehicles.
- Enact regulation that supports the use of electricity as a transportation fuel.
- Support the expansion of renewable fuel infrastructure for commercial vehicles.
- Maximize the beneficial use of compostable materials.
- Use City authority over local waste management to support the use and development of renewable energy.

T.4 Develop car-sharing and regional mobility pricing to encourage rational journey choice

T.4.1 Support increased car-sharing and the uptake of renewably powered vehicles in car-sharing fleets.

T.4.2 Advocate for comprehensive regional mobility pricing

T.5 Better manage commercial vehicle journeys and transition heavy-duty (commercial) vehicles to sustainable biofuels, biomethane, hydrogen and electricity

T.5.1 Improve the delivery of commercial freight, goods and services according the direction set in Transportation 2040

- Support efficient goods and services movement and delivery while minimizing environmental and community impacts.
- Enhance local goods and service movement logistics.

T.5.2 Work with fleet operators and contractors to transition to renewably powered vehicles

- Engage commercial vehicle fleets to transition to renewably powered vehicles.
- Partner with Port Metro Vancouver to accelerate the transition to renewably fuelled freight transport.
- Encourage movement of goods by renewably powered rail when goods must be shipped over longer distances.
- The City will work with the Provincial Government and Metro Vancouver to require non-road engines/equipment to operate on renewable energy.


BEAUTIFUL
ZRO GAS
BRITISH

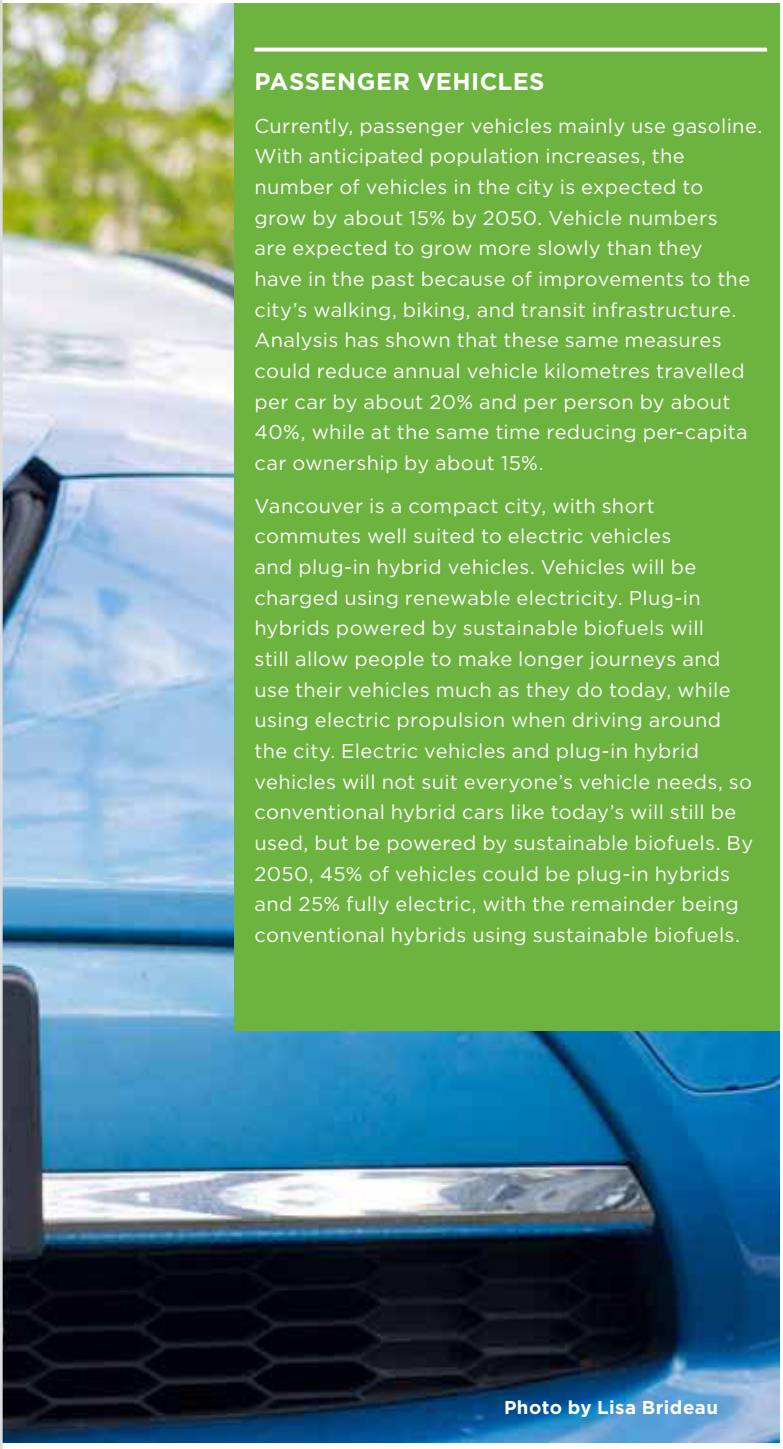


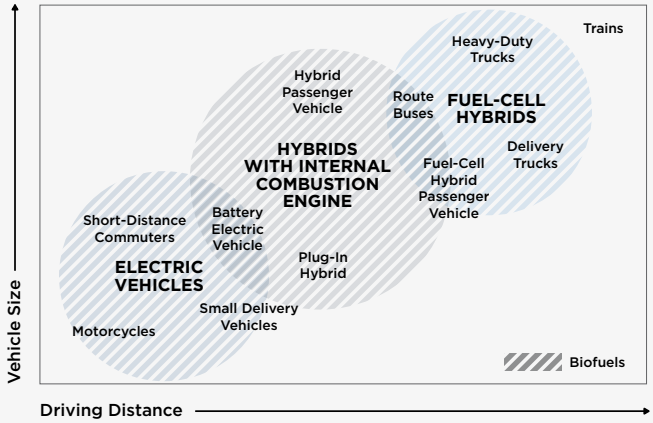
Photo by Lisa Brideau

PASSENGER VEHICLES

Currently, passenger vehicles mainly use gasoline. With anticipated population increases, the number of vehicles in the city is expected to grow by about 15% by 2050. Vehicle numbers are expected to grow more slowly than they have in the past because of improvements to the city's walking, biking, and transit infrastructure. Analysis has shown that these same measures could reduce annual vehicle kilometres travelled per car by about 20% and per person by about 40%, while at the same time reducing per-capita car ownership by about 15%.

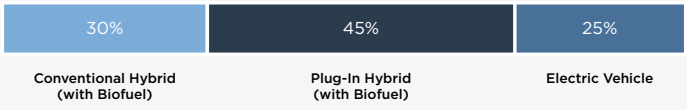
Vancouver is a compact city, with short commutes well suited to electric vehicles and plug-in hybrid vehicles. Vehicles will be charged using renewable electricity. Plug-in hybrids powered by sustainable biofuels will still allow people to make longer journeys and use their vehicles much as they do today, while using electric propulsion when driving around the city. Electric vehicles and plug-in hybrid vehicles will not suit everyone's vehicle needs, so conventional hybrid cars like today's will still be used, but be powered by sustainable biofuels. By 2050, 45% of vehicles could be plug-in hybrids and 25% fully electric, with the remainder being conventional hybrids using sustainable biofuels.

LOW-CARBON VEHICLES



- **Battery Electric Vehicles:** Battery electric vehicles, often just called electric vehicles, have an on-board battery that is charged up to drive an electric motor which moves the car. Electric vehicles make ideal urban vehicles, and through development will suit some light-truck needs also.
- **Plug-in Hybrid Electric Vehicles:** Plug-in hybrid electric vehicles have a battery and a combustion engine. The battery is charged by plugging in the car, just as you would for an electric vehicle, and the car can then be driven using only the battery. When the battery runs flat, the regular engine starts and the vehicle uses that to get around. If the regular engine is fuelled using biofuels (see section on sustainable biofuel supply) and the battery charged using renewable electricity, plug-in hybrids are a renewable way to get around.
- **Hydrogen Fuel Cell Vehicles:** Hydrogen fuel cell vehicles use a fuel cell to convert hydrogen into electricity, which then drives an electric motor. The car does not have a battery; the hydrogen itself is stored in the car and converted into electricity when it's needed.

PASSENGER VEHICLE TYPES BY 2050




EARLS
LOGISTICS
& MEGACARRIER
21

RENEWABLE ENERGY OPTIONS FOR TRANSPORTATION

COMMERCIAL VEHICLES

Economic growth is expected to lead to an increase in commercial vehicle trips.

The energy used by light-to-medium commercial transport is driven not so much by the number of vehicles, but by the distance they travel. For smaller commercial vehicles, there is likely to be significant electrification with the remainder powered by sustainable biofuels or hydrogen. Meanwhile, the use of electricity within Vancouver's transportation system will remain high because of the city's trolley bus system.

For heavy freight, both the distance travelled and the weight transported by the large vehicle fleet impacts energy use. The transformation in large commercial vehicles is a lot less clear. Current trends in technology suggest a small portion of the fleet will run on hydrogen and the majority will use biofuels and biomethane, although these proportions are sensitive to fuel supply and vehicle economics.

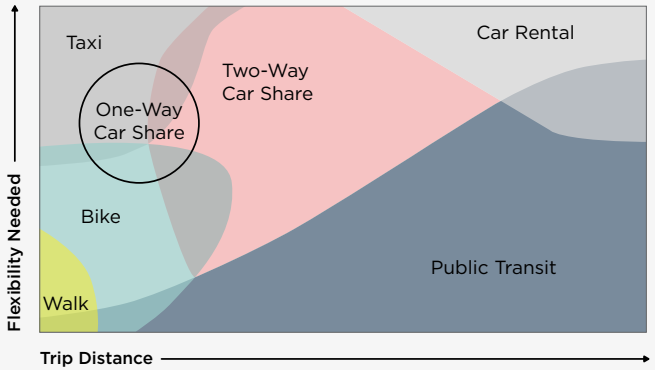
- **Biofuel-Powered Commercial Vehicles:** Biofuels are liquid fuels that can be used in combustion engines and can replace gasoline and diesel. Biofuels are suited to large vehicles like buses and trucks but can be used in engines of any size. The amount of energy stored in biofuels is more than that of hydrogen and biomethane, which means that biofuels are particularly good for long-distance freight vehicles.
- **Biomethane-Powered Commercial Vehicles:** Biomethane is methane produced by natural processes. It is a high-grade energy source and can be used as a direct replacement for natural gas.
- **Hydrogen-Powered Commercial Vehicles:** The technology needed to power commercial freight and other large vehicles with hydrogen is almost identical to that for personal vehicles; it is simply larger and more powerful. In many ways hydrogen is more favourable for larger vehicles than passenger vehicles, since the more complex fuelling systems take up less relative space and can more easily be installed into trucks or buses.
- **Electric and Hybrid Commercial Vehicles:** Although unlikely to be suitable for long distances, electric powertrain technologies may develop to support urban commercial use. Overhead power cables, much like those used for trolley buses could be adapted for heavy commercial vehicles, particularly those on fixed routes like to and from the port. Improved battery and charging technologies may also allow vehicles like buses to charge rapidly at their depots or at the end of their routes. Hybrid heavy-duty vehicles that use a battery to get moving or help acceleration, then switch to a combustion engine for cruising are under development and are very well suited to stop-start applications like garbage and delivery trucks.

REDUCE MOTORIZED TRANSPORTATION DEMAND

LAND-USE AND URBAN DESIGN AS RENEWABLE ENERGY TOOLS

Our transportation choices depend on a variety of factors, including travel time and reliability, cost, how far we have to go and how flexible we need that journey to be. For example, do we have things to carry, are we in a rush, are we meeting people, is parking available close to the destination, and will we have to pay for it? Focusing on the factors that affect Vancouver's transportation choices promotes the design of communities that facilitate these choices. *Transportation 2040*'s '5 D's' of the built environment—destinations, distance, density, diversity, and design—are core considerations in ensuring our communities are complete and well connected.

TRANSPORTATION CHOICES



Regional and city growth are planned for through:

- Ensuring that Vancouver has a compact urban area to promote energy conservation and efficiency;
- Delivering a sustainable economy that is both local and international and not bound to fossil fuels;
- Effectively protecting the environment and responding to climate change through use of only renewable energy sources; and
- Developing complete communities that rely less on personal motorized transport.

Vancouver is an urban planning success story that has fostered complete, compact, communities, first in the downtown and now throughout the city. Vancouver is a city of unique neighbourhoods which, although diverse, are working towards a set of common goals that underpin what a 100% renewable energy city can achieve:

1. Creating an urban form that is environmentally sustainable;
2. Developing a range of affordable housing options to meet a diverse set of needs;
3. Contributing to a robust and diversified economy, which as a result is resilient;
4. Supporting communities that enhance culture, heritage, and creativity;
5. Developing sustainable transportation options that are not just viable but preferable;
6. Enhancing public open spaces, parks, and green linkages; and
7. Promoting resilient, sustainable, safe, and healthy communities.

INCREASE WALKING

Walking will continue to be the City's top transportation priority. Almost every journey has a walking component to it at some point. For short trips, walking is the best option for people and the environment, and businesses benefit from passing customers. Vancouver's grid network, good urban planning, and pleasing urban design mean walking trips are often direct, convenient, and interesting. As part of its *Transportation 2040* efforts, the City will address gaps in the walking network, improve sidewalk connectivity, create more temporary and permanent public spaces, and maximize accessibility for those with visual or mobility impairments.

INCREASE CYCLING

Cycling creates no emissions, is inexpensive, improves health, and allows easy access to much of Vancouver. It is often the fastest way to get around for short-to-medium length trips, with many destinations accessible by bike within 20 minutes. There is also increasing evidence that cycling, similar to walking, is good for local businesses.

To reach a wider audience, the City is focusing on building a direct, intuitive network of routes that efficiently connect destinations and are comfortable for everyone, including families with children, the elderly, and novice riders. Providing more secure, convenient, and abundant parking and end-of-trip facilities like showers and change rooms is also important, as is promotion and education to encourage cycling as an everyday, normal activity.

INCREASE USE OF RENEWABLE TRANSPORTATION OPTIONS

INCREASE TRANSIT USE

The city's compact urban form is complemented by Vancouver's comprehensive public transit system. A large portion of the transit service in Vancouver is already electrified—the SkyTrain, Canada Line and trolley buses—but there are still diesel bus services on many of the routes. Meeting the City's 100% renewable energy goals will require expanding the trolley network and/or converting these non-electric routes to other renewable fuel sources.

INCREASE SHARED VEHICLE JOURNEYS

Car sharing is a membership-based service that gives access to a fleet of cars which can be rented. Car sharing allows people to go car-light or even car-free and save money compared to owning their own vehicle, yet still maintain the flexibility of car ownership. People often have multiple memberships to meet their exact journey needs based on whether they need a quick one way trip or a particular type of vehicle. A single car share vehicle can replace up to 11 personally owned vehicles, freeing up road space for other uses. The already significant ability of car sharing to cut energy demand from transportation is further enhanced through the potential to use renewably powered cars in car sharing fleets.

INCREASE RENEWABLY POWERED PERSONAL VEHICLE CHOICE

With the exception of the electrified SkyTrain, Canada Line and trolley buses in Vancouver, today's transportation system is almost exclusively based on the combustion of gasoline and diesel. The transportation system of the future will have a greater range of energy sources and vehicle types than are common today.

The transportation system is expected to evolve so that most short-distance and local journeys will be made on foot or bike, most longer trips by transit, and remaining trips by electric vehicles of various types, depending on the needs of the journey. Electric vehicles already have ranges that are ample for peoples' everyday use. If drivers need to make longer journeys that cannot be served by the range of battery technology or where battery technologies are not cost efficient, alternatives like hydrogen and sustainable biofuels will need to be considered.

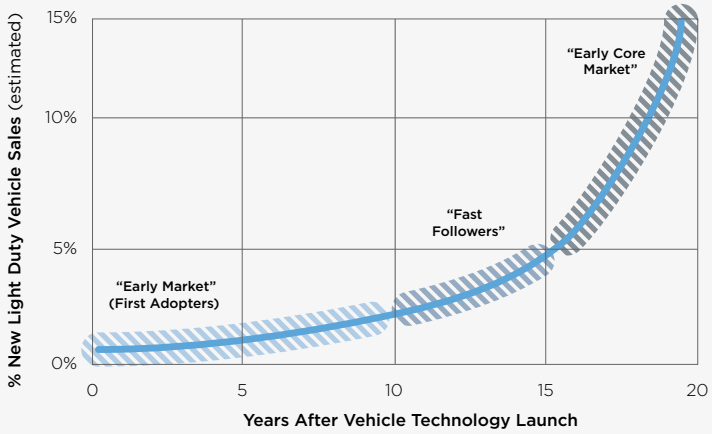
Plug-in hybrid electric vehicles, already available today, combine a battery and a regular engine, so that for short distances the car acts like an electric vehicle; if the battery runs flat, the regular engine takes over. For those people who regularly travel long distances, renewable fuel solutions will come from sustainable biofuels and renewable hydrogen fuel cell vehicles. Similar solutions can also be expected for larger vehicles like buses and trucks.

It typically takes between 15 and 20 years to see significant changes in automobile fleets, and about the same amount of time again for technologies to be adopted into widespread uptake. This means that although vehicles tend to be changed every seven to ten years, action must be taken now, particularly to support market-ready technologies.

"...investing in public and low emission transport, building efficiency, and waste management in cities could generate savings with a current value of US$17 trillion by 2050."

- New Climate Economy, 2015

NEW VEHICLE TECHNOLOGY ADOPTION



adapted from Hybrid Electric Vehicle Launch Trend graph, California Environmental Protection Agency Air Resources Board

QUICK STARTS

Electric Vehicle Infrastructure Quick Start: Develop and implement an electric vehicle infrastructure strategy to accelerate electric vehicle uptake

The electrification of personal transport will require new infrastructure to support the charging of electric vehicles and plug-in hybrids. That infrastructure will mostly be required at home, but will also be needed to support workplace charging and charging while out and about. The City will develop a comprehensive strategy to address how to expand the provision of charging infrastructure in both new and existing buildings where there are clear routes to doing so, while also identifying strategic partnerships to solve challenges where no immediate solution is apparent.

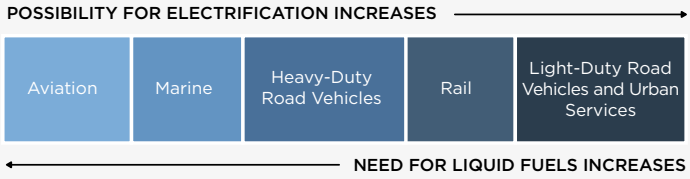
Civic Renewable Transport Fuel Quick Start: Accelerate the integration of renewable fuels into the City of Vancouver fleet

The City of Vancouver fleet has about 1,800 vehicles and equipment, with a fuel blend of 5% biodiesel and 95% regular diesel as the majority fuel used by the fleet. Moving the City fleet to use more renewable fuels demonstrates clear leadership and the viability of alternative fuels, and supports broader market uptake.

INCREASE SUPPLY OF RENEWABLE TRANSPORTATION FUELS

The 'hierarchy of fuels' establishes the ease with which new renewable fuels can be adopted. For mobile uses, liquid fuels are preferable since they are more easily transported and handled during refuelling. However, with improvements in battery and charging technology, electrification is becoming an option for more vehicles, although the ease with which electric powertrains can be used decreases as vehicles get larger.

HIERARCHY OF FUELS



ELECTRICITY SUPPLY

Electricity generation in BC is required by law to be at least 93% clean and a move to 100% renewable electricity would secure further environmental benefits. Current and anticipated future electrical generating capacity in BC is able to meet the increased demand that electrification of the transport system would create; but ensuring that local electrical systems are able to meet the needs of electrified transportation is important. There will be a need to ensure that the vehicle-charging infrastructure is available for people to recharge their vehicles, particularly through personal home and workplace charging.

Plug-in hybrid electric vehicles will mostly use only electricity when driving in the city; electric vehicles will only use electricity. There is still a need to develop charging infrastructure, and ensure that a network of fuelling stations exists for drivers to top up with biofuel when needed. This diversity leads to shared infrastructure needs and increased resilience so the vehicles are not tied to a single fuel source.

SUSTAINABLE BIOFUEL SUPPLY

Sustainable biofuels can be produced from wood, grass, plants, and even algae, with different technologies at various stages of development. There is the potential to develop significant sustainable biofuel production throughout the Pacific Northwest and central Canada. It is important to ensure that the feedstocks used to make the biofuels are sourced responsibly, most preferably from what is currently considered the waste stream (e.g., agricultural waste). The supply of sustainable biofuel feedstocks, typically canola in Western Canada, is more than sufficient to meet near-term local requirements since much of the current production is exported. The diversity of feedstocks and agricultural methods that can be used to produce biofuels limits any potential impacts to food supplies and pricing, since with the right regulation biofuel production should not complete with food production.

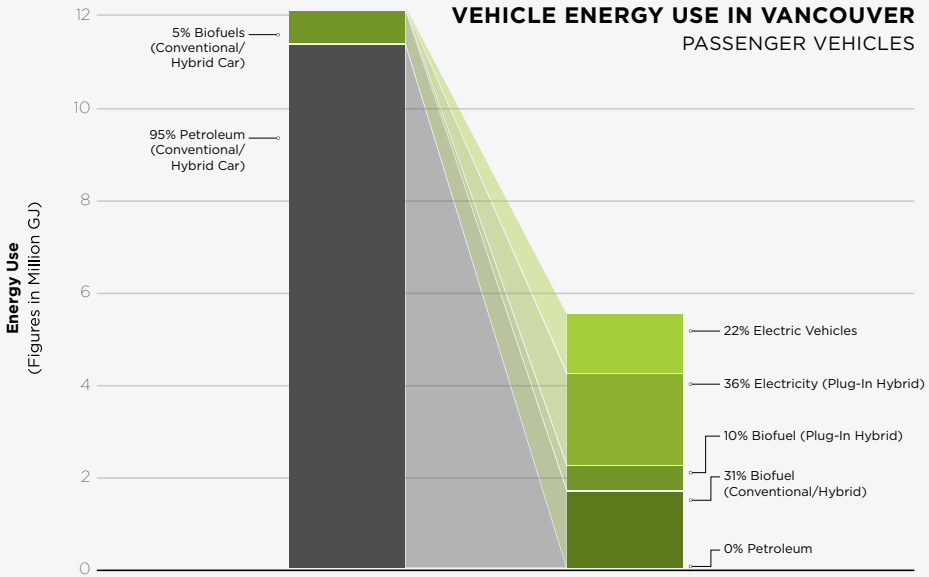
BIOMETHANE SUPPLY

Technology such as anaerobic digestion produces biomethane from food scraps, and the material left over from that process is used in the production of compost and fertilizer. Biomethane is currently in limited supply in BC since there are few sites producing it. However, as the need to replace natural gas grows, demand is expected to increase. Production increase will likely be met by landfills, anaerobic digesters (which take organic waste like kitchen scraps and yard trimmings to make biomethane), and waste water/sewage treatment plants. As waste diversion programs take effect and better ways to use the waste stream are implemented, biomethane production from landfills is expected to decline, while anaerobic digesters will increase production volumes.

HYDROGEN SUPPLY

Hydrogen is in plentiful supply since it is the major constituent of water. However, the majority of hydrogen used today comes from natural gas. Using renewable electricity to electrolyze water could produce clean hydrogen in the quantities needed. A move to increase hydrogen use will require new fuelling-station infrastructure, which would be similar to the gas stations of today.

VEHICLE ENERGY USE IN VANCOUVER
PASSENGER VEHICLES

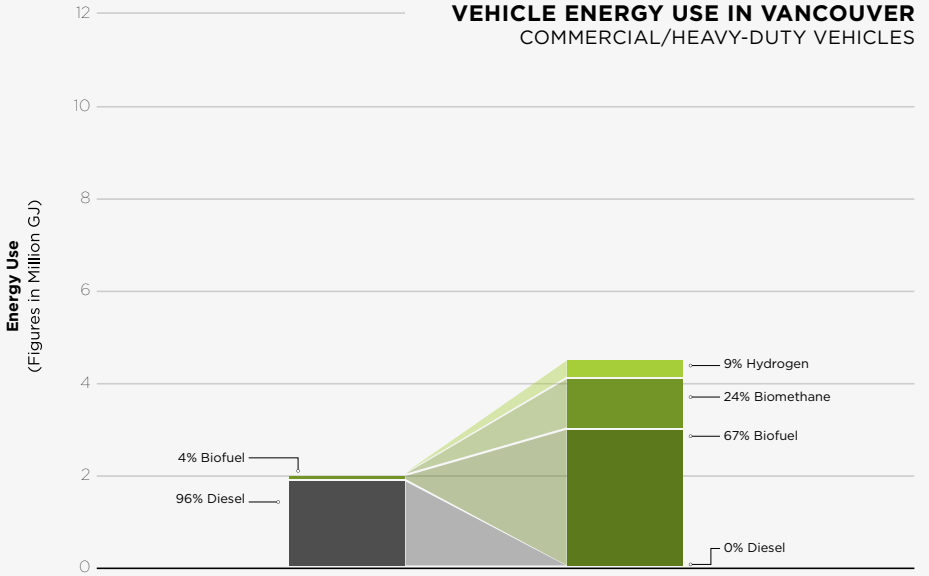


2014
Total Energy Use
12.2 Million GJ

2050
Total Energy Use
5.6 Million GJ

Due to rounding, numbers presented may not add up precisely to the totals provided.

VEHICLE ENERGY USE IN VANCOUVER
COMMERCIAL/HEAVY-DUTY VEHICLES

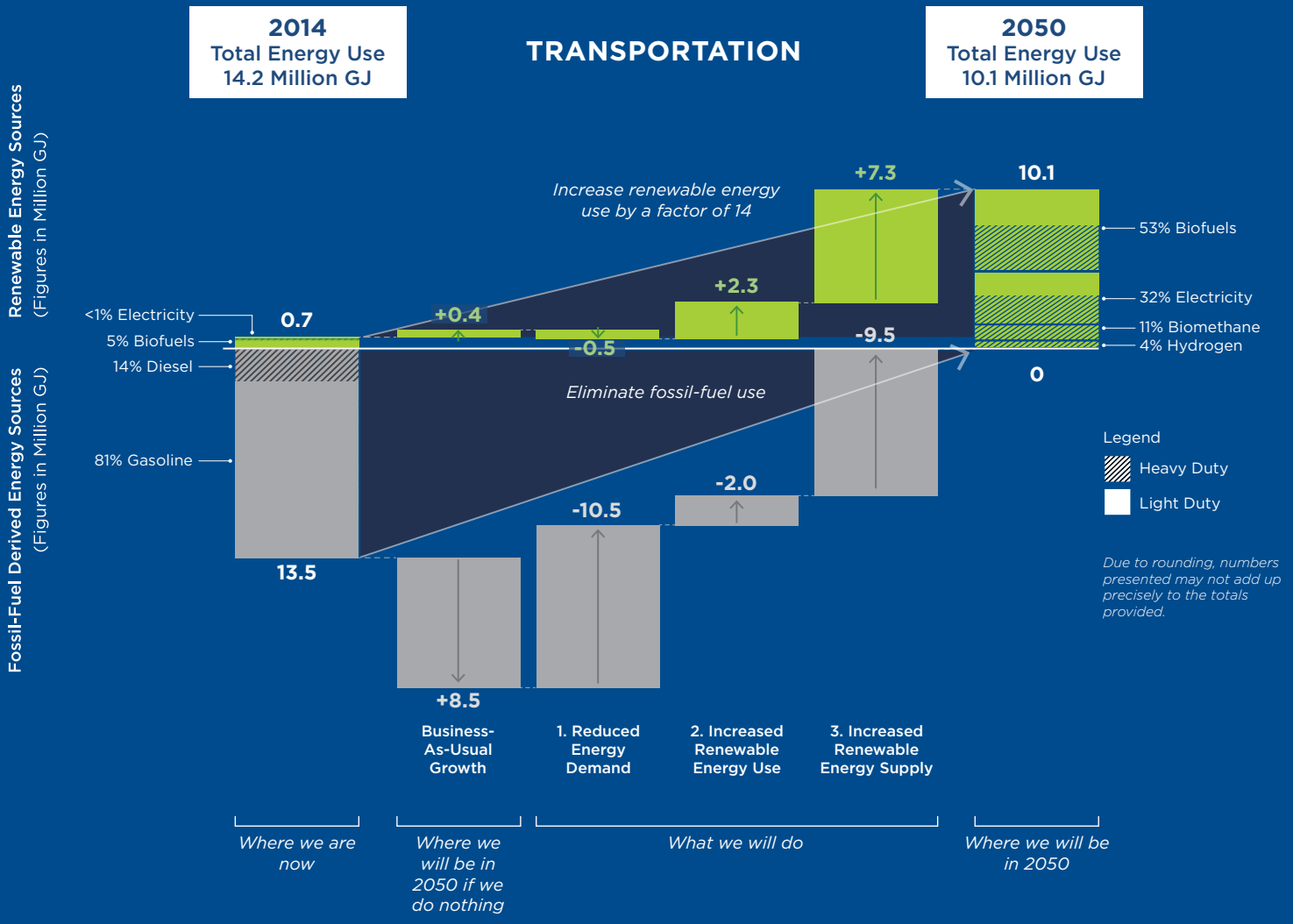


2014
Total Energy Use
2.0 Million GJ

2050
Total Energy Use
4.5 Million GJ

Due to rounding, numbers presented may not add up precisely to the totals provided.

HOW VANCOUVER WILL GET TO 100% RENEWABLE ENERGY BY 2050



Due to rounding, numbers presented may not add up precisely to the totals provided.

QUICK START

Underway Now: Expand the beneficial use of biomethane produced by the Vancouver Landfill

The Vancouver Landfill in Delta is undergoing significant infrastructure improvements to optimize the capture of landfill gas at the site. With this optimized system in place, the City will work with industry and business partners to put more of the biomethane in the landfill gas to beneficial use by introducing it to the natural gas system or using it to fuel biomethane-powered vehicles.

"Reduction in emissions is driven most significantly by a dramatic reduction in the carbon intensity of energy use, as renewables and biomass become the dominant energy sources and there is broad fuel switching across the economy toward electricity and biofuels."

- Pathways to Deep Decarbonization, for the United Nations

CITY OF VANCOUVER SERVICES AS A CATALYST

CITY SERVICE RENEWABLE ENERGY PRIORITIES

S.1 The City will adopt a comprehensive approach to the consideration of climate change as part of its service planning

S.2 The City will adopt a comprehensive approach to pricing carbon emissions for municipal operations

S.3 The City will develop a framework to assess how City enabling tools may be used to support the transition to 100% renewable energy

S.4 The City commits to keep abreast of financing mechanisms available that enable the delivery of renewable energy technology and other green infrastructure

OVERVIEW

The City of Vancouver can catalyze change by being a leader in the use of renewable energy in its own operations. Out of its 180 passenger-vehicle fleet, the City already has 46 hybrids and 29 electric vehicles. The City has fitted 107 idle-stop devices to its fleet vehicles to limit emissions form idling, and since 2008 has cut fleet emission by 10% and overall corporate emissions by 25%.

The City also provides a range of services to its citizens, and the pursuit of 100% renewable energy will be integrated into those services. Vancouver's services are funded through property taxes (56%), utility fees (20%), and user fees (24%) like parking meter revenues and business licenses.

The City must also work in partnership with senior levels of government, charitable foundations and private financiers to enable the private sector to develop viable and cost-effective renewable energy technologies.

The mid-to-long-term implications of transitioning Vancouver to 100% renewable energy will be determined as part of the City's strategic service, capital and financial planning, taking into consideration long-term financial, environmental and social sustainability.

The approach will be structured to take into account:

- Where the City has regulatory authority to enable and/or require the transition to 100% renewable energy (typically in building codes, land use, licensing and permitting and bylaw enforcement) the City will develop, in consultation with key stakeholders, strategies that set clear and attainable goals, timelines, and implementation approaches;
- Where other levels of government have regulatory authority to enable and/or require the transition to 100% renewable energy, the City will focus on education and advocacy to support the case for such regulation;
- Where businesses, consumers, academia or other entities are the key agents for change, the City will focus on strategic partnership, education and advocacy; and
- Where the City's operations are involved, the City will develop implementation and funding strategies that balance financial, environmental, and social considerations.

QUICK STARTS

Licensing Powers Quick Start: The City of Vancouver will investigate how best to use its licensing and permitting powers to accelerate the adoption of renewable energy

Purchasing Power Quick Start: The City of Vancouver will investigate how best to use its purchasing power to accelerate the adoption of renewable energy

ACKNOWLEDGEMENTS

The *Renewable City Strategy* is the culmination of many hours of work, conversations, research and development. The expertise, leadership, willingness to work with the City of Vancouver and enthusiasm to set Vancouver on a path to a renewable future.*

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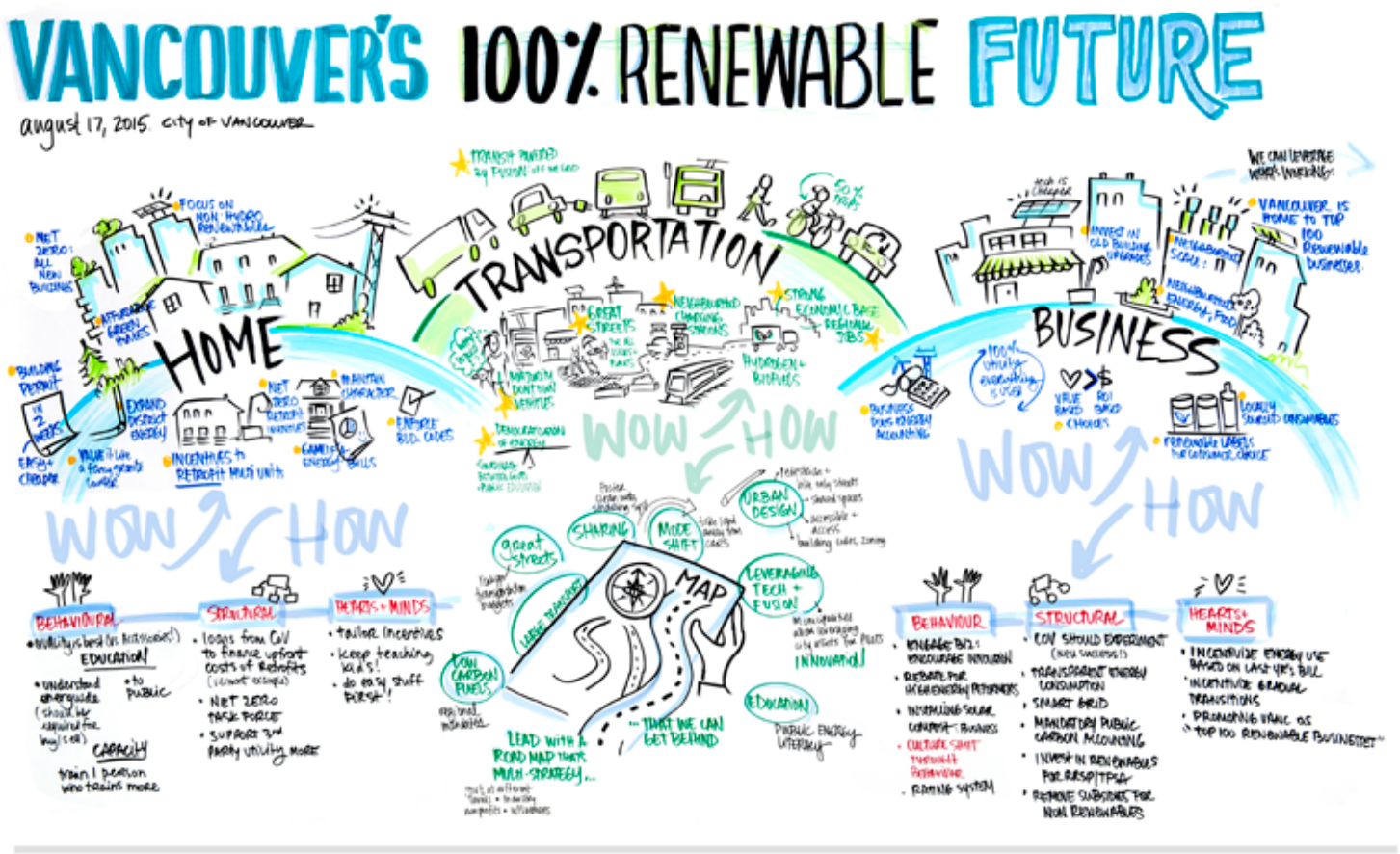
GLOSSARY

Renewable energy is energy that is naturally replenished as it is used

Term	Definition
Anaerobic digestion	A collection of processes by which microorganisms break down biodegradable material in the absence of oxygen. The process is used for industrial or domestic purposes to manage waste and/or to produce fuels.
Biofuel	A fuel (such as wood or ethanol) composed of or produced from biological raw materials.
Biomethane	Methane produced by natural processes; can be used as a direct replacement for natural gas.
Clean tech	Clean technology is a diverse range of products, services, and processes that harness renewable materials and energy sources, dramatically reduce the use of natural resources, and cut or eliminate emissions and wastes.
Climate resilience	The capacity for a city, organization or other system absorb stresses and maintain function in the face of external stresses imposed upon it by climate change and to adapt, reorganize, and evolve into more desirable configurations that improve the sustainability of the system, leaving it better prepared for future climate change impacts.
CO_2	Carbon dioxide, the primary greenhouse gas in the Earth's atmosphere.
CO_2e	Carbon dioxide equivalent: a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same global warming potential (GWP), when measured over a specified timescale (generally 100 years). For example, methane (CH_4) has a global warming potential that is 25 times greater than carbon dioxide, giving 1 tonne CH_4 = 25 t CO_2e.
Electric vehicle	A generic term that usually includes any vehicle that plugs into an external electrical source, including both battery electric vehicles that use only electricity; and, plug-in hybrid electric vehicles, that primarily use a battery but have an on-board gasoline engine to extend range. 'EV' does not usually refer to more traditional 'hybrid' vehicles, which do not obtain electric power from plugging into an external source.
Electrolysis	Chemical decomposition produced by passing an electric current through a liquid or solution containing ions.
Embedded carbon/ Embedded emissions	Also known as 'embodied carbon' is the amount of carbon released from material extraction, transport, manufacturing, and related activities for a given product or energy source.
Embedded energy	Embedded energy, also known as embodied energy, is the sum of all the energy required to produce any goods or services, considered as if that energy was incorporated or 'embodied' in the product itself.
Feedstock	A raw material that supplies or fuels an industrial process.
Fuel cell	An electrochemical device in which the energy of a reaction between a fuel, such as liquid hydrogen, and an oxidant, such as liquid oxygen, is converted directly and continuously into electrical energy.
Fuel switch	The substitution of one fuel for another. In the context of greenhouse gas emissions, fuel switching implies the switch from a high carbon fuel to a low carbon fuel.

Term	Definition
Geothermal/geoexchange	Energy systems that obtain heat from the earth and/or use the ground for cooling.
Greenhouse gas	A gas that contributes to the greenhouse effect by absorbing infrared radiation, such as carbon dioxide or methane.
Heat pump	A device that transfers heat from a colder area to a hotter area by using mechanical energy. Heat pumps can draw heat from air external to a building ('air source') or from geothermal energy ('ground source').
Hydrogen	A chemical element that can be burnt or used in fuel cells and which does not relsease any greenhouse gases.
Large hydro	Hydroelectric power stations that generate more than 10MW of electricity.
LED	A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it.
Major Roads Network	Also known as arterial roads, are major through roads expected to carry the largest volumes of traffic.
Neighbourhood renewable energy system	Neighbourhood renewable energy systems are local energy networks that have a neighbourhood energy centre to generate heat which is piped to local buildings for space heat, hot water and, in some cases, cooling.
Passive House	The term Passive House (Passivhaus in German) refers to a rigorous design philosophy that allows ultra-low energy use.
Plug load	The energy used by products that are powered by means of an ordinary outlet. This term excludes building energy that is attributed to major end uses (e.g., heating and ventilation, lighting, water heating, etc.)
Photovoltaic	A method of converting solar energy into direct current electricity (as opposed to heat) using semiconducting material.
Renewable energy	Energy that is naturally replenished as it is used.
Residuals	Residuals are waste materials that remain after reusable, recyclable and compostable materials have been removed from a waste stream.
Sewer heat	Wastewater (what gets flushed down toilets, mixed with millions of gallons of hot water from showers, dishwashers, washing machines, and more) maintains a fairly constant temperature as it travels through sewers to the treatment plant.
Small hydro	Hydroelectric plants that capture energy in flowing water, including run-of-river projects. Small hydro are considered to be projects that generate between 2 megawatts (MW) and 10MW of power.

Term	Definition
Solar thermal/solar heat	Heat radiation from the sun collected by heat-absorbing panels through which water is circulated: used for domestic hot water, central heating, and heating swimming pools.
Solar power	The use of the sun's energy to generate electricity through solar photovoltaic systems.
tCO₂e	Metric tonnes (equal to 1,000kg) of carbon dioxide equivalent.



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