Vancouver, British Columbia

Summary

This report is part of a series on best-practice municipal energy strategies within Europe and North America. The series is part of a larger project of recommendation on *TransformTO*, with other series' discussing waste, transportation, and buildings. This document highlights strategies & recommendations from Vancouver to improve *TransformTO*. Similar reports are written for Vienna, Munich, Lyon, Manchester, New York City, Portland, and San Francisco. This report is focused on heating/cooling, energy efficiency, renewable energy, electricity, intergovernmental & utilities co-operation, and district/community energy. The report finds that although Vancouver has a warmer climate than Toronto, the cities face similar challenges reducing energy use in buildings. Prioritizing a transition to heat pumps with supplemental add-ons for winter in, enforcing stringent policies on new building construction, extensive retrofitting programs for older buildings and assessing feasibility of a neighborhood energy utility could lead to significant overall emissions reductions

Background on city

The city of Vancouver has a population of 631 486 with 2 463 431 living in the metropolitan region of Vancouver (The Canadian Press, 2017). It is the most densely populated city in Canada at 5400 people/square km (Campion-Smith, 2017). Annual temperatures range between 1 °C and 22 °C. (Climates to Travel, n.d.). Vancouver is often cloudy and rainy during the winter but gets frequent sunshine in the summer with average annual hours of sun from 2 to 9 (Climates to Travel, n.d.). Vancouver has an average of 7 extremely windy days annually and the average windspeed is 12.2 km/hour (Environment Canada, 2010).

The city is mostly dependent on small and medium sized business and industries for its' economy, "over 90% of Vancouver businesses have fewer than 50 employees, and over 70% have 10 employees or fewer" and the city has only three large industrial facilities (City of Vancouver, 2015). Vancouver has high housing costs and a busy but limited transit system (City of Vancouver, 2015).

Energy/Climate Change Plans

Overview

The city's climate action targets have remained relatively consistent over time with some acceleration due to the city declaring a climate emergency in 2019 (Collins, 2020). Vancouver's first climate action report was released in 1990, followed by three consecutive reports in 1997, 2005 and 2008 (Vancouver City Council, 2019). In 2011, Vancouver declared that it intended to become the greenest city in the world. *The Greenest City Action Plan* (GCAP) was released to supplement that goal and committed to reduce community emissions 33% by 2017, require newly constructed buildings to be carbon neutral by 2020 and reduce building emissions and energy use by 20% (City of

Vancouver, 2011). In 2015, *The Greenest City Action Plan Part Two* was released which assessed implementation progress finding emissions had decreased 7% in four years and extended the deadline for 33% emissions reduction to 2020 (City of Vancouver, 2015b). The GCAP part two outlined a target for reduction of city operations emissions by 50% and long-term 2050 targets including deriving 100% of energy from renewable sources and reducing overall emissions by 80% (City of Vancouver, 2015b). Annual implementation & progress updates have been released up to July 2020.

In 2015, the city established the *Renewable City Strategy* and in 2017, the city released a *Renewable City Action Plan* (RCAP) outlining initiatives to achieve 100% renewable energy (City of Vancouver, 2017). By 2016, overall emissions reductions reached 11% and building emissions decreased by 13% below 2007 levels. Other reports published by the city include the *2016 Zero Emissions Building Plan*, *2019 Community Energy & Emissions Plan for North Vancouver* and the *2018 Energy Modelling Guidelines*. In 2019, Vancouver City council declared a climate emergency and released the *Climate Emergency Response* emphasizing accelerating progress in six major target areas with high emissions reduction potential and increasing the stringency of targets including achieving carbon neutrality by 2050 (Vancouver City Council, 2019). In July of 2020, an update on implementation of the Climate Emergency Response occurred in city council which acknowledged COVID-19 and reinforced the urgency of the city's goals.

Key Initiatives (2007 baseline emissions)

- *Greenest City Action Plan Part Two & Climate Emergency Response:* reduce overall emissions 33% by 2020 and 100% by 2050 (City of Vancouver, 2015b; Vancouver City Council, 2019)
- *2018-2019 Implementation Report*: reduce energy use & emissions in existing buildings by 20% increased to a 40% reduction below 2018 levels in the *Climate Emergency Response* and new buildings should achieve carbon neutrality by 2020 (City of Vancouver, 2019; Vancouver City Council, 2019)
- *Climate Emergency Response:* By 2025, all new and replacement heating & hot water systems will be zero emissions (Vancouver City Council, 2019)
- *2018-2019 Implementation Report*: Increase renewably sourced energy in Vancouver's Neighborhood Energy Utility from 70% to 100% (City of Vancouver, 2019)
- *2018-2019 Implementation Report*: Reduce emissions from municipal operations 50% (City of Vancouver, 2019)
- *RCAP:* Achieve 55% of energy from renewable sources by 2030 & 100% by 2050 (City of Vancouver, 2017)

Energy

Vancouver's 2015 energy usage by type is displayed in Figure 1 and broken down into greater detail in Figure 2. Most of Vancouver's energy comes from natural gas, followed by electricity and gasoline/diesel with a small portion from biogas (City of Vancouver, 2017). Vancouver's electricity is sourced from 97.8% low-carbon energy from 30 hydroelectric plants, 2 thermal generating stations, and 130 energy projects, some of which are renewable (BC Hydro and Power Authority, 2019). The burning of natural gas for heating & hot water is the single largest source of emissions at 56% (Vancouver City Council Update, 2020). The city's 5000 rental apartment buildings are a major challenge to emissions reductions, 80% of which were built before 1970 and require extensive retrofitting (C40 Cities, 2016). A diagram outlining Vancouver's energy usage in buildings from 2014 is provided in Figure 3.

Implementation Status of Key Initiatives

Vancouver has not achieved Greenest City status by 2020. When the 2018-2019 implementation update was released, the city had achieved a 12% reduction in overall emissions, but this decreased to a 9% reduction from baseline in the 2019-2020 implementation update (City of Vancouver, 2019; City of Vancouver, 2020). The city states it is on track to meeting many goals, including achieving zero emissions status in new buildings (Collins, 2020). Emissions in existing buildings had been reduced by 11% in 2018-2019 but increased 2% in 2019-2020 (City of Vancouver, 2020). Emissions in new buildings have been reduced by 43% since 2007 and Figure 4 outlines one potential zero emissions pathway (City of Vancouver, 2020; City of Vancouver, 2017). Regarding the *Climate Emergency Response's* Big Moves, city staff were instructed to generate plans for these goals by the fall of 2020 (Vancouver City Council, 2019). The city has reduced municipal operations emissions by 56%, surpassing its' target (City of Vancouver, 2019).

Heating/Cooling

In the 2018-2019 implementation update, the city committed to replace residential gas furnaces with high efficiency electric heat pumps and to install heat pumps in municipal facilities including city hall and community ice rinks gas where boilers were replaced with waste-heat recovery systems (City of Vancouver, 2019). The city invested $5 million in these transitions (City of Vancouver, 2019). In North Vancouver, it is predicted that the switch to heat pumps will reduce emissions 18% and energy usage 16% by 2050 (North Vancouver, 2019). In the 2019, the *Climate Emergency Response* directed that by 2025, only carbon neutral heating & hot water systems can be installed in the city (Vancouver City Council, 2019).

Energy Efficiency

In 2016, *Operation Cost Cutter* was organized by the city to increase retrofitting initiatives amongst residential landlords. Landlord BC (building owners/managers association) worked with building owners to form a retrofitting program based on education, building energy assessments, framing energy conservation in a business lens, and making connections with suppliers, contractors & utility company incentives (C40 Cities, 2016). During its first year, 18 buildings participated leading to significant reductions in emissions and natural gas usage (C40 Cities, 2016). It was found that "69% of buildings that received an energy assessment implemented a measure, which included high efficiency space heaters and hot water boilers, advanced direct digital control (DDC) systems, re-commissioning of heating and ventilation equipment, pipe insulation, clothes washing machines, direct installation of showerheads and faucet aerators, and high efficiency toilets" (C40 Cities, 2016). This program is being expanded provincially through utilities providers (C40 Cities, 2016).

Vancouver is investing in the construction of passive housing projects to reduce energy costs and increase efficiency (City of Vancouver, 2019). As of July 2019, 50 passive housing projects containing approximately 2300 units have been completed or are currently underway (City of Vancouver, 2019). Of the projects underway, 80% are for multi-family or rental buildings (City of Vancouver, 2019). The city has committed to use passive housing standards to construct any new city-owned buildings including a fire hall (City of Vancouver, 2017). The City contributed $350 000 to funding the *Zero Emissions Building Exchange,* "an industry hub that facilitates knowledge exchange to accelerate market transformation" to assist in the growth of passive housing construction (ZEBx, n.d.).

British Columbia established a Step Building Code in 2017 requiring new buildings to be constructed to net-zero standards by 2032 and permits Vancouver to increase the stringency of its code beyond provincial requirements. In 1997, Vancouver passed the *Higher Building Policy* which has undergone numerous amendments and is one of the strictest environmental building guidelines in North America resulting in 90% less emissions than in 2014 (City of Vancouver, 2019). This policy requires that construction of tall buildings meet one of the following: *Passive House Certification* or *Low Carbon Energy System Requirements/BC Energy Step Code: Code 4* (based on total energy usage intensity, thermal energy demand intensity and GHG intensity) (City of Vancouver, 2018). New tall buildings are encouraged to reduce hot water usage, manage peak loads in innovative ways and sub-meter suites to reduce overall energy demand (City of Vancouver, 2018). The *Green Building Policy for Rezoning* requires builders to measure embodied carbon associated with the construction of new buildings to encourage a shift towards lower carbon building materials (City of Vancouver, 2019). The city intends to place a limit on carbon pollution for existing buildings which will apply to all buildings by 2030, with increasing stringency in five-year intervals (City of Vancouver, n.d. b). The *Vancouver Building Bylaw* (VBBL) is based on the 2018 provincial building code and includes two amendments designed to decrease emissions in the city. The VBBL requires new low-rise residential buildings (3-6 stories) to install

zero-emissions space/water heating to reduce wasted energy and to incorporate mass timber construction into new building developments up to 12 stories which will result in improved insulation and energy efficiency (Vancouver City Council, 2020; City of Vancouver, 2017).

Renewable Energy

Vancouver derives 31% of its energy from renewable sources, mostly hydro as displayed in Figure 5 and Figure 2 (City of Vancouver, 2015). The city intends to reach its renewable energy goal by reducing overall energy use, increasing energy sourced from renewables and doubling the use of renewables (City of Vancouver, 2015). By 2050, the city intends to source its energy from 60% electricity, 15% *Neighborhood Energy Utility Project (NEU)* systems, 14% biofuels, 10% biomethane and a small portion of hydrogen as displayed in Figure 4 (City of Vancouver, 2015). The city is encouraging solar panel installation on the rooftops of public buildings (City of Vancouver, 2019).

Intergovernmental & Utilities Co-operation

Vancouver's 80% emissions reduction targets are on par with both the provincial and federal governments (City of Vancouver 2017). The province released a climate action plan in 2008 which lacks significant progress (City of Vancouver, 2017). In 2008, the province enacted a carbon tax charging "$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," (City of Vancouver, 2015). The city controls municipal infrastructure, land use & zoning policies, building standards and can establish energy utilities as discussed above (see NEU), "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" (City of Vancouver, 2015). BC Hydro is a crown corporation regulated by the province that supplies electricity to Vancouver. Fortis BC is a privately owned utility company that supplies natural gas to Vancouver. Prior provincial government programs such as *LiveSmart BC* (a climate action toolkit) and utility company rebates have helped reduce emissions in Vancouver buildings (City of Vancouver, 2017).

District/Community Energy

In 2010, the City of Vancouver established its first renewable district heating system (City of Vancouver, n.d. a). The Neighborhood Energy Utility (*NEU)* uses recycled energy to heat buildings in four neighborhoods covering 534,000 m2 of floor space and reducing typical emissions associated with heating by 60 % (City of Vancouver, n.d. a). Cairns & Baylin-Stern explain the funding model for this district energy (DE) system, "a $21 million share of the capital cost of a local district energy and sewer heat recovery

system (which delivers energy cost savings to connected users, in addition to broader environmental benefits) has been financed in part from a City reserve, and will be repaid over the 25 year asset life through a fixed energy rate charged to connected users," (2016, p.30). This system was approved for expansion in 2018 and the city is looking into its' feasibility in three neighborhoods (City of Vancouver, n.d. b). The city has committed to transition the NEU from being powered by 70% renewably sourced energy to 100% by 2030 but has not provided explicit plans for this transition (City of Vancouver, n.d. b).

Discussion

Vancouver's emphasis on heat pump transition poses some challenges for Toronto's colder climate. Typical heat pumps are less efficient when operating below -10 degrees Celsius but cold climate heat pumps can function efficiently from -20 to -24 degrees Celsius (Peterson et al., 2019; Grant-Braid, 2018). Heat pumps could remain a feasible option for Toronto for a portion of the winter although the coldest days would require supplemental heat sources to be installed e.g. add-on heat pumps that work in conjunction with a gas, electric, propane or hydrogen fueled heating (Grant-Braid, 2018; Committee on Climate Change, 2018). A 2019 report found that when heat pumps are combined with tight insulation and rooftop solar PV in cold climates, utility bill costs are on-par with higher carbon heating alternatives (Peterson et al., 2019). Toronto should follow Vancouver's lead investing significant time, money and effort into efficiency upgrades and retrofits to its' large proportion of older, high emitting residential/commercial buildings. Toronto should adapt similar passive housing standards for new buildings, particularly those owned by the city. Toronto has committed to feasibility studies for community energy plans and could benefit from incorporating a neighborhood energy utility system as developed in Vancouver.

Recommendations for Toronto

- Replace gas furnaces in homes, buildings & municipal facilities with high efficiency cold climate electric heat pumps supplemented with natural gas, electricity, propane, or hydrogen
- Create a program to facilitate retrofitting of residential buildings amongst landlords such as *Operation Cost Cutter*
- Incentivize and support passive housing building standards, particularly for city-owned facilities
- Adapt components of building policies and energy codes (e.g. *Higher Building Policy, Green Building Policy for Rezoning, VBBL, BC Energy Step Code)* that fit into the Toronto context
- Develop roadmap with clear targets for transitioning to renewable energy
- Determine feasibility of NEU pilot project in select Toronto communities

Appendix

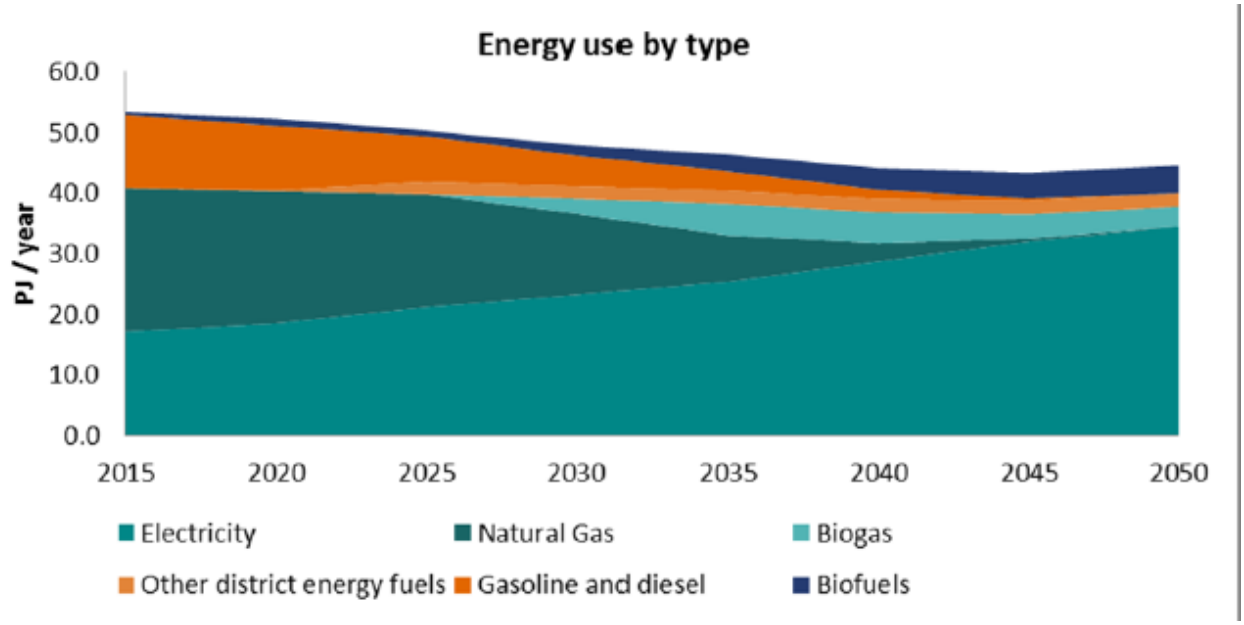

Figure 1: Vancouver's 2015 Energy Use by Type and One Potential Future Scenario (RCAP, 2017)

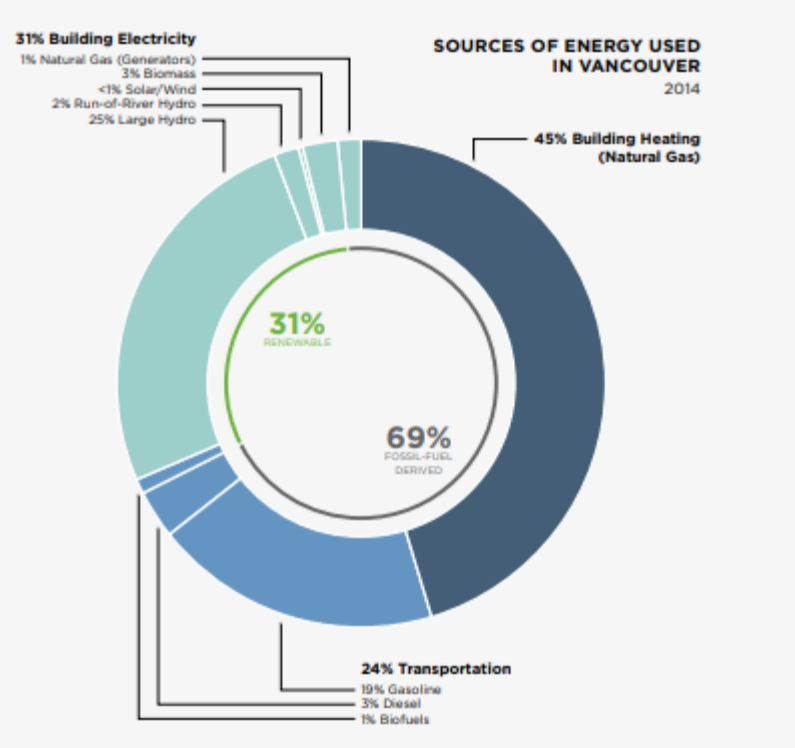

Figure 2: Sources of Energy Used in Vancouver, 2014 (City of Vancouver, 2015)

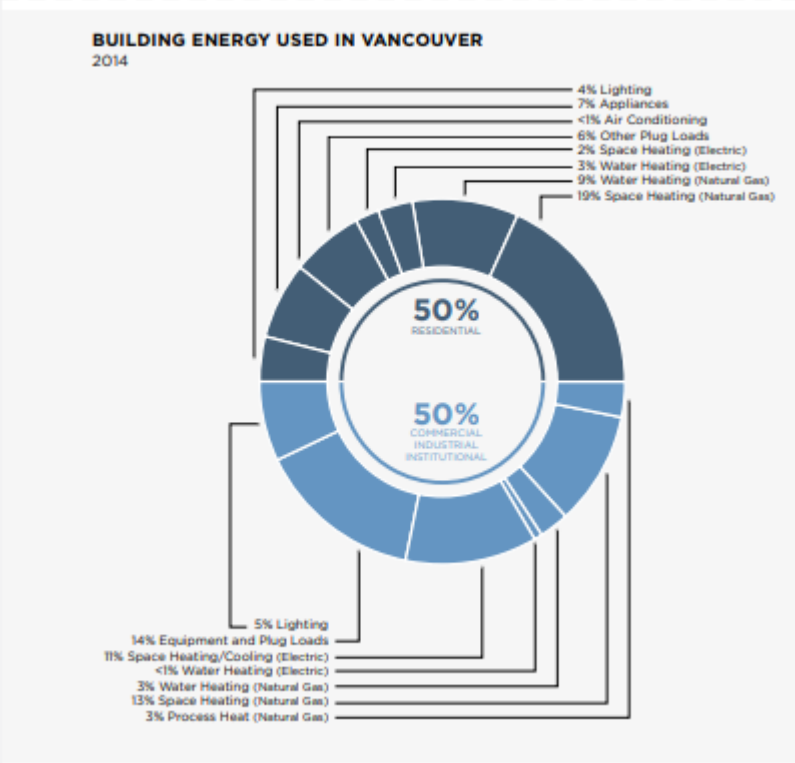

Figure 3: Vancouver's 2014 Building Energy Use (City of Vancouver, 2015)

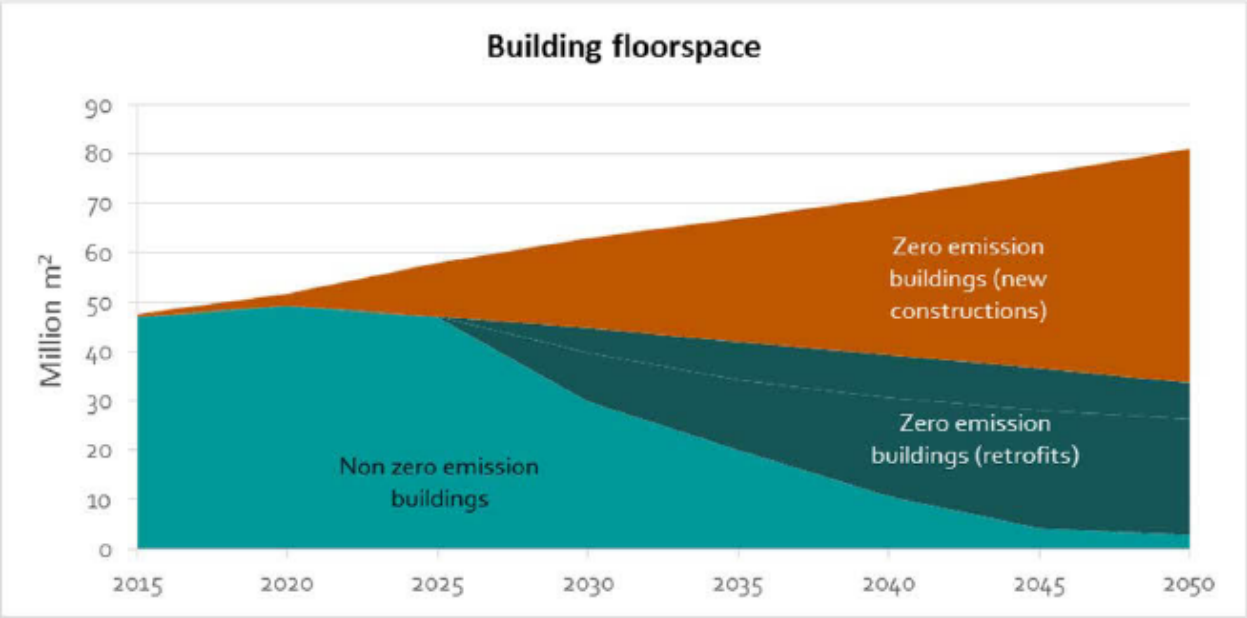

Figure 4: Projected Transition to Zero Emissions Buildings (new & retrofits) (RCAP, 2017)

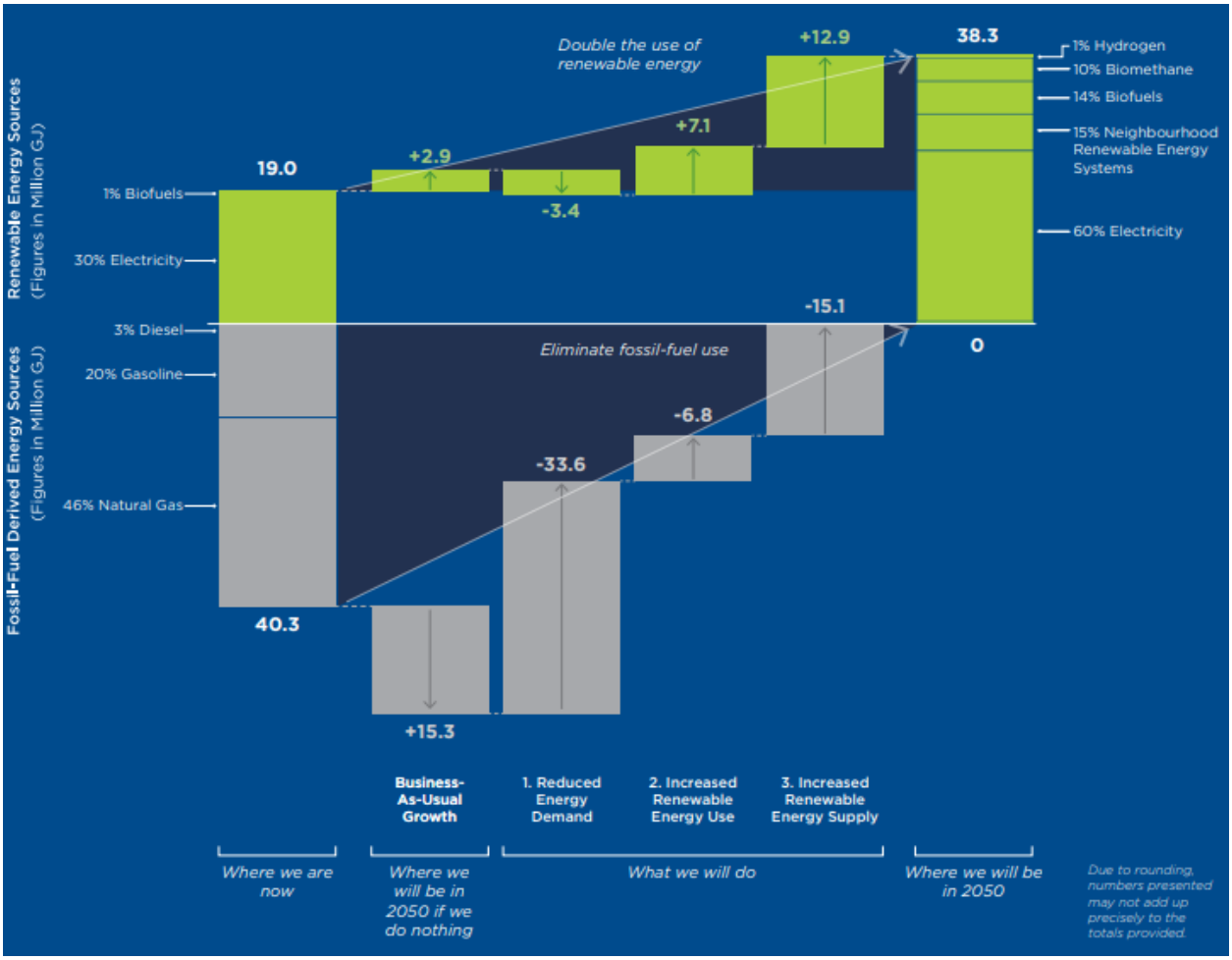

Figure 5: Vancouver's' transition to 100% renewable energy by 2050 (City of Vancouver, 2015).

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