North Cowichan

Climate Energy and Action Plan Update

November, 2021

DRAFT

Contents

Land Acknowledgement

To be added.

Mayor's Message

To be added.

CAEP Preparation Acknowledgements

North Cowichan's Climate Action and Emissions Plan (CAEP) Update development took place over two years. We thankfully acknowledge the following individuals and organizations in the CAEP Update's preparation.

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CAEP Update Preparation

Sustainability Solutions Group and whatIf? Technologies performed the energy, emissions, land-use, and financial modelling, research, and analysis presented in this report, and contributed to the public engagement that informed the CAEP Update's development.

Disclaimer and Liability

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A Note on the Impact of Coronavirus (COVID-19)

The analysis in this document was completed during the COVID-19 pandemic in Canada. The longevity of the socio-economic changes the pandemic created is difficult to predict. Some changes may be here to stay, while others may revert once conditions are safe again, while still others may become a hybrid of old and new conditions. This uncertainty presents a challenge for long-term modelling assumptions. Even so, the analysis in this document continues to be relevant because the climate crisis persists, and because the climate actions presented in this analysis can stimulate the economy during and after the pandemic. The solutions recommended—ranging from energy efficiency housing retrofits to investing in renewable energy—are designed to decrease emissions and increase energy efficiency while creating jobs and bolstering the local economy.

Here are some key points to consider in the context of COVID-19:

- A global health crisis: The pandemic has radically transformed societies and economies, resulting in strains on health and healthcare and disrupting work and home life everywhere.[1]
- The impacts of coronavirus are unclear: The negative impact of COVID-19 on people, workplaces, and the economy, as well as the duration of those impacts, presents many uncertainties. The recovery will be affected by a combination of factors such as public health guidance for opening up society, the evolution of the pandemic, the design of public policy responses, and the continuing response by global institutions.
- The climate emergency remains: A decline in activity has resulted in a short-term reduction in GHG emissions but concentrations of GHG emissions in the atmosphere continue to climb and global temperatures continue to increase.[2] The pandemic has also disrupted international efforts to address climate change.
- In the short term, the impacts of COVID-19 both challenge and reinforce actions outlined in this document.
- Substantively addressing climate change is more relevant than ever: Investments made now lock in the emissions effects of those investments for decades. This report identifies investments that stimulate the economy and decarbonize over the next 30 years.
- Alignment with green stimulus: As Canada initiates efforts to recover from the impact of the coronavirus, there is an opportunity to stimulate the economy with investments that simultaneously address the climate crisis. This document describes investment opportunities that will generate jobs, stimulate businesses, reduce GHG emissions, and provide local benefits.

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[1] World Health Organization (2020). World health statistics 2020: monitoring health for the SDGs, sustainable development goals. Retrieved from: https://apps.who.int/iris/bitstream/handle/10665/332070/9789240005105-eng.pdf

[2] World Meteorological Organization (2020). The Global Climate in 2015-2019. Retrieved from: https://library.wmo.int/doc_num.php?explnum_id=10251

Abbreviations

BAU	Business-as-Usual scenario
EAC	Environmental Advisory Committee
EV	Electric vehicle
GHG	Greenhouse gas
ICI	Industrial, commercial, institutional buildings
IPCC	Intergovernmental Panel on Climate Change
$ktCO_2e$	Kilotonnes of carbon dioxide equivalent
kW	Kilowatt
kWh	Kilowatt hour
LC	Low-carbon
LCS	Low-carbon scenario
m^3	Cubic metre
$MtCO_2e$	Megatonnes of carbon dioxide equivalent
MW	Megawatt
PACE	Property Assessed Clean Energy
PV	Photovoltaics (solar photovoltaic energy generation)
tCO_2e	Metric tonnes of carbon dioxide equivalent

PART 1: Updating the CAEP

Welcome to the Municipality of North Cowichan's Climate Action and Energy Plan Update! This plan was developed over the course of two years and is the culmination of statistical modelling, data analysis, research, and community and stakeholder inputs. The CAEP Update refreshes the information and analysis of the original 2013 CAEP and provides current direction for energy efficiency, emissions reductions, and improved quality of life efforts across North Cowichan. The plan sets a low-carbon course for the community to achieve Council's adopted emissions reduction target of -80% of 2007 GHG emissions levels by 2050.

Climate action and energy and emissions plans benefit from routine updates that check on plan implementation progress, update technical assumptions and processes, and align efforts with current best practices. This section provides context for the Update.

Council and Environmental Advisory Committee Resolutions

The CAEP Update project was mandated by North Cowichan Council when it authorized staff to apply to the Federation of Canadian Municipalities to provide project co-funding on July 19, 2017, for the purpose of updating the greenhouse gas emissions modelling performed for the original CAEP. Appendix 1 summarizes the related Council and Committee of the Whole motions and Environmental Advisory Committee discussions.

The CAEP Update project was developed by municipal staff and approved by the Environmental Advisory Committee (EAC) in a recommendation to Council for endorsement on September 26, 2018.

The CAEP Update project commenced in May, 2019 and concluded in December, 2021.

Global Context

The Intergovernmental Panel on Climate Change's Sixth Assessment Report[3] (August, 2021) provides the summary conclusion of thousands of scientists' recent climate change studies. The report confirms that greenhouse gases (GHGs) emitted from human use of fossil fuels are causing unprecedented changes to climate and weather on global and regional scales. These changes are occurring faster than previously expected and their impacts are proving to be even more severe than anticipated. Widespread and rapid deterioration in the stable functioning of the atmosphere, ocean, cryosphere (frozen water areas), and biosphere have already occurred and continue to accelerate.

At current and projected rates of GHG emissions production, global heating of greater than 2^{o}C will occur in the next 30 to 80 years. Heating of 1.5^{o}C is the point at which climate change will result in major, disruptive weather, environmental, and ecosystem impacts. Heating beyond 2^{o}C will result in major and frequent catastrophes.

The Assessment Report confirms that limiting GHG emissions – especially carbon dioxide and methane – and reaching at least net-zero emissions will limit global heating and changes to the climate. Air quality improvements would be noticeable immediately while the abatement of other climate change impacts (e.g. droughts, floods, sea ice melt) could take decades to realize.

The Assessment Report concludes that rapid fossil fuel use elimination across all socio-economic sectors is imperative to avoid the worst climate change impacts possible.

[3] Intergovernmental Panel on Climate Change, August 21, 2021. Sixth Assessment Report.

Federal Context

There are several policies and initiatives issued by the federal government that guide and support provincial and municipal climate change efforts. Under federal jurisdiction, many of the national policies have direct relevance and application to climate change, energy, and emissions efforts.

The Pan-Canadian Framework on Clean Growth and Climate Change

The Pan-Canadian Framework (2016) is a plan to grow the Canadian economy while reducing emissions and building resilience to adapt to a changing climate.[4] It summarizes Canada's approach to GHG emissions reduction by 2030, addressing clean technology, innovation, and jobs; carbon pricing mechanisms adapted to the specific circumstances of each Province and Territory; and in particular the realities of Canada's Indigenous peoples and Arctic and sub-Arctic regions.[5] It provides the umbrella direction under which provinces and municipalities make their climate change efforts.

Carbon Pricing

Following direction in the Pan Canadian Framework, the Greenhouse Gas Pollution Pricing Act (2018) established a Canadian benchmark carbon price that began at $20/t$CO_2$e in 2019, rising to $50/t$CO_2$e in 2022. The tax will then increase $15/t$CO_2$e every year until it reaches $170/t$CO_2$e in 2030. The federal carbon pollution pricing system has two parts:

- A trading system for large industry, known as the output-based pricing system; and
- A regulatory charge on fuel (fuel charge).

Provinces and Territories can implement their own carbon pricing that meets or exceeds this national benchmark.

Zero Emissions Vehicles

2019's Zero Emission Vehicle Infrastructure Program is supporting the transition to zero-emissions vehicles by helping to address the required investments and upgrades to the EV charging network.[6] The program targets public, on-street, workplace, multi-unit residential buildings, and commercial and public fleet charging infrastructure improvements.

As of June 2021, the federal government has established a mandatory target for all new light-duty cars and passenger trucks sales to be zero-emission by 2035.[7]

Building Energy Efficiency

The federal government's Canada Greener Homes Program was launched mid-2021, providing homeowners with federal grant funding for energy efficiency upgrades and EnerGuide evaluations.[8] There are several related federal government efforts supporting green building programs including Local Energy Efficiency Partnerships[9] for new construction and Integrated Community Energy Solutions[10] for built community environments.

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[4] Government of Canada. Pan-Canadian Framework on Clean Growth and Climate Change: http://publications.gc.ca/collections/collection_2017/eccc/En4-294-2016-eng.pdf
[5] Prime Minister's Office: http://pm.gc.ca/eng/news/2016/03/03/communique-canadas-first-ministers
[6] https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876
[7] https://www.canada.ca/en/transport-canada/news/2021/06/building-a-green-economy-government-of-canada-to-require-100-of-car-and-passenger-truck-sales-be-zero-emission-by-2035-in-canada.html
[8] https://www.nrcan.gc.ca/energy-efficiency/homes/canada-greener-homes-grant/23441
[9] https://www.nrcan.gc.ca/energy-efficiency/homes/local-energy-efficiency-partnerships-leep/17338
[10] https://www.nrcan.gc.ca/homes/about-integrated-community-energy-solutions/4369

Provincial Context

2007's Climate Change Accountability Act marked the beginning of earnest emissions reduction efforts by the province, regional, and municipal jurisdictions in BC. The reduction targets were: at least 40% below 2007 levels by 2030, 60% by 2040, and 80% by 2050.

Many related Acts have followed since, including BC's own carbon tax legislation (to be superseded by the federal legislation after 2022) and regulation requiring BC industries whose operations emit over 10,000 tCO_2e/year to report their GHG pollution annually (operations emitting over 25,000 tCO_2e are required to have their emission reports independently verified), e.g. the Catalyst Mill in Crofton (see emissions inventory section).

CleanBC Roadmap to 2030

In October 2021 the Government of BC released the Clean BC Roadmap,[11] providing more guidance on emissions reduction efforts set out under the Clean BC initiative. Among other initiatives, the Roadmap includes:

- A zero-emission vehicle law achieving 26% of new light-duty vehicle sales by 2026, 90% by 2030, and 100% by 2035.
- A target of 10,000 public EV charging stations by 2030.
- Actions supporting mode-shift toward active transportation and public transit.
- Nearly eliminating all industrial methane emissions by 2035.
- Enhancing the CleanBC Program for industrial emissions reductions.
- A cap on emissions for natural gas utilities.
- New requirements for all new buildings to be zero carbon and new space and water heating equipment to be highest efficiency by 2030.
- Implementing a 100% Clean Electricity Delivery Standard for the BC Hydro grid.
- A new program to support local government climate and resiliency goals with predictable funding.

BC Step Code

BC has an updated target for all new buildings to be zero carbon by 2030. The Step Code is an optional compliance path in the BC Building Code that local governments may use to incentivize or require increasing levels of energy efficiency in new construction that goes above and beyond the requirements of the BC Building Code. Builders may voluntarily use the BC Energy Step Code as a new compliance path for meeting the energy-efficiency requirements of the BC Building Code. Many municipal governments are increasingly adopting more stringent Step Code levels in advance of their planned implementation dates to achieve improved energy efficiency in new buildings sooner.

Regional Context

In the past decade the Cowichan Valley Regional District (CVRD) has studied potential climate change impacts and performed energy use and generation options studies for the area. The Cowichan Valley Energy Mapping and Modelling Study identified that 60% of CVRD homes heat with baseboard electricity, an inefficient use of electricity. The study recommends switching to heat pumps for space and water heating to increase energy efficiency – effectively creating local renewable energy production. The study identifies that this transition, plus some biomass and district energy use, can eliminate emissions from residential heating across the CVRD. Energy efficiency measures in homes are shown in the study to substantially reduce home energy costs.

[11] CleanBC Roadmap:https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_to_2030.pdf

CVRD's current New Normal Cowichan 4-phase project is assessing climate projections and performing risk and vulnerability analysis to produce a climate action implementation plan. The Phase 1 Climate Projections for the CVRD report gives detailed projections of how climate change will affect the Cowichan Valley.[12] Wetter winters, hotter, drier summers, and an increase in extreme weather events are projected for the 2050s and 2080s. The Phase 2 work has updated flood plain mapping[13] and is further identifying risks and vulnerabilities. CVRD's Natural Hazard Risk Tolerance Policy[14] establishes considerations for CVRD land use decisions. Phase 3's Climate Change Adaptation and Risk Management Strategy identifies 4 key themes, 21 objectives, and many actions for preventing and adapting to climate change impacts.[15]

Local Climate Context[16,17]

Weather and climate observations over the past 70 years indicate that the Cowichan Valley's mean annual temperature has risen by 0.8-1°C. The region's average maximum temperature has also risen by the same amount. The region's average minimum temperature has risen by about 0.8°C. Temperatures are generally getting warmer, the hottest days are getting hotter, and the coldest days are becoming less cold.

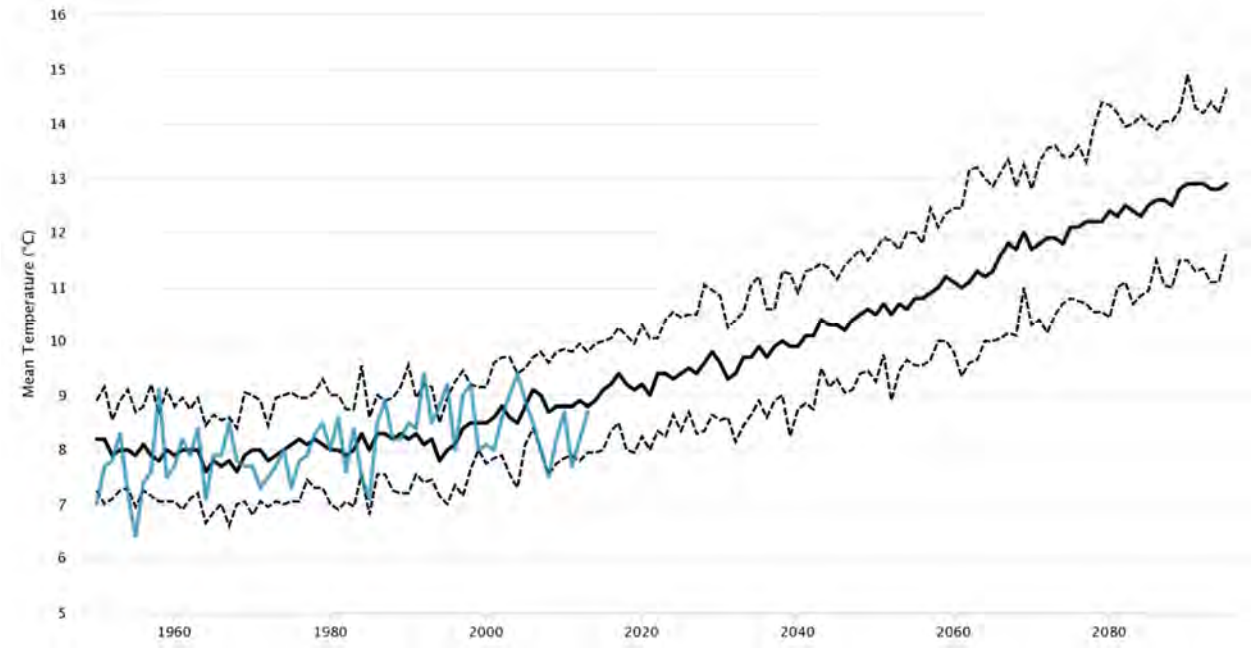


Figure 1. Historic and projected mean air temperature for the Cowichan Valley under an RCP8.5 scenario.[18]

[12] Climate Projections for the CVRD report: https://www.cvrd.bc.ca/DocumentCenter/View/81884
[13] CVRD flood mapping resources: https://cvrd.ca/3195/Flooding/#floodmapping
[14] CVRD Natural Hazard Risk Tolerance Policy: https://www.cvrd.ca/DocumentCenter/View/94625/Natural_Hazard_Risk_Tolerance_Policy
[15] CVRD Climate Change Adaptation and Risk Management Strategy: https://www.cvrd.ca/DocumentCenter/View/100254/2021-01-18-CVRD-Climate-Change-Adaptation-and-Risk-Management-Strategy
[16] Climate Projections for the CVRD report: https://www.cvrd.bc.ca/DocumentCenter/View/81884
[17] Canada Climate Atlas data for Duncan: https://climateatlas.ca/data/city/230/plus30_2030_85/line
[18] A Representative Concentration Pathway (RCP) is an atmospheric greenhouse gas concentration trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC). The pathways describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases emitted in the years to come. The RCPs – originally RCP2.6, RCP4.5,

The average date of the first fall frost is getting later in the year, while the average date of the last spring frost is occurring earlier in the year. Growing degree days are increasing. Heating degree days (days on which the outdoor temperature typically requires indoor heating) are decreasing while cooling degree days (days on which the outdoor temperature typically requires cooling) are increasing. The growing season is extending, however the risk of heat wave impacts is increasing and, consequently, air conditioning is increasingly necessary to maintain comfortable indoor spaces.

The region's average annual precipitation has not substantially changed. However, a larger fraction of precipitation arrives as rain instead of snow. Therefore, precipitation amounts during 3-5 day rainfalls show an increased trend, increasing the risk of flood events. In addition, snowpack depths are decreasing and snowpack is melting more quickly, which reduces the amount of surface water in the summer, negatively impacting agriculture, fish habitat and fire risk.

Global Trends

As the window for meaningful climate change action narrows, climate policy, energy system advances, and financing options are changing rapidly. These changes are creating new opportunities for municipalities. Examples of key trends include:

- **Governments and institutions increasingly support low or zero-carbon energy options**: Federal and state/provincial policies, as well as private institution and investment policies, are increasingly supporting and adopting low or zero-carbon energy system approaches. This facilitating the shift from fossil fuel industry subsidy and investment to support for renewable energy and conservation activities.
- **Costing carbon creates new opportunities**: There is a growing market for carbon reductions as emitting become increasingly costly via pollution pricing on fossil fuels.
- **Renewable energy is more accessible than ever**: It is becoming easier for households, businesses, governments, and small power providers to generate their own energy. Net-metering arrangements with power providers and the ease of establishing small utilities and energy resellers provide support for small-scale renewable energy projects. The costs of renewable energy technologies like wind turbines and solar photovoltaic systems keep dropping. Renewable energy system uptake is also spurred by new financing mechanisms.
- **Energy storage technologies are changing the grid**: Technologies like large lithium-ion batteries are already available for houses and businesses. Installations will increase rapidly as their costs continue to decline. Energy storage allows the use of renewable energy during peak demand times of day, which would typically draw energy from the electricity grid, which is not fossil fuel free.
- **New models of electric vehicles are increasingly available**: Electric vehicle sales are increasing quickly. EV ranges are increasing and charging options are more common, creating consumer security. As EV prices continue to decline and more models become available, EVs will increasingly displace internal combustion engine vehicles.
- **Heating systems remain a challenge, but new options are coming online**: Heat pumps continue to improve in efficiency and more models are available than ever. District energy is an efficient system for heating and cooling communities in certain applications, with the flexibility to add or subtract energy sources easily as energy technologies evolve. Heat pumps are particularly effective in mild winter climates like North Cowichan's.
- **New financing strategies are increasing participation**: Municipalities and financial institutions are offering mechanisms that reduce financial barriers to energy retrofits and renewable technologies. PACE programs are a good example. Municipalities around the world are creating innovative policies and strategies to support or engage with these trends while advancing local

RCP6, and RCP8.5 – are labelled after a possible range of radiative forcing values in the year 2100. RCP8.5 represents the high end of estimated atmospheric GHG concentrations. Figure 1 shows the aggregation of 24 climate models.

priorities such as reducing air pollution, stimulating economic development and new employment opportunities, increasing the livability of the community, and improving affordability.

The North Cowichan CAEP

North Cowichan completed the original CAEP in 2013. It inventoried the community's existing energy use and greenhouse gas (GHG) emissions and identified future trends in energy and GHG emissions. It also identified opportunities to reduce energy consumption and emissions through policy and other municipal mechanisms. Co-benefits of climate action were explored, and adaptation approaches detailed. An implementation framework was developed by municipal staff, identifying elements for successful achievement of the plan's recommendations. To date, progress has been made on many of the recommended actions. However, many of the more challenging actions have not been achieved, primarily due to the scale of the challenges as well as various local and global circumstances (e.g. energy efficiency retrofits for buildings, low-carbon transition of transportation).

One major achievement of the original CAEP was the establishment of the CAEP Reserve Fund. It facilitates funding for climate action and corporate energy projects through a 0.5% annual tax. The fund is replenished by energy cost savings realized from projects enabled by fund. Money from the fund offsets the costs of community climate action or municipal corporate energy projects, helping ensure sustainable funding sources into the future and reducing the municipality's capital budgets.

On July 17, 2019, North Cowichan council officially acknowledged the climate emergency. The direction stemming from this acknowledgement included to "look at all applicable decisions through a climate lens, including but not limited to: rewriting our Official Community Plan and reviewing the management of our municipal forests." Council approved the modelling of a CAEP emissions reduction target of 80% below 2007 levels (January 20, 2020) and passed a motion to incorporate the conclusions of CAEP update modelling in the updated OCP target of net-zero emissions by 2050 (Oct 21, 2020). More details of these motions can be found in Appendix 1.

As with the 2013 CAEP, public engagement was an important element of the CAEP Update. A live webinar session on July 27, 2020 presented the climate action modelling results and hosted discussion on climate action in North Cowichan. A question and answer document followed this and was posted to the PlaceSpeak engagement website. A survey in February 2021 focused on climate action prioritization and land use discussion. The Environmental Advisory Committee (EAC) and Council also reviewed emissions reduction actions and modelling outputs at various stages of the project. Engagement inputs informed the development of goals and actions for the CAEP Update, detailed in Section 3.

Contextual Differences Affecting the CAEP Update

The energy, emissions, and technology updates over the past several years affect the CAEP energy and emissions modelling outcomes. The following table summarizes the most important changes and comments on their effects on the CAEP Update's versus the original CAEP's "business as usual" energy and emissions scenario.

Context Summary

A variety of climate change assessment and planning work has been done at the local and regional levels over the past decade. Observations and projections indicate that local climate impacts are happening and will intensify. Local and regional plans have been made with recommended actions to mitigate and adapt to these impacts. Progress has been made on some of these actions, but many remain unfulfilled. New federal and provincial legislation and direction should bolster climate action efforts across most municipal sectors, particularly in EV uptake, existing building energy system transitions, and energy efficiency in new buildings. Global technology trends should also help, as costs and efficiencies of renewable energy technologies are increasingly favourable. The carbon pollution pricing implemented by the federal

government and supported by the provincial government will decrease fossil fuel energy system affordability in coming years, encouraging a transition to electric systems.

The energy and emissions projections for the original CAEP differ from those for the CAEP Update due to improved understanding of energy context, a more precise, inventory approach, and more realistic modelling factors. As such, the base year emissions inventory differs slightly, as do the emissions modelling outcomes to 2050. This means that some of the recommended emissions reduction actions have evolved.

Table 1: Summary of the most significant context differences between the original CAEP and the CAEP Update on the "business as usual" energy and emissions scenario.

Context Element	Original CAEP	CAEP Update
Electric vehicle uptake	New sales of hybrid vehicles and EVs were assumed to be a low.	New sales of hybrid vehicles and EVs is assumed to be increasing to 100% of total new vehicles sold by 2035.
Energy efficiency in buildings: BC Step Code	New buildings were assumed to be marginally more energy efficient every 5 years.	New homes are net zero emissions by 2030.
Total building stock	An estimated 5,000 to 7,000 homes by 2050.	3,700 additional homes are considered. (as per Rennie Intelligence Report and OCP modeling)
New housing distribution	• 20% to James/Alexander • 25% to Gibbins/Prevost • 15% to Chemainus • 10% to Crofton • 10% to south of Quamichan Lake • 5% to Maple Bay • 15% distributed over rural areas	• 10% to Chemainus • 6% to Crofton • 22% University Village • 32% South End - West • 30% South End - East (as per 2021 OCP work)
Emissions inventory approach	A non-standardized emissions approach was used, inventorying emissions across these sectors: • Buildings • Transportation • Energy generation • Agriculture and food • Some industrial (major industrial omitted)	The Global Protocol for Community-scale Greenhouse Gas Emissions Inventories (GPC) was used, standardizing the inventory approach for consistency with global jurisdictions. The emissions inventory follows a BASIC+ designation, which includes scopes 1 and 2 emissions, as well as scope 3waste and energy transmission emissions (Figure 3).
Modelling approach	GHGProof spreadsheet model	CityInSight software model (described below)

Electric Vehicle Uptake Outlook Implications

Actions to decrease vehicle trips in the original CAEP resulted in large emissions reductions. As the total vehicle stock turns over to low and zero emissions vehicles, however, the emissions reduction potential of reducing vehicle trips is all but eliminated by 2050 in the CAEP Update. There are, of course, many other benefits to transitioning transportation to active and transit modes.

New Housing Energy Efficiency Direction Implications

Fewer new homes than previously anticipated and increasingly stringent energy efficiency requirements under the Step Code mean that emissions from new buildings are minimized.

Currently and by 2050, the majority of total buildings emissions are produced by building stock extant in 2020.

Land Use Considerations Implications

As vehicles electrify and new buildings are increasingly energy efficient, emissions from new transportation and building energy use activities wanes. Under 2013 CAEP assumptions housing distribution had a large transportation and buildings emissions impact. The contextual change in energy use in these sectors means that the emissions difference between distributed and concentrated housing is much smaller than previous projections indicated.

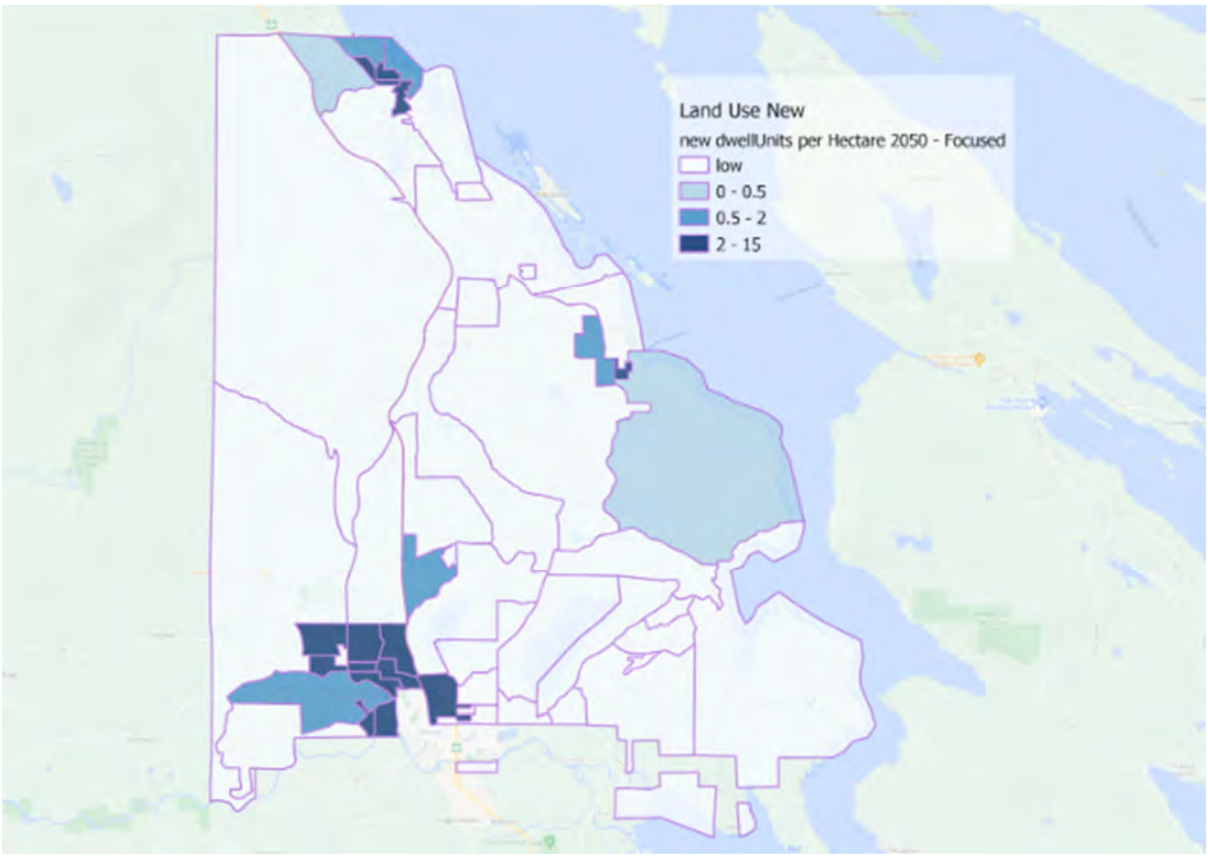


Figure 2: CAEP Update new housing distribution, based on 2021 OCP work. Note that houses are not equally distributed throughout the polygons. Polygon overlap with the Urban Containment Boundary does not necessarily imply new homes will be developed in these areas.

Emissions Inventory Approach Implications

The GPC Protocol is a standardized emissions inventory approach for communities, ensuring consistency, transparency, and replicability. Emissions sectors and emissions-producing activities are well-defined. The BASIC+ level of GPC used for the CAEP Update includes all emissions sources inside the municipal boundary, as well as some from activities occurring outside the boundary for which North Cowichan residents, visitors, and commuters are responsible. Thus, the BASIC+ emissions inventory includes scope 1 emissions from stationary energy (primarily buildings), transportation, waste, industrial processes and product use, agriculture, forestry, and other land use, as well as scope 3 emissions from transboundary transportation, waste, and energy transmission and distribution.

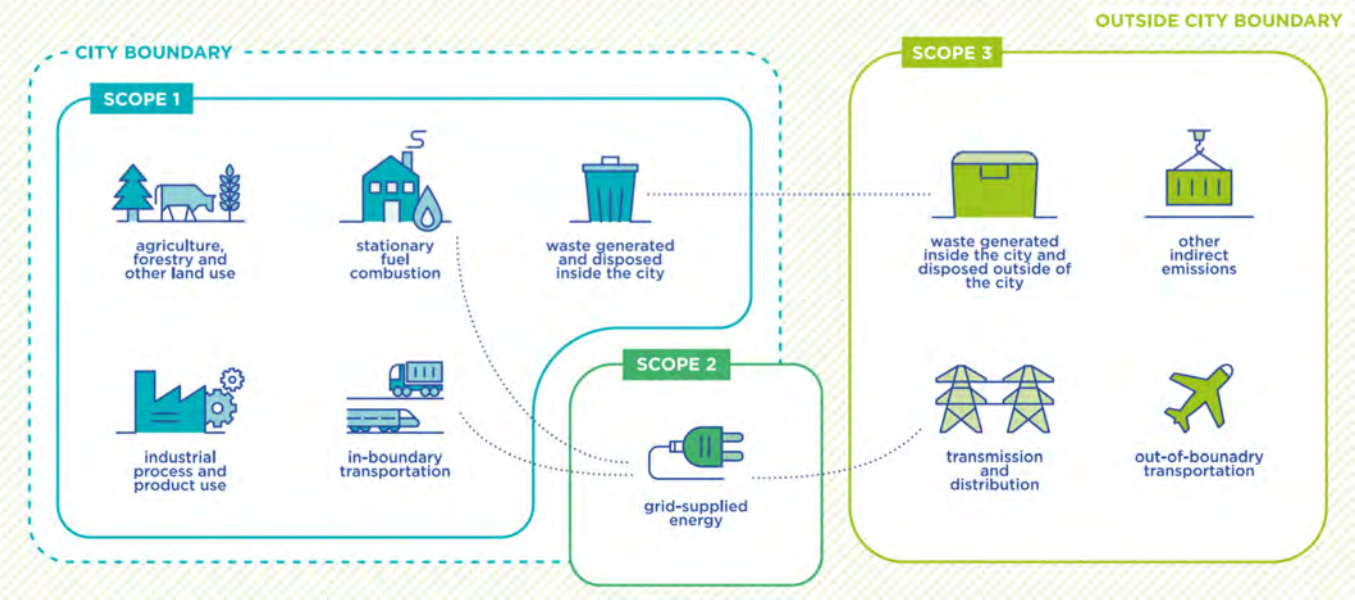


Figure 3: Emissions scopes as they relate to geographic and inventory boundaries.[19]

Table 2: Key emissions inventory similarities and differences between the CAEP and CAEP Update.

Inventory Element	CAEP	CAEP Update
Building energy use	✓	✓
Energy generation and use	✓	✓
Local transportation	✓	✓
Transboundary transportation	✓	✓
Industrial processes		✓
Catalyst mill		
Imported food	✓	
Solid and liquid waste	✓	✓
Agriculture	✓	✓
Forests	✓	✓

The Catalyst mill in Crofton has been excluded from North Cowichan emissions inventories because it is considered a large emitter (>10,000 tCO_2e/year) and reports to the province under the Greenhouse Gas Industrial Reporting and Control Act. Under this arrangement, the mill's emissions are governed by the province. Also, if the mill's emissions were included in the CAEP inventories, their comparable size would dwarf the emissions across all other sectors, making data visualizations challenging.

Updated Modelling Approach Implications

The original CAEP energy, emissions, and finances modelling used GHGProof – a spreadsheet model developed by Sustainability Solutions Group (SSG) in the early 2000s. In 2015, GHGProof was updated by SSG and WhatIf? technologies to a more sophisticated and comprehensive software model – CityInSight. CityInSight incorporates the GPC Protocol and includes important emissions modelling and assessment elements, such as relationships and feedback loops that accurately account for emissions reductions effects between actions that have bearing on one another.

[19] Image source: Consumption-Based Inventories of C40 Cities. https://www.c40.org/researches/consumption-based-emissions

BC Electricity Grid Emissions

Emissions resulting from electricity generation in BC are very low. Over 91% of electricity generation is from hydroelectric stations.[20] At the time of modelling for the CAEP Update, the grid emissions factor was reported as 10.67 grams per kWh. Under the new CleanBC Plan Roadmap, electricity delivery is slated to be net-zero emissions by 2030.[21] This makes the argument for new renewable electricity generation installations (e.g. solar PV, wind turbines) weak, from an emissions reduction perspective.

[20] Canada Energy Regulator Provincial and Territorial Energy Profiles – British Columbia: https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-british-columbia.html
[21] Clean BC Roadmap, p.8: https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

PART 2: North Cowichan's Energy and Emissions Future

To determine the actions needed to reach North Cowichan's emissions reduction targets, we need to understand what the emissions profile of the community is expected to be over the next few decades, to the target year of 2050. This requires the base year inventory, modelling a business as usual (BAU) reference scenario, and modelling of a low-carbon scenario (LCS) alternative in which actions are taken to achieve the emissions reduction target of 80% below base year emissions by 2050, which was approved by North Cowichan Council on 20 Jan 2020.

The emissions inventory provides the current, base year catalogue of energy using activities and their resulting emissions across the community. It describes where energy is currently sourced and how it is used, as well as the GHG emissions associated with its use. North Cowichan has two base years: 2007 and 2016. 2007 was used in the 2013 CAEP and is the benchmark year for emissions reduction targets. 2016 is the base year against which the new modelling is calibrated, as 2016 has more complete data sets for the updated modelling approach. Most of the data presented in this report uses 2016 as the baseline year. North Cowichan's 2016 GPC base year emissions report is in Appendix 2 and is included in the modelled scenario graphs (i.e. year 2016 data).

Scenario modelling provides the likely energy and emissions outlooks over the next 30 years, given certain assumptions across the buildings, transportation, energy, industry, land use, forestry, agriculture, and waste sectors.

The BAU scenario forecasts the community's expected energy use and GHG emissions profile year-over-year until 2050. The BAU assumes no major emissions reduction interventions are introduced beyond what are currently expected.

The LCS models potential emissions reduction actions that can be taken in each sector of the community to reach North Cowichan's 2050 emissions reduction target. Each action is defined by a set of assumptions and is modelled year-over-year until 2050. The following sections present the supporting ideas for the development of actions considered in the LCS.

Charting the CAEP Emissions Reductions Pathway

Lowering North Cowichan's emissions requires reducing energy use, shifting to improved, low-carbon energy sources, and switching to renewable sources. Electricity can be produced in many ways, providing flexibility in how energy is generated, delivered, stored, and used. Because the majority of North Cowichan's electricity is from hydro power, a power grid of renewable energy is already in place.

Three key concepts are used in the CAEP Update to help chart the emissions reduction pathway:

- The Reduce-Improve-Switch paradigm;
- Community energy planning; and
- Infrastructure, mechanical, and energy systems turnover.

The Reduce-Improve-Switch Paradigm

Low-carbon community planning considers a wide variety of actions in the transportation, buildings, industrial activity, energy use and generation, waste, and land-use. The actions can be classified under one or more categories of Reduce, Improve, and Switch: reducing energy consumption, improving the efficiency of the energy system (supply and demand), and fuel switching to low or zero carbon renewable sources.

The most effective approach in transitioning to a low-carbon future is to first reduce the amount of energy needed as much as possible through energy efficiency and conservation, and then to switch to low carbon fuel sources to supply the remaining demand. The sequence of the approach is important: by avoiding energy consumption (Reduce), retrofit requirements (Improve), and the need to generate renewable energy (Switch) are both also reduced.

Table 3. Sample Reduce-Improve-Switch actions.

	Buildings	Transportation	Waste
REDUCE Reduce energy use and optimize energy demand.	Build efficient andlow-carbon new buildings.	Build compact, complete communities andtransit-oriented development.	Implement strategies to prevent the creation of waste.
IMPROVE Increase energyuse efficiency.	Upgrade to energyefficient lighting systems. Perform energy retrofits forexisting buildings.	Improve vehicle fuel efficiency.	Improve the efficiency of waste collectionpractices.
SWITCH Shift to low carbon energysources.	Source energy from renewablesources.	Switch to electric vehicles that are supplied by renewable energy sources.	Collect landfill fugitive emissions for useas renewable natural gas.

Community Energy Planning Prioritization

The actions can also be categorized broadly as applying to new infrastructure or existing infrastructure. Infrastructure is the priority in community energy planning as it locks communities into usage patterns for decades. The second planning goal should be to address industrial processes, transportation modes, and building design. The final planning goal is making energy-using equipment efficient. This prioritization helps to focus the number of actions required as well as their relative cost.

Infrastructure, Mechanical, and Energy Systems Turnover

There are cyclical opportunities to address existing infrastructure, such as the natural transition at the end of an appliance's serviceable life, between now and 2050. Different types of infrastructure have different degrees of longevity, for example building HVAC systems (moderate longevity) versus their envelopes (high longevity).

Increased energy efficiency can be realized by investing in appropriate upgrades during cycles of infrastructure maintenance and renewal. For example, as natural gas boilers in homes become aged, they can be conveniently replaced with heat pump systems.

Low-carbon Scenario Actions

Through the consideration of these paradigms and through technical analysis, research, and public, stakeholder, and City staff input, dozens of energy and emissions actions were identified for the LCS modelling. The actions are grouped into seven categories:

1. **Compact, complete communities.** Historical development patterns have led to high energy use and high emissions lifestyles. Although the emissions reduction argument for new, densified development with low emissions vehicles is not as strong as it was under high fossil fuel use, there are still some emissions to be avoided by developing compact, complete communities (i.e. some

emissions are still saved by shifting vehicle trips to active transportation trips, multi-unit buildings are still typically more energy efficient per unit than single homes).

2. **Efficient buildings.** Deep energy efficiency retrofits to all buildings in the community and ensuring that new buildings have superior energy standards decreases energy use and costs.
3. **Low-carbon transportation.** Vehicle electrification, increasing and improving public transit services, and making more trips by walking, cycling and other means of active transportation can eliminate most transportation emissions.
4. **Local renewable energy generation.** Solar PV on new buildings and renewable natural gas (RNG) capture from composting and wastewater treatment facilities produce renewable power locally and reduce transmission losses.
5. **Renewable energy procurement.** To reduce natural gas use, the introduction of hydrogen and RNG to natural gas lines will likely be needed.
6. **Efficient water and waste.** Education and incentive programs coupled with upgrades to the water distribution, wastewater treatment, and solid waste diversion systems aim to achieve energy efficiencies and emissions reductions in these sectors. Emissions in this sector are already low in North Cowichan.
7. **Low-carbon industry, agriculture, and forestry.** Local industries are already researching options for increasing energy efficiency and decreasing energy costs. Vehicle electrification and increasing the efficiency of industrial processes will achieve emissions reductions while benefitting the industrial bottom line. Afforestation and improved management practices in the municipal forest reserve and urban forest can sequester carbon and help bridge the emissions gap remaining after Reduce-Improve-Switch actions have been taken.

Actions in all categories are needed to achieve the 80% emissions reduction by 2050 target. Table 4 summarizes the modelling assumption of these actions.

Table 4: BAU and LCS actions modelling assumptions.

	Business as Usual Scenario	Low-carbon Scenario
DEMOGRAPHICS		
Population Employment	29,676 (2016) – 39,470 (2050) 31,618 (2016) – 43,576 (2050)	
Households Vehicles	12,686 (2016) – 13,340 (2050) 19,400 (2016) – 17,600 (2050)	
COMPLETE, COMPACT COMMUNITIES		
Homes distribution	Follow current trends.	As indicated in Table 1.
Dwelling size	Current average dwelling size maintained.	Decrease the average dwelling size by 20% by 2050 as more multifamily buildings are built.
Building type mix	The mix of new building types reflect the current mix.	Decrease the share of new buildings that are single family homes to 10% by 2050.
EFFICIENT BUILDINGS		
New residential	Follow BC Step Code: 2022: 20% more energy efficient as compared to 2018 BC Building Code 2027: 40% more energy efficient 2032: 80% more energy efficient–net-zero energy ready	
New commercial	Follow BC Step Code.	
Retrofit homes	No retrofits.	Achieve 50% thermal and 50% electrical savings in all existing dwellings by 2040.
Retrofit ICI buildings	No retrofits.	Achieve 50% thermal and 50% electrical savings in all existing ICI buildings by 2040.
Retrofit municipal buildings	Current efficiencies held constant.	100% of existing municipal buildings are retrofit to net zero emissions by 2030.
Heat pump installations	Current instances are extrapolated.	100% of buildings' space heating and cooling is met by electric systems by 2050.
Electric water heater installations	Current instances are extrapolated.	100% of buildings' water heating needs are met by electric systems by 2050.
LOW-CARBON TRANSPORTATION		
Expand transit	Follows BC Transit planning.	Transit mode share is 25% by 2050.
Electrify transit	Follows BC Transit planning	100% EVs by 2030.
Municipal fleet	No action.	100% EVs by 2030.
Cycling, walking, and rolling infrastructure	Mode shares held current.	35% of trips are Active by 2050.
Electric vehicles	8% of new vehicle sales are EVs by 2030.	100% of all new vehicle sales are EVs by 2035.
Electric commercial vehicles	Current mix held constant.	100% of all new vehicle sales are EVs by 2040.
LOCAL RENEWABLE ENERGY GENERATION		

Solar PV net metering	Current instances of solar PV use held constant.	By 2030, 100% of new buildings have solar PV installed, providing at least 10% of the buildings' electric demand.
District energy	Current instances of DE held constant.	New DE system added in the University Village/Civic Arena area.
Renewable natural gas	None.	New anaerobic digestion facilities capture biogas from wastewater and compost.
RENEWABLE ENERGY PROCUREMENT		
Renewable Natural Gas (RNG)	None.	Replace 50% of post-efficiency measures natural gas with RNG by 2050.
Hydrogen	None.	Replace natural gas use with hydrogen: +15% by 2030, +50% by 2050. Focus on industry.
EFFICIENT WATER AND WASTE		
Increase water pumping efficiency	Current intensity held constant.	Decrease energy used in pumping by 2%/year to 2050.
Increase water use efficiency	Current intensity held constant.	Decrease water volume use by 2%/year to 2050.
Waste diversion	Baseline generation and diversion rates extrapolated. 100% landfill gas capture already in place.	90% of residential and ICI waste diverted by 2050. 95% of organic waste diversion by 2030.
LOW-CARBON INDUSTRY, AGRICULTURE, AND FORESTRY		
Industrial processes	No change to current efficiencies.	Increase efficiency by 50% by 2050.
Agricultural practices	No change from current practices (agricultural buildings and transportation actions are included in those sectors).	
Carbon capture and storage	Maintain current Municipal Forest Reserve practices.	High sequestration forest management strategy adopted to absorb 20,000t/year.

The BAU emissions trends and LCS actions were modelled in CityInSight, a sophisticated energy, emissions, land use, and finances model. The following sections detail the modelling outcomes.

Energy Outlook

Total and Per Capita Energy Demand

Total community energy use includes all energy used by buildings, transportation, and infrastructure. Under the BAU scenario, energy use is expected to increase by only 2% by 2050 (Figure 4) from 2016. Despite the expected increase in population from ~30,000 to ~40,000, expected energy efficiency advances in new buildings, fuel efficiencies, electrification of vehicles (electricity is more efficient than gasoline), and reduced building heating demand due to decreased heating degree days temper the increase.

The actions modelled in the LCS reduce energy use 33% from the base year. Despite increasing population, more homes, and more vehicles, energy efficiency efforts are very successful in reducing overall energy demand. In 2050, total energy use across the community is 35% less in the LCS than in the BAU. This means that household energy costs and costly upgrades that may be required to the grid to meet increased electricity demand are mitigated.

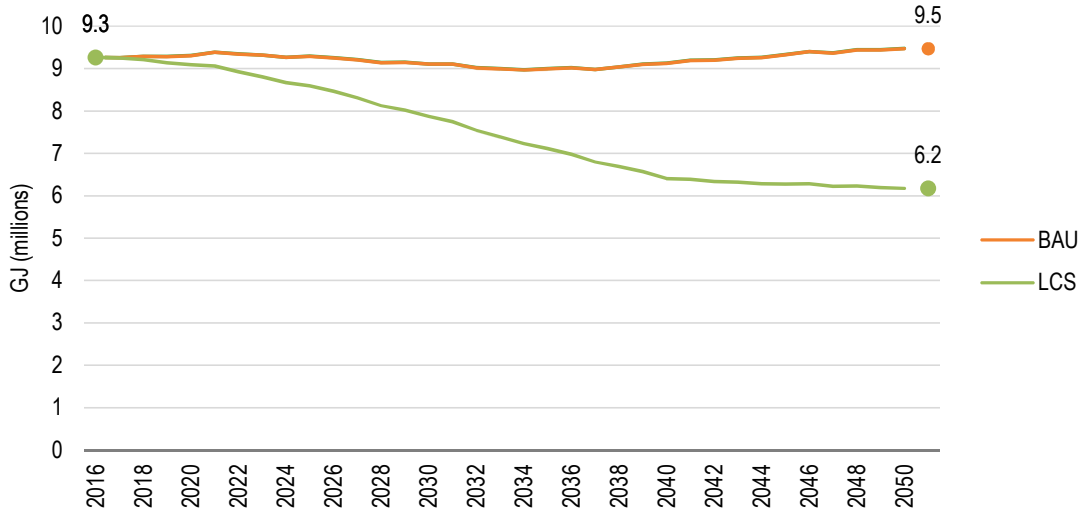


Figure 4: BAU and LCS total community energy use, 2016-2050.

North Cowichan's expected population growth paired with increases in energy efficiency and, in the LCS case, decreased total energy use, result in decreased per capita energy use in both scenarios (Figure 5). In both cases, households and businesses are reducing their total annual energy use but in the LCS by much more.

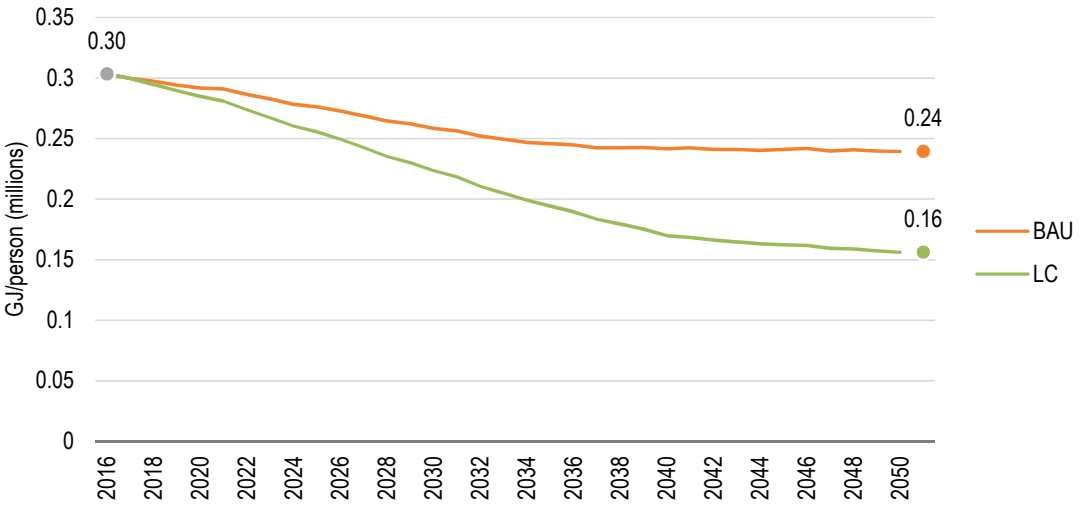


Figure 5: BAU and LCS per capita energy use, 2016-2050.

Where Energy is Used

Small scale industrial operations remain the largest energy user in North Cowichan. Industrial businesses are expected to grow but overall processes are expected to become more efficient, driven in part by higher energy prices and regulations from federal and provincial agencies. Although industrial process and buildings energy use decreases 23% by 2050, they account for 73% of total energy use in that year.

Transportation energy use decreases substantially as vehicles electrify in the LCS – electricity use in motors is far more efficient than fuel use. Total transportation energy use decreases 67% by 2050.

Despite housing growth, the energy efficiency of new homes and decreased energy use in existing homes thanks to energy efficiency retrofits and switching from fossil fuel and electric baseboard heating to heat pumps decreases total residential energy use 44% by 2050. Commercial buildings' total energy use is decreased by 27%. Energy use in the agricultural sector decreases 33% as buildings are retrofit and increasingly use heat pumps, and some vehicles electrify.

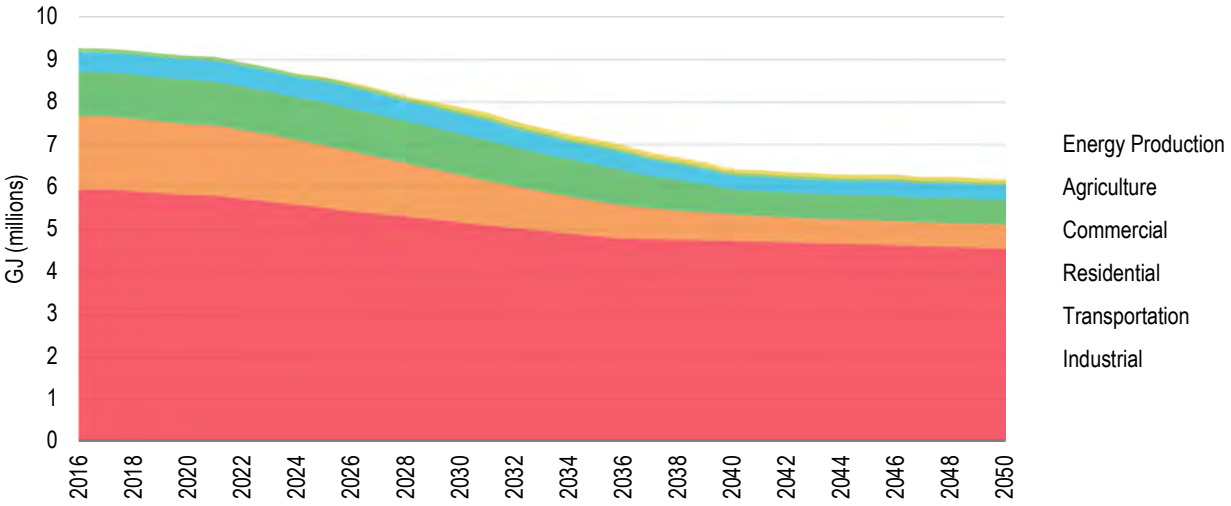


Figure 6: LCS total energy use by sector, 2016-2050.

Where Energy Comes From

Actions in the LCS phase out fossil fuel use across all sectors, replacing most of it with grid electricity. Grid electricity provides 60% of total energy used across the community in 2050. Solar PV energy generation on new buildings is responsible for supplying 1% of total energy used in 2050. The new district energy system in University Village is responsible for generating another 1% of total.

Renewable natural gas (RNG) and hydrogen displace natural gas use in buildings and make up 8% and 15% of the total energy supply in 2050, respectively. Natural gas is still used to meet 8% of total energy demand in 2050, explicitly in the industrial sector.

Gasoline is all but eliminated by 2050 as vehicles electrify. Although reduced by 60% between 2016 and 2050, there is still some diesel use as heavy duty and freight vehicles are slower to electrify.

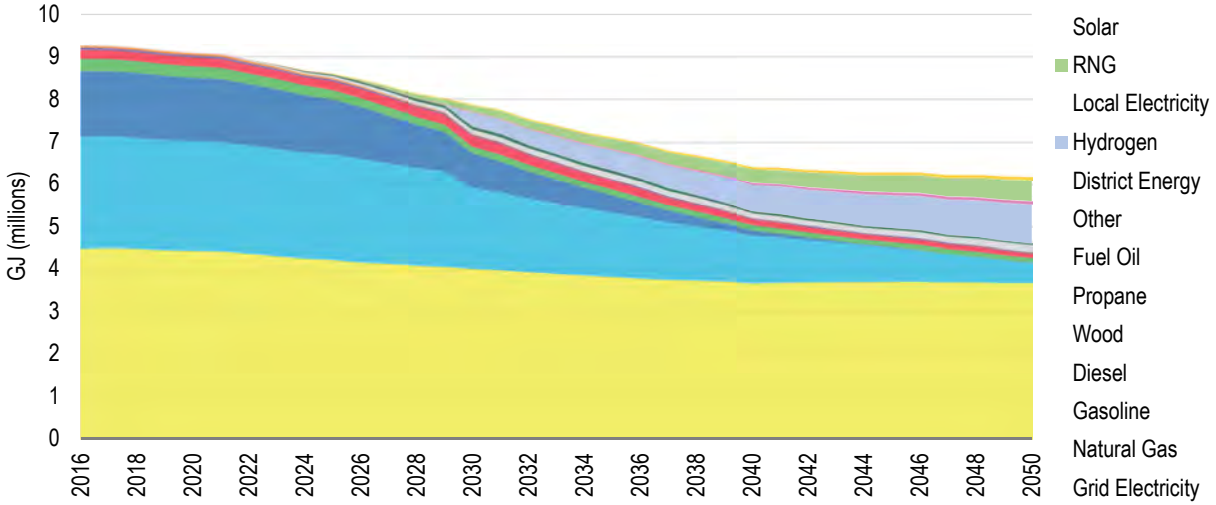


Figure 7: Energy by source under LCS implementation, 2016-2050.

How Energy is Used

Industrial processes (not including industrial building energy use) account for 64% of total energy end use in 2050. Transportation accounts for 9% of total. Due to decreased heating demand in the warming winters and large increases in space heating energy efficiency through heat pumps, space heating energy use is cut in half by 2050 and accounts for 11% of total energy use by 2050.

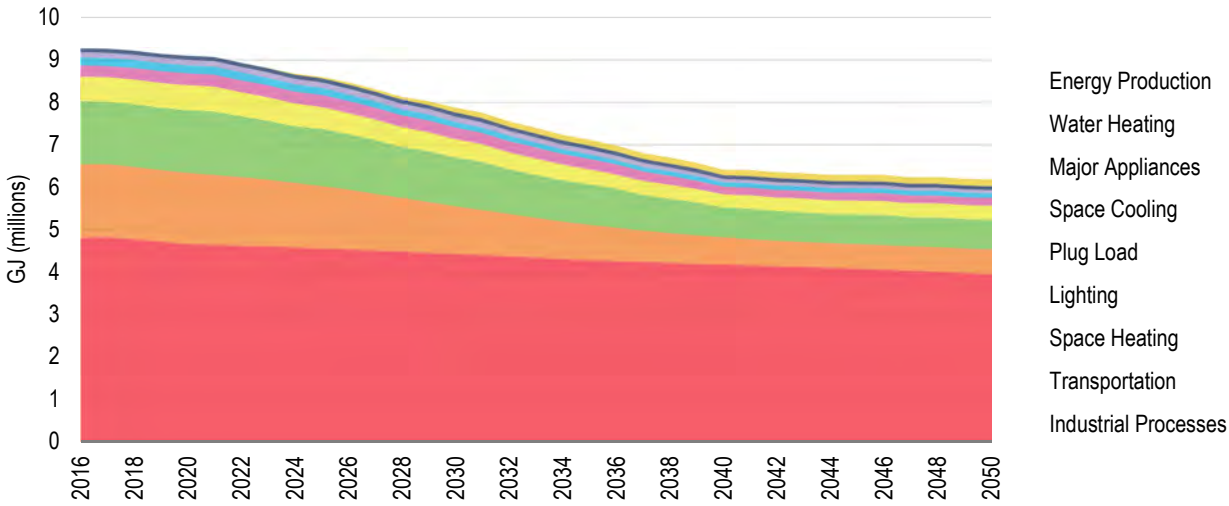


Figure 8: LCS energy use by end use, 2016-2050.

Energy Outlook Summary

North Cowichan's energy mix changes dramatically over the next 30 years under LCS implementation. As vehicles electrify, the transportation sector shifts almost completely off fossil fuels – the most dramatic shift across all sectors. Although the demand for electricity increases substantially as building heating systems, water heaters, and vehicles shift from fossil fuels, the energy efficiency of electric vehicle motors and heat pumps (typically 300%-500% more efficient than baseboard heaters) actually reduce overall grid electricity demand. Solar PV systems on new buildings help by providing substantial electricity supply for those buildings' energy demand. Hydrogen and RNG help make the shift away from natural gas, supplying some heating demand and industrial processes where electric applications are challenging. LCS actions achieve their goal: reducing total energy demand and eliminating fossil fuel use.

Emissions Outlook

Total and Per Capita Emissions

As energy sources shift to renewables and energy demand is decreased under LCS implementation, GHG emissions decline. Whereas emissions do not vary substantially in the BAU scenario, LCS implementation will achieve 80% emissions reduction under 2007 levels by 2050 in North Cowichan.

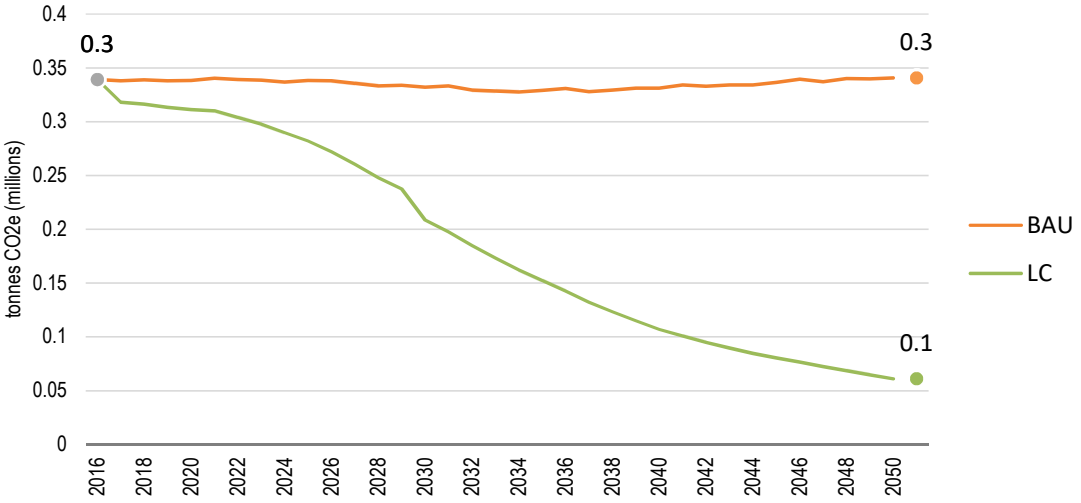


Figure 9: BAU and LCS modelled GHG emissions, 2016-2050.

Although per capita emissions are dropping substantially in the BAU, the drop in the LCS is much greater. In 2050, 1.5 tonnes per person per year is well below the current Canadian per capita emissions average of over 19 tonnes/year.

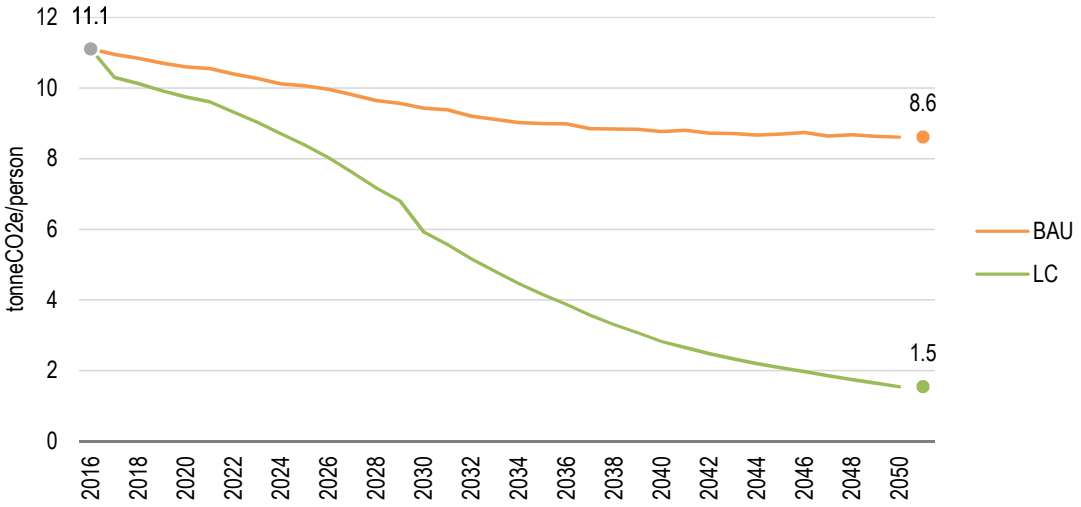


Figure 10: BAU and LCS per capita emissions, 2016-2050.

Where Emissions Come From

Community-wide GHG emissions are 339,000 tCO_2e in 2016. LCS action implementation reduces emissions over 82% compared to these levels, and 80% compared to 2007 levels. This includes 20,000

tonnes of carbon sequestration by the municipal forest reserve (shown below the horizontal axis in Figure 11). 61,000 tCO_2e remains in 2050.

Although much energy is still in demand from the industrial sector (41% of total), industrial emissions are reduced 74% by 2050. Emissions in the transportation sector see an even greater reduction of 95%, with some emissions remaining from diesel vehicles and a slight amount from grid electricity used to charge EVs. Emissions from residential and commercial buildings are reduced by 91% and 94%, respectively.

The waste treatment facility in Washington State responsible for the disposal of North Cowichan's garbage uses a landfill gas capture system, thus the community's emissions from waste are never substantial. Emissions from trucks and trains used to transport solid waste to the facility are captured under the transportation sector.

The agricultural sector sees only a modest 15% emissions reduction, primarily due to building energy efficiency and some vehicle electrification. By 2050, the sector is responsible for 44% of remaining emissions, primarily due to heavy duty vehicle use and emissions from livestock.

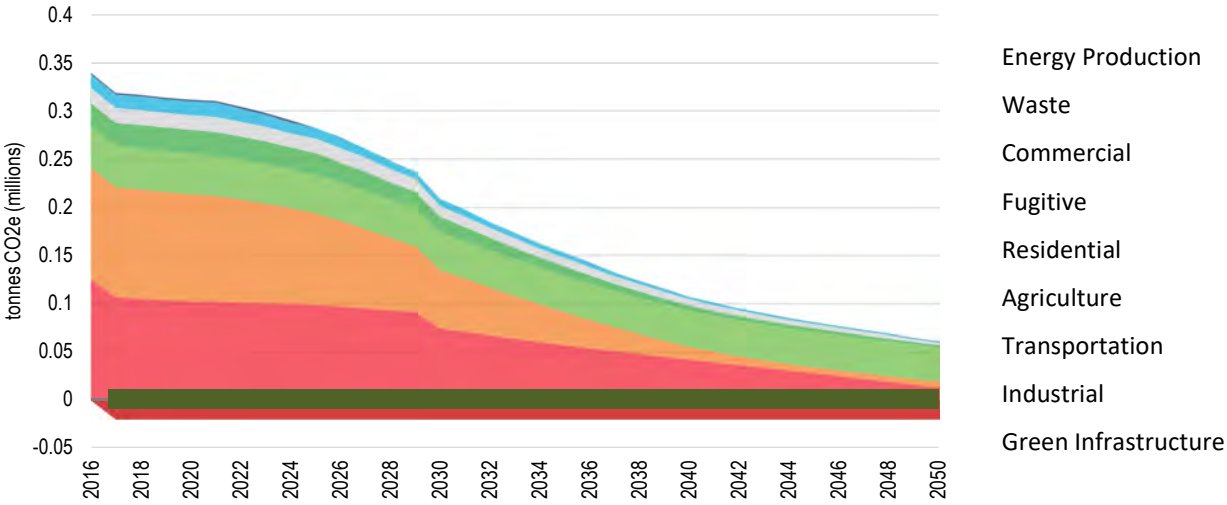


Figure 11: LCS emissions by sector, 2016-2050.

Emissions by Fuel Type

Fossil fuel emissions are effectively phased out by 2050, with only some industrial natural gas use, some diesel used in heavy vehicles, and a portion of grid electricity imported from fossil fuel fired electricity generation plants in Alberta making up the remaining emissions from fuels. "Non energy" emissions remain from the agricultural sector.

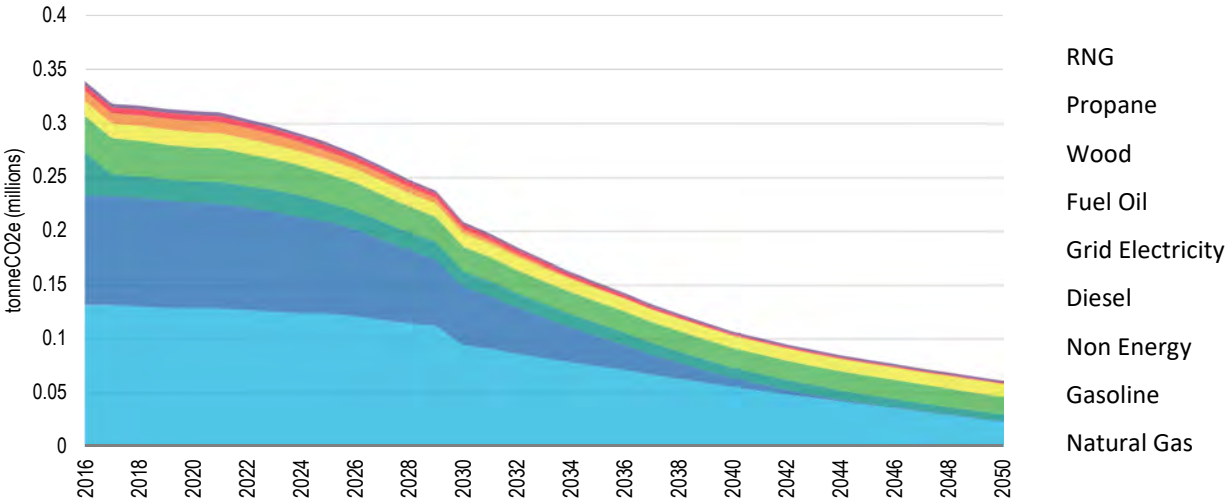


Figure 12: LCS emissions by fuel source, 2016-2050.

Future Development and Emissions

The original CAEP focused on densifying future development in the previously built-up areas of North Cowichan to achieve greater energy efficiencies in homes (i.e. multi-unit homes are typically more efficient than single detached) and decreases in vehicle trip numbers and distances travelled. The original CAEP also assumed that embedded emissions in food products were a substantial portion of transportation emissions. Therefore, it recommended increased local agricultural production to lower emissions. However, these emissions are not accommodated in the updated, GPC-standardized community emissions inventories methods. While local agriculture will remain one aspect of lowering North Cowichan's emissions and increasing food security it does not have as large an effect on transportation emissions as previously understood.

Three growth scenarios considered in the 2021 OCP update were modelled to determine the scale of emissions difference between them. The BAU scenario has the same assumptions as the BAU detailed already in this document. The Centre scenario distributes homes primarily to the areas near Duncan as well as to Crofton and Chemainus. The Focused scenario concentrates most development in the areas near Duncan, with the rest going to Crofton and Chemainus. None of the scenarios assume absolutely no development anywhere else. The scattered development of some new homes is included in all three scenarios. Table 5 and Figure 13 summarize the housing distribution and neighbourhood designations.

Table 5: Percent distribution of new homes for three growth scenarios.

Area	**BAU**	**Focused**	**Centre**
Chemainus	10	10	10
Crofton	6	6	10
University Village/Bell McKinnon/Somenos Rd (North of Hwy 18)	22	22	80
South End – West	32	32	
South End – East (Quamichan Lake, Maple Bay)	30	30	

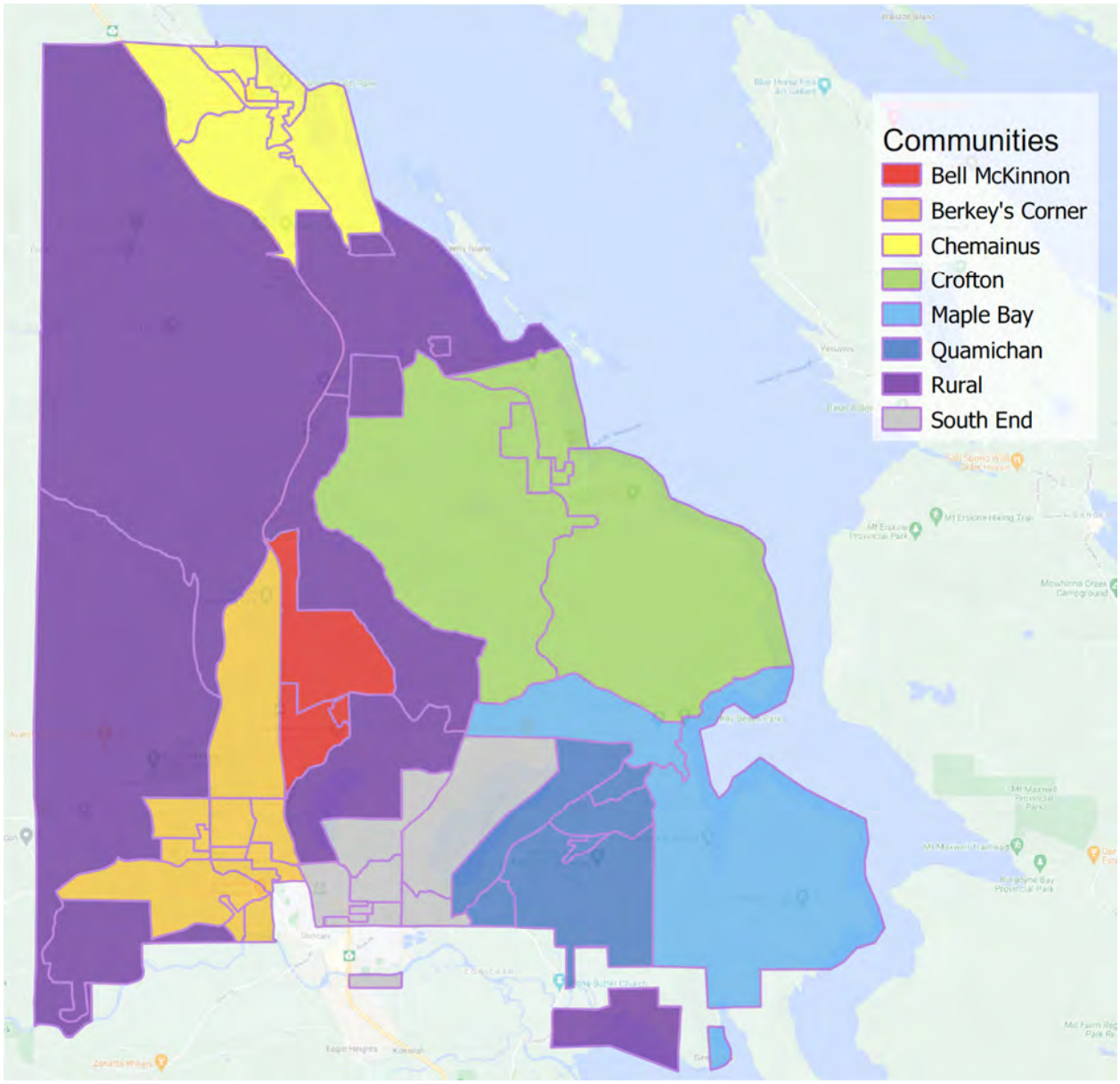


Figure 13: Association of modelling areas (polygons) with North Cowichan neighbourhoods. Statistics Canada community polygons were used as they provide an ability to reproduce data and link census data to different neighborhoods. These polygons were grouped together to best match the neighborhoods used in the 2021 Official Community Plan growth modelling scenarios

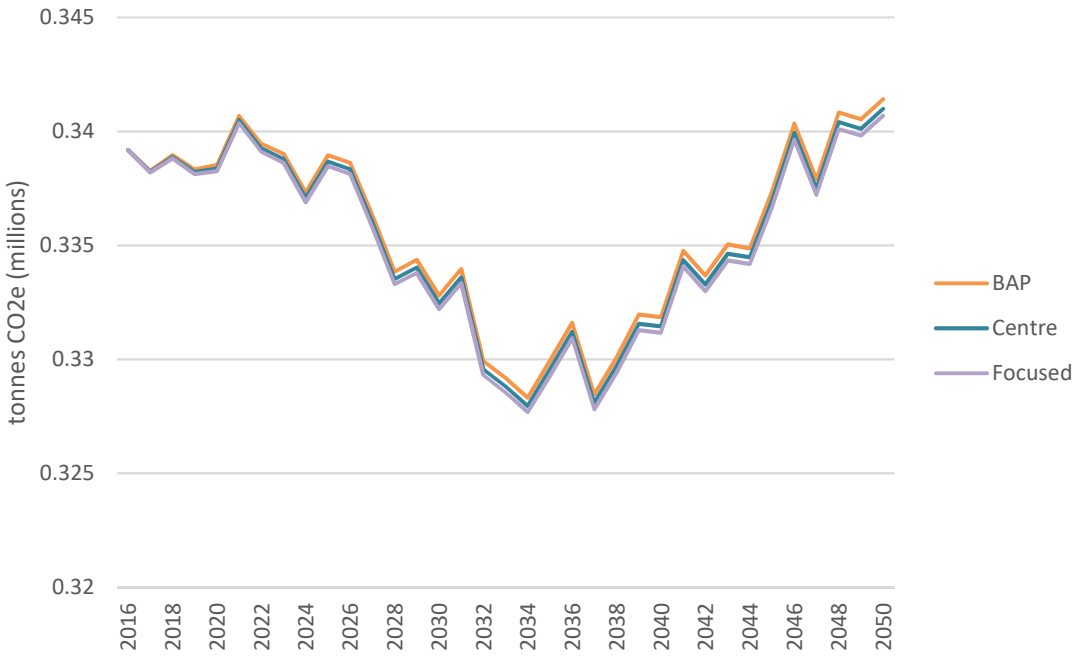


Figure 14: Detail of the emissions difference between three 2021 OCP development scenarios, 2016-2050. (vertical axis between 320,000 and 345,000 tCO_2e).

The emissions difference between scenarios is small. As compared to the BAU growth scenario:

- The Centre growth scenario saves 7,176 tCO_2e (2,655 tCO_2e for transportation only) cumulatively between 2016-2050.
- The Focus growth scenario saves 18,948 tCO_2e (10,551 tCO_2e for transportation only) cumulatively between 2016-2050.
- In the year 2050 alone, there is less than 1,000 tCO_2e difference between the scenarios.

North Cowichan can save almost 20,000 tCO_2e over the next 30 years if the Focus scenario is chosen – about 6% of total 2016 emissions. This is equivalent to taking about 6,000 cars off the road over the next 30 years.

Two additional reasons why the total emissions differences between the scenarios aren't greater:

- The number of homes being added is very small compared to the existing building stock. Existing stock is less efficient and responsible for far greater emissions than new homes will be.
- The transportation patterns resulting from new homes are responsible for few emissions compared to existing trips made, especially as vehicles electrify. For those trips that are to Victoria and Nanaimo, the relative placement of new homes in North Cowichan has only a small bearing on the emissions of these trips.

In the absence of strong emissions reductions between different growth scenarios, there are still, of course, many reasons to develop complete, compact communities, including:

- Improved social and public health well-being;
- Local economic benefits of housing and amenity proximity;
- Environment and habitat conservation (plus the carbon sequestration value of trees); and
- Reduced infrastructure construction and (especially) maintenance costs.

Emissions Outlook Summary

LCS actions effectively phase out emissions from fossil fuels. The transportation and industrial sectors see the greatest shifts while emissions from waste are already minimized through current treatment practices. The difficulty in transitioning high-heat industrial processes off natural gas is evident in the remaining emissions in 2050. Without eliminating livestock, agricultural emissions will remain an issue. The electricity grid poses a surprising challenge in 2050, accounting for a large proportion of remaining emissions, despite the province's nearly clean electricity grid.

PART 3: Actions for a Low-carbon Future

The low-carbon scenario actions modelled demonstrate North Cowichan can achieve 80% emissions reductions by 2050. The modelling exercise also demonstrates how net-zero emissions by 2050 can be achieved. Energy efficiency and energy switching actions can be scaled up in ambition, minimizing energy demand and supplying remaining demand for fossil fuels with RNG, hydrogen, and renewable electricity. Recent announcements from the government of BC to have a net-zero electricity grid by 2030 are encouraging and will help North Cowichan achieve its targets.

Through the consistent, sustained implementation of emissions reducing actions, policies, and measures, North Cowichan can help mitigate climate change impacts while producing a higher quality of life for residents. The following explores some of the considerations of the low-carbon actions.

Compact, Complete Communities Actions

Goal 1: Achieve energy efficiency and emissions reductions by creating compact, complete communities through infill developments, decreasing dwelling size through an increase in multi-unit buildings, and increasing building type mix.

Primary Action: Coordinate land-use development through the Official Community Plan and Transportation Master Plan to direct land-use development in achieving compact, complete communities.

Discussion

As mentioned previously, the emissions reduction argument for densified future housing growth is not as strong as it once was under a more fossil fuel intensive context. However, there are still some emissions to be avoided – and improvements to quality of life to be achieved – with well-considered land use planning. Land use and transportation planning should include considerations such as:

- A focus on infill development in built-up areas and minimizing rural area development;
- Increasing minimum housing densities;
- Transportation oriented development approaches to coordinate transit and active transportation options with development densities;
- A focus on mixed-use and multi-unit buildings to increase building energy efficiency and provide population density to support neighbourhood services and amenities; and
- Green space and urban forestry requirements for developments and community spaces to increase carbon sequestration capacity and quality of place.

Efficient Buildings Actions

Goal 2: Decrease the potential emissions of new buildings.

Primary Action: Periodically increase the energy efficiency of new buildings using Step Code mechanics until all new buildings in 2030 onward are net-zero emissions

Discussion

The Step Code clearly establishes the path to energy efficient and fossil fuel free buildings. Using the thermal energy demand intensity targets (TEDI) and mechanical energy use intensity (MEUI) targets of the Step Code are the preferred path to using the standard (the energy use reduction as compared to comparable base building is too vague an approach to achieve the same TEDI and MEUI outcomes).

For new Part 3 and Part 9 Buildings, the following is targeted by 2030 at the latest:

- All new buildings are constructed to net-zero GHG emissions standards by performing at or better than an MEUI of 30 kWh/(m2·year) and TEDI of 15 kWh/(m2·year).
- All new buildings have at least 10% of their electricity produced on-site by solar PV systems.
- Efficient fixtures and irrigation achieve a 30% reduction in water use compared to typical base building of the same type, floor area, and occupancy.

Ideally new buildings are built to achieve these targets as soon as possible. New construction must avoid connecting to natural gas systems in order to achieve North Cowichan's emissions reduction targets.

Goal 3: The existing building stock is retrofit for 50% increased energy efficiency by 2040 and large buildings are routinely recommissioned.

Primary Action: Develop a municipally-led deep energy efficiency and heating systems retrofits program.

Discussion

Retrofitting all pre-2022 homes – with a primary focus on pre-1980 homes - will be a monumental undertaking. A strong program focused on energy efficiency retrofits could involve partnerships with Provincial and Federal governments, utilities, industry, and higher education, with the Municipality as the lead program manager and deliverer.

The program would be accessible to anyone wanting to upgrade the energy efficiency of their building or switch their energy systems to heat pumps, and would also actively target groups of buildings, such as neighbourhoods and specific sectors (e.g. restaurants, grocery stores, offices, etc.).

Retrofit funding could be offered through property-assessed clean energy (PACE) programs. The retrofit program would include incentives to building owners and minimum requirements for building energy efficiency performance and heating systems performance. A promotional and educational campaign would accompany the program.

Partnerships with the province and local contractors is essential to the success of the program. As much as possible, the program must be able to reduce barriers and expedite building retrofits so that the disruption of livelihoods and businesses is minimal.

This action requires scaling up contractor resources and skills. Partnerships with trades education and skills development programs may be necessary.

Additionally, municipal permitting and inspection staff should require routine, 5-year recommissioning of large buildings. Recommissioning ensures buildings are operating at peak efficiency and identifies potential building upgrades. Building commissioning agents can identify when energy systems are reaching end of life and can perform the cost benefit analysis of early upgrades to more efficient energy systems.

Goal 4: Achieve net-zero emissions in municipal buildings by 2030.

Primary Action: Develop a prioritized list of municipal buildings to retrofit and perform energy audits, payback analyzes, and retrofits starting with the highest priority buildings. Carry out retrofits starting as soon as possible to meet the 2030 timeline.

Discussion
Through retrofitting its own building stock for enhanced energy efficiency, the municipality will show leadership to homeowners and ICI building owners and operators. The lessons learned through municipal building retrofit processes will be transferable to retrofit efforts in other sectors. Prioritizing high energy use buildings will help make money available for other buildings' upgrades.

Low-carbon Transportation Actions

Goal 5: Enhance transit service to increase transit mode share to 25% by 2050.

Primary Actions:

In partnership with BC Transit,

- Update the Transportation Master Plan periodically with increasingly ambitious transit mode share targets;
- Enhance transit service through expanded routes and frequency, as possible;
- Right-size the transit fleet with smaller vehicles serving short and/or low passenger count routes;
- Develop an employer and institution transit incentive program that can be offered to employees and students to encourage transit use; and
- Perform an assessment of public transit bus stops and stations for accessibility and mode integration (e.g. secure bicycle parking). From this assessment, create a plan to upgrade the stops and stations to improve accessibility and integration.

Goal 6: Achieve 35% active mobility transportation mode share by 2050.

Primary Actions:

- Implement the recent Transportation Master Plan recommendations, developing the recommended cycling and walking infrastructure and networks; and
- Dedicate and deploy annual capital budget to new active transportation infrastructure.

Discussion
Annual investments in, and realization of, new infrastructure are good metrics of plan implementation progress. Delivering education and awareness programs with community partners is an important

component of creating the behaviour shift to choose making trips by active transportation, especially in winter months.

Goal 7: Electrify 100% of transit and municipal fleet by 2030.

Primary Action: Replace transit and city fleet vehicles with electric versions.

Discussion
The rapid increase in electric vehicle model availability and continuing decrease in pricing greatly facilitates vehicle replacement. Municipal fleet replacement can occur through the dedication of annual capital budget. The municipality can also require its contractors to use electric vehicles through the contracting process and agreements. BC Transit has already planned for electrification of its fleet over the next decade.

Goal 8: 100% of new vehicle sales are electric by 2030.

Primary Actions:

- Implement the EV supporting recommendations of the updated Transportation Master Plan;
- Update building development applications, building permits, rezoning and retrofitting policies to include EV charging infrastructure provisions and requirements;
- Develop a partnership program with large and multi-unit building owners to establish solutions for retrofitting buildings with EV charging infrastructure;
- Require the inclusion of EV infrastructure data in building records;
- Coordinate and promote EV subsidies, purchase incentives, and bulk purchases;
- Coordinate and deliver various sector-specific education and awareness campaigns; and
- Install civic charging infrastructure.

Discussion
The electric vehicle market is evolving quickly. However, EV sales remain only a small fraction of overall car sales. Accelerating EV uptake through these actions will help decrease transportation sector emissions quickly.

Local Renewable Energy Generation Actions

Goal 9: Build local capacity to install solar PV systems, coordinate renewable energy incentive programs, and provide renewable energy education.

Primary Action: Establish and/or work with local renewable energy cooperatives (RECs) to advance solar energy systems and other renewable energy efforts of the CEEP.

Discussion
Renewable energy cooperatives will be essential to providing the capacity to perform solar PV system installations on new building developments. Local RECs like Vancouver REC or Viridian have experience in sizing and installing solar PV systems.

Goal 10: Starting in 2030 at the latest, install net metered solar photovoltaic (PV) systems on all new buildings, supplying at least 10% of their electric load.

Primary Actions:

- Include this action as part of the approach of Goal 2;
- Deliver developer and builder information and training through the REC;
- Coordinate homeowner outreach and incentive programs through the REC;
- Coordinate ICI outreach and incentive programs through the REC;
- Arrange bulk solar PV system purchasing; and
- Coordinate with electrical utilities on new metering programming.

Discussion
New building solar PV system requirements can be made alongside the Step Code implementation. RECs can help train developers and builders in the installation of solar PV systems while coordinating outreach and incentive programs.

Goal 11: Install a district energy system in the University Village/Civic Arena area.

Primary Action: Follow through on current studies for a DE system installation. Conduct any outstanding system feasibility studies that identify building connection considerations, determine system requirements, and demonstrate the business case.

Discussion
The University Village/Civic Arena area should be a prime location for a district energy system that would provide efficient thermal energy provision to major buildings in the area. Care should be taken in coordinating DE feasibility and sizing (if deemed viable) with building energy efficiency retrofits. If it is viable to retrofit buildings in the area to high energy efficiency standards, the business case for DE may not be favourable and the system may not be necessary

Goal 12: Install an anaerobic digestion facility at one of North Cowichan's wastewater treatment facilities to accommodate organic waste and wastewater treatment for renewable natural gas capture.

Primary action: Perform a feasibility study of the municipal wastewater treatment plants to determine the best option for an anaerobic digester facility.

Discussion
Anaerobic digestion facilities have a threefold benefit: they process compost, agricultural, and wastewater; they produce renewable natural gas; and they produce fertilizer. They are expensive facilities to install, however, and a proper feasibility study should be done to establish the best location and business case. Household and ICI compost collection fees and the sale of renewable natural gas captured from the facility would help payback the initial capital costs over time.

Renewable Energy Procurement Actions

Goal 13: Replace 50% of post-efficiency measures natural gas with RNG by 2050.

Primary Action: Work with Fortis BC to increase natural gas line RNG content.

Discussion

Shifting from natural gas to other sources of heating energy is imperative to meeting North Cowichan's emissions reduction goals. Some buildings and processes will find it challenging to shift away from combustion energy for heat production. Introducing increasing amounts of RNG to the natural gas infrastructure will help reduce emissions, even though combustion is maintained. With an anaerobic digestion facility in place, North Cowichan will be able to contribute fuel toward this goal. North Cowichan should work with Fortis BC to ensure RNG is coming from truly renewable sources.

Goal 14: Replace natural gas use with 15% hydrogen by 2030 and 50% by 2050, primarily focusing on industrial applications.

Primary Action: Work with Fortis BC and local industries to increase hydrogen use over natural gas.

Discussion
The industrial sector is responsible for significant remaining emissions in 2050. The BC Hydrogen Strategy[22] suggests the trajectory of hydrogen production and use in BC in coming years. It discusses hydrogen use in natural gas lines and the in industrial applications with high heat processes. The strategy outlines steps over the next decade for studies, production and storage solutions, and application of hydrogen. North Cowichan can expedite hydrogen use locally by coordinating with energy utilities and industries to host pilot studies and projects, to be the first to be serviced with hydrogen infrastructure.

Efficient Water and Waste Actions

Goal 15: Decrease energy use in the potable water treatment and distribution system by 2%/year to 2050.

Primary Actions:

- Continue with water treatment and distribution system upgrades through pump replacements with more energy efficient models; and
- Decrease potable water use community-wide through incentive and education programs.

Discussion
End-of-life water pumps can be replaced with current, more efficient models. If the municipality would like to be more proactive, a replacement program could be developed to replace pumps before their end-of-life. Water metering programs and leak detection are also effective methods at improving water conservation, thus reducing energy use for its potability treatment.

Water conservation education and awareness programming is already present via local community groups. Expanding these programs and offering a water efficient fixtures replacement incentive program would encourage homeowners and businesses to conserve water.

Goal 16: Achieve 90% solid waste and 95% organic waste diversion by 2050.

Primary Actions:

- Continue to coordinate with the CVRD and waste haulers to reduce waste generation and improve waste diversion rates;
- When ready, coordinate household, ICI, and agricultural waste collection for treatment at new anaerobic digestion facilities; and
- Work with community partners to deliver consumption, conservation, and waste reduction education and awareness programs.

Discussion
Although solid waste emissions are largely neutralized at the waste facility in Washington State, there are still some emissions associated with its collection and transportation. Solid waste collection and treatment

[22] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/electricity/bc-hydro-review/bc_hydrogen_strategy_final.pdf

is a multi-faceted sector with overlapping governmental jurisdictions and service considerations. Education and awareness programs employing demonstration projects and social media have proven effective in other jurisdictions; similar programs could be employed in North Cowichan. Ultimately, a variety of evolving approaches (already known to the municipality) will be needed to achieve such high rates of solid and organic waste diversion.

Low-Carbon Industry, Agriculture, and Forestry Actions

Goal 17: Increase industrial process efficiency by 50% by 2050.

Primary Action: Convene an industrial emissions reduction working group.

Discussion

Increasing energy costs – whether on typical fossil fuel energy sources or on new, more expensive RNG or hydrogen sources – will help drive energy efficiency innovation in the industrial sector. The province's Hydrogen Strategy also provides some direction for lowering fossil fuel emissions through fuels improvements. A working group of local industrial representatives would help facilitate the transfer and uptake of fuel efficiency and emissions reduction innovations. Convening the working group monthly or quarterly, with reports to staff and council would help keep local industry current with technological advances and effective emissions reduction efforts.

Another potential action in this area is to designate an eco-industrial lands policy. Such a policy would require existing or new industrial businesses in a designated area to achieve energy efficiency and/or GHG emissions intensity targets in their buildings and operations. A feasibility and procedural study should be performed to determine the proper approach to such a policy.

Goal 18: Increase natural carbon sequestration.

Primary Action: Implement a high sequestration forest management strategy.

Discussion

The municipal forest reserve (MFR) provides a unique opportunity to sequester carbon locally. Through afforestation and proper forest management, the carbon sequestration potential of the MFR can be increased to the 20,000 tCO2/year modelled in the CAEP Update.

Goal 19: Increase adoption of regenerative agricultural practices.

Primary Action: Convene a regenerative agricultural practices working group.

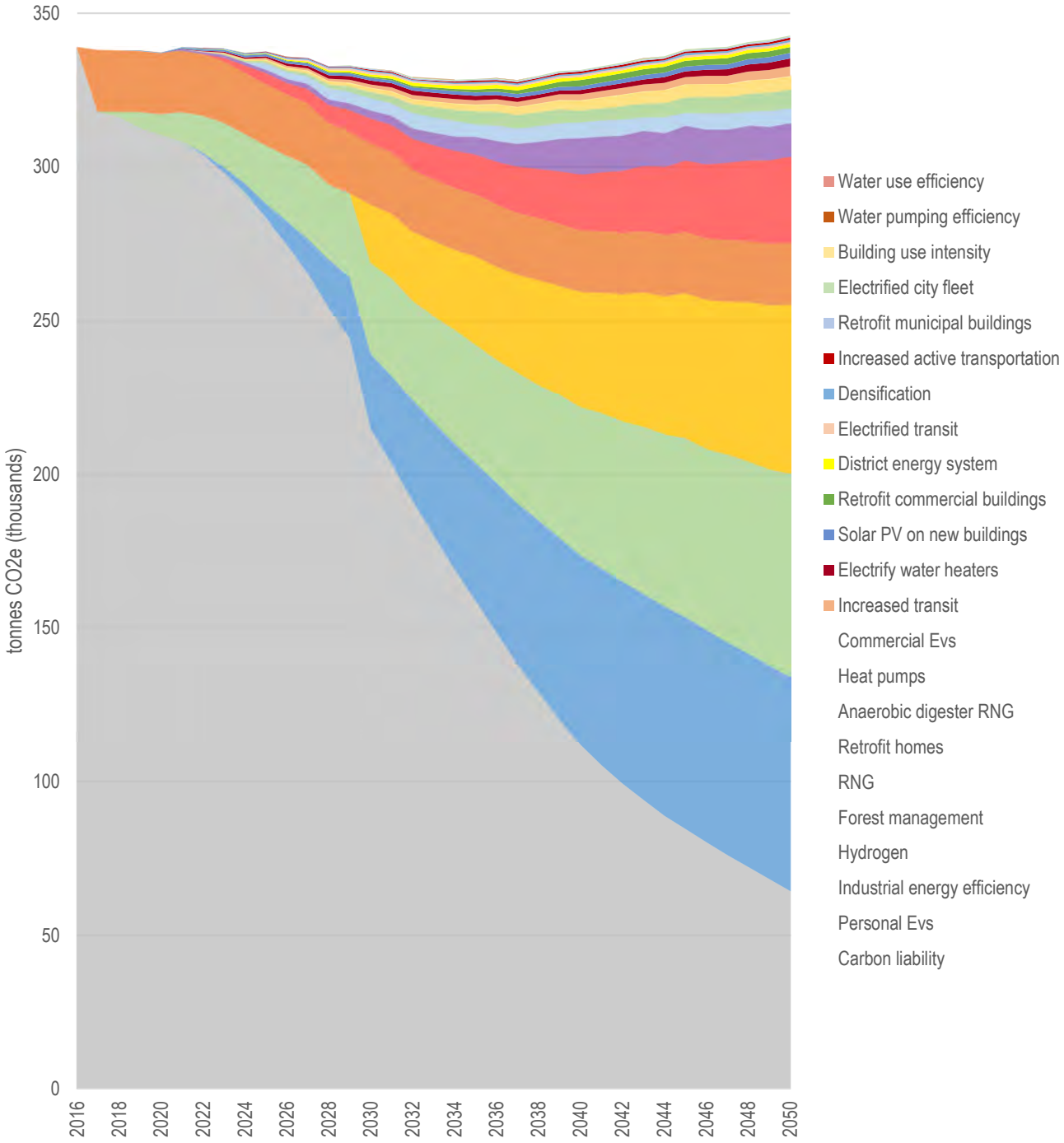
Discussion

Agriculture is an important activity in North Cowichan. Livestock, crop production, agricultural buildings, and farm vehicles all have GHG emissions implications. An agricultural working group could focus on actions that simultaneously address agricultural issues and agricultural emissions sources. Researching, trialing, and broadly implementing regenerative farming practices through North Cowichan could be primary activities of the group.

Emissions Reduction Summary

There are many primary and smaller actions that make up the implementation of the low-carbon scenario and achieve the 2050 emissions reduction target. Figure 15 displays the emissions reduction of each action from 2016 to 2050. Most actions start after 2022. The carbon liability is the emissions remaining year-over-year as emissions reductions are made. Reducing carbon liability reduces climate change impact risks and financial risks associated with managing climate impacts.

Figure 15: Wedge diagram of low-carbon scenario actions' emissions reductions.



There are 9 major actions that reduce 95% of emissions by the year 2050:

1. Electrifying personal vehicles;
2. Industrial energy efficiency;
3. Replacing natural gas with 15% hydrogen;
4. Maximizing the municipal forest reserve sequestration capacity;
5. Replacing natural gas with RNG;
6. Retrofitting homes to be more energy efficient;
7. Installing an anaerobic digester to treat wastewater and organic wastes;
8. Replacing fossil fuel building heating systems with heat pumps; and
9. Electrifying commercial vehicles.

Implementing these actions are imperative to achieving North Cowichan's emissions reduction target by 2050. Other actions achieve the remaining 5% of emissions reductions by the year 2050. These actions are also required to meeting the emissions reduction target and some are comparatively easy to achieve, such as electrifying the municipal fleet and transit.

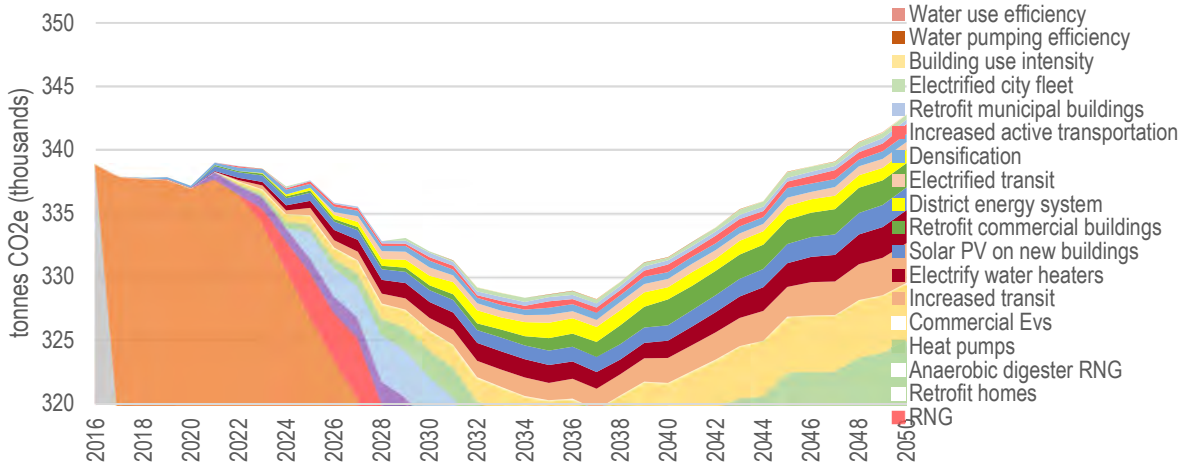


Figure 16: Detail of the wedge diagram (vertical axis starts at 320,000 tCO_2e, legend is accurate to the right hand side of the diagram).

The actions achieve the following milestone emissions reductions:

Year	Emissions reduction from 2016 levels
2025	15%
2030	35%
2035	50%
2040	65%
2045	75%
2050	82%

Emissions in 2050 are 80% below 2007 levels.

PART 4: Financing the Low-carbon Future

A high-level financial analysis of the low-carbon scenario actions was performed. Expenditures, savings, net present value, marginal abatement costs, and employment were determined for the suite of actions as compared to the BAU scenario (i.e. the financial information is additional to what would occur in the BAU scenario). The costs and savings modelled represent those incurred across the municipal, private, and public sectors and are not municipality-only costs and savings.

Financial Elements Considered

Costs and savings modelling considers upfront capital expenditures, operating and maintenance costs (including fuel and electricity), and carbon pricing. Table 6 summarizes expenditure types that were evaluated for the CEEP.

Table 6. Categories of expenditures evaluated.

Category	Description
Residential buildings	Incremental cost of energy efficient dwelling construction and retrofitting, as well as operating and maintenance costs (non-fuel).
Residential equipment	Cost of appliances and lighting, heating, and cooling equipment.
Residential fuel	Energy costs for dwellings and personal transportation.
Residential emissions	Costs resulting from a carbon price on GHG emissions fom dwellings and transportation.
Commercial buildings	Incremental cost of energy efficient building construction and retrofitting; operatingand maintenance costs (non-fuel).
Commercial equipment	Cost of lighting, heating, and cooling equipment.
Commercial vehicles	Cost of vehicle purchase; operating and maintenancecosts (non-fuel).
Non-residential fuel	Energy costs for commercial buildings, industry, and transportation.
Non-residential emissions	Costs resulting from a carbon price on GHG emissionsfrom commercial buildings, production, and transportation.
Energy productionemissions	Costs resulting from a carbon price on GHG emissions forfuel used in the generation of electricity and heating.
Energy production fuel	Cost of purchasing fuel for generating local electricity,heating or cooling.
Energy production equipment	Cost of the equipment for generating local electricity,heating or cooling.
Municipal capital	Cost of the transit system additions (no other forms ofmunicipal capital assessed).
Municipal fuel	Cost of fuel associated with the transit system.
Municipal emissions	Costs resulting from a carbon price on GHG emissionsfrom the transit system.
Energy production revenue	Revenue derived from the sale of locally generated electricity or heat.
Personal use vehicles	Cost of vehicle purchase; operating and maintenance costs (non-fuel).
Transit fleet	Costs of transit vehicle purchase.
Active transportation infrastructure	Costs of bike lane and sidewalk construction.

Total Investments and Savings

Figure 17 summarizes modelled annual low-carbon scenario costs and savings over those in the BAU scenario. Costs vary year-over-year as investments in transit vehicles, active transportation infrastructure, City fleet, solar PV installations, building retrofits, and other elements are made. Costs wane after 2040 as building retrofit efforts conclude.

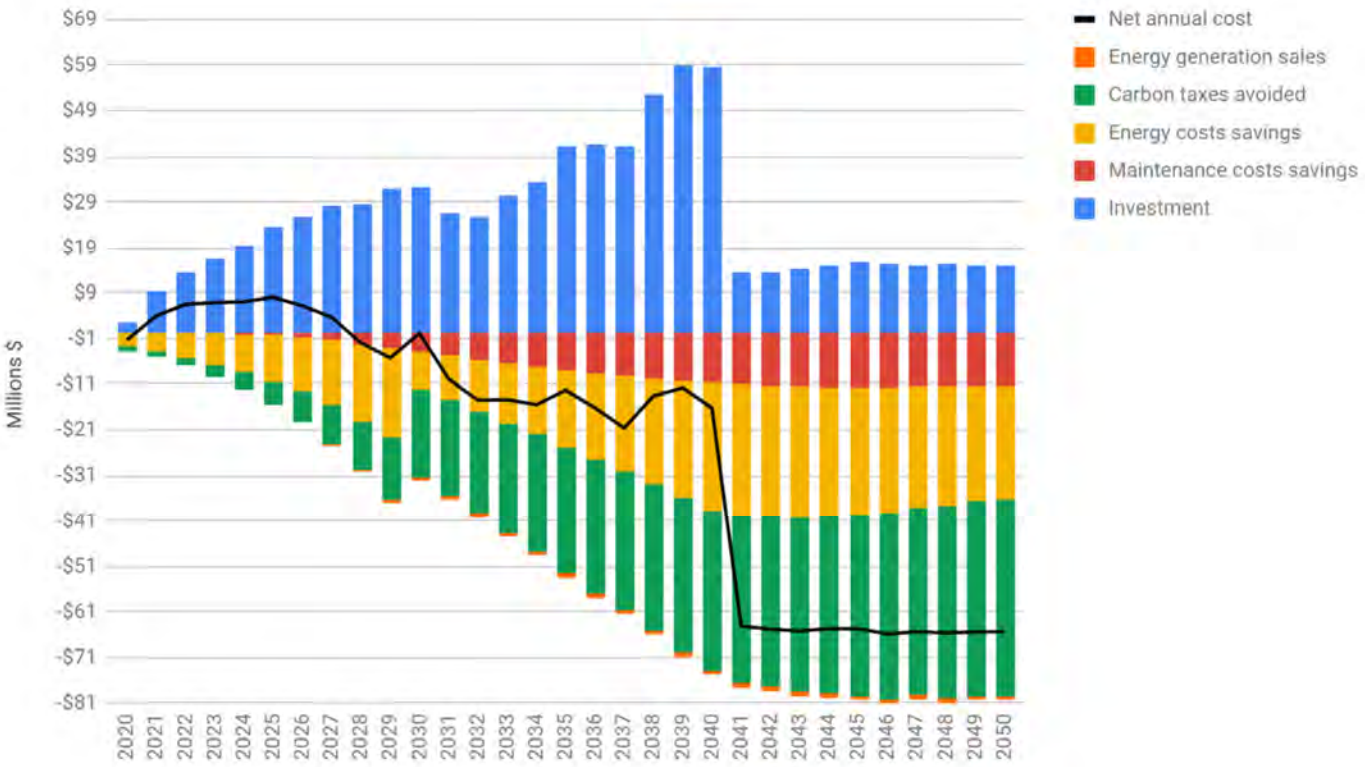


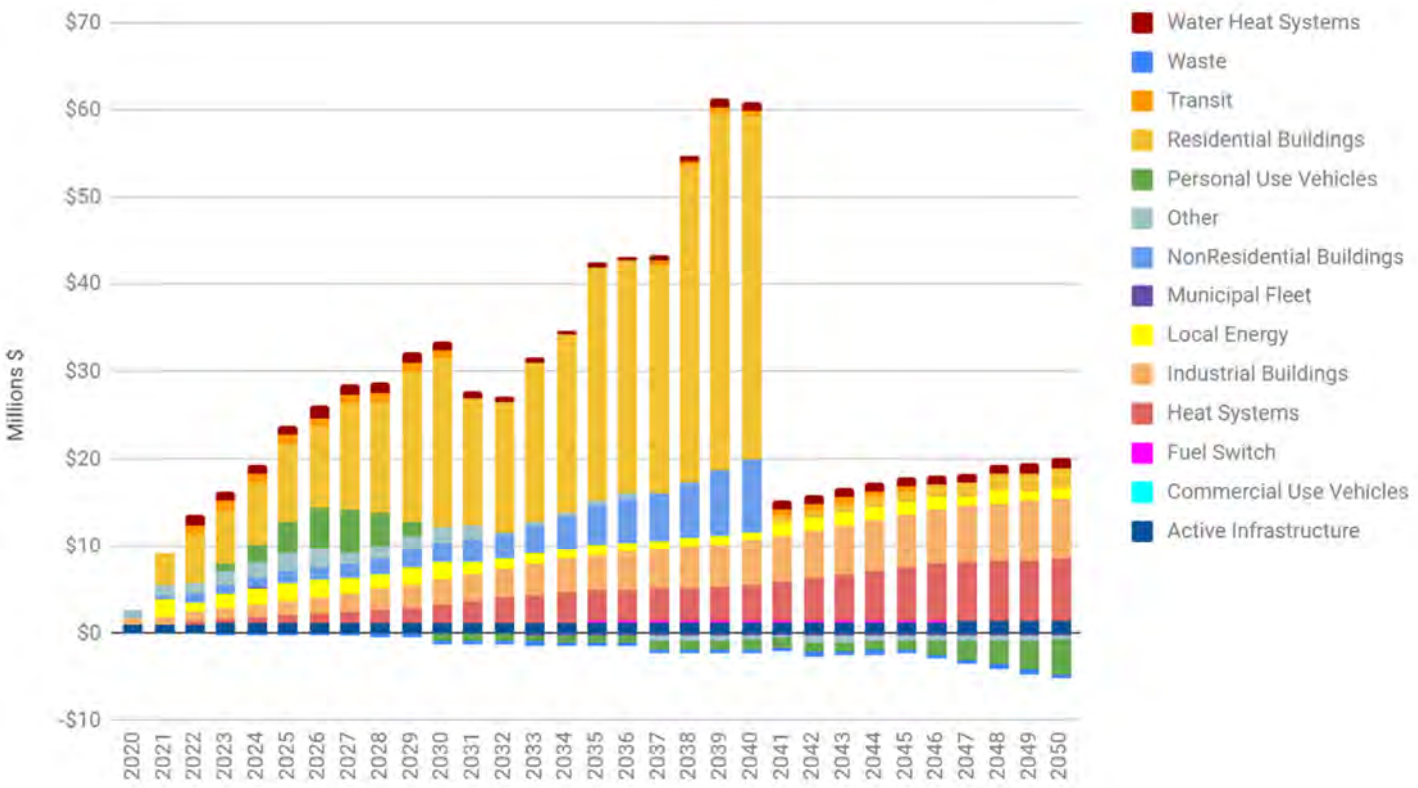
Figure 17: Summary of annual low-carbon actions costs (above x-axis) and savings (below x-axis) relative to the BAU scenario.

Meanwhile, building mechanical systems and electric vehicles operations and maintenance (O&M) savings grow over the next thirty years as systems become more efficient and electricity powered, requiring less servicing and replacement. Energy cost savings grow substantially as energy savings are realized from more efficient buildings and vehicles, as well as increased transit use and active transportation (more affordable trips than those made by car). Some energy generation sales are realized by new rooftop solar PV and RNG from the anaerobic digestion facility.

Carbon pricing increases the value of fuel and electricity savings. Federal carbon pricing is currently will be $50/tonne in 2022, escalating to $170/tonne in 2030.

Figure 18 shows the low-carbon scenario investments by sector. Residential building retrofits require the largest investments. Investments for heating system replacement with heat pumps ramps up over the time period as more and more homes are serviced. Consistent investments in active transportation infrastructure and solar panels on new buildings occur over the time period. EV purchases incur additional costs over the next decade as they are typical more expensive than gas vehicles. Once reaching price parity at the end of the decade, their total cost of ownership becomes a savings as operations and maintenance costs are reduced compared to those of gas vehicles.

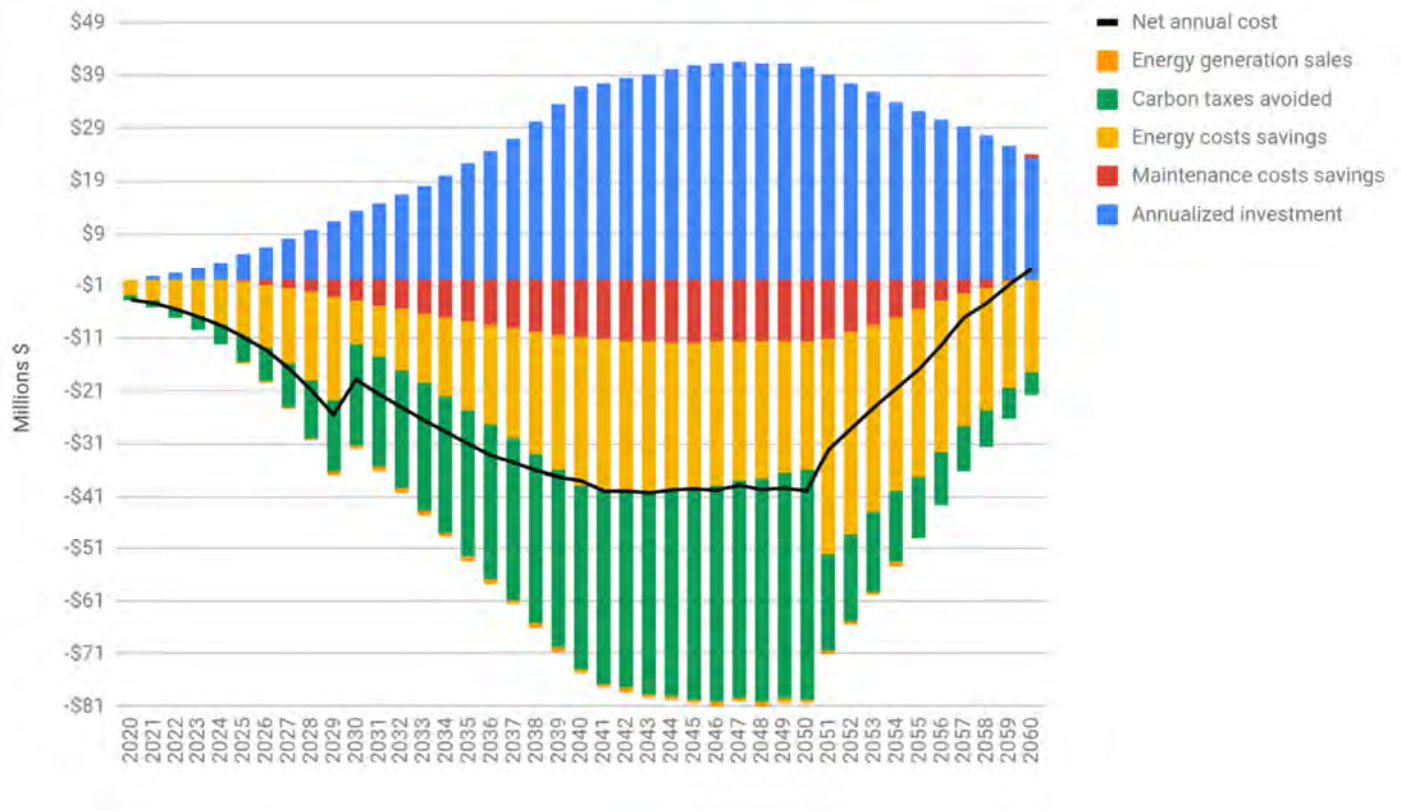
Figure 18: Low-carbon scenario action investments by sector.



Amortized Financial Summary

As many of the investments and savings aren't necessarily made and realized in the same year, an amortized financial assessment is useful to get an idea of how financial transactions are likely to look over time. Things like loans for building retrofits, EV leases, and multi-year infrastructure projects are better represented in the amortized financial presentation. For this analysis, the timeline extends to 2060.

Figure 19: Amortized financial analysis of the low-carbon scenario.



Total Investments and Savings

The financial analysis summary is presented in Figure 20 and Table 7. As compared to the business-as-usual scenario, the low-carbon scenario requires half a billion dollars of investments over the next 30 years (and about $15M more when amortized). The savings and avoided costs are over one billion dollars, resulting in a net savings of over $587M.

Figure 20: Present value of investments and savings of the low-carbon scenario over the BAU scenario.

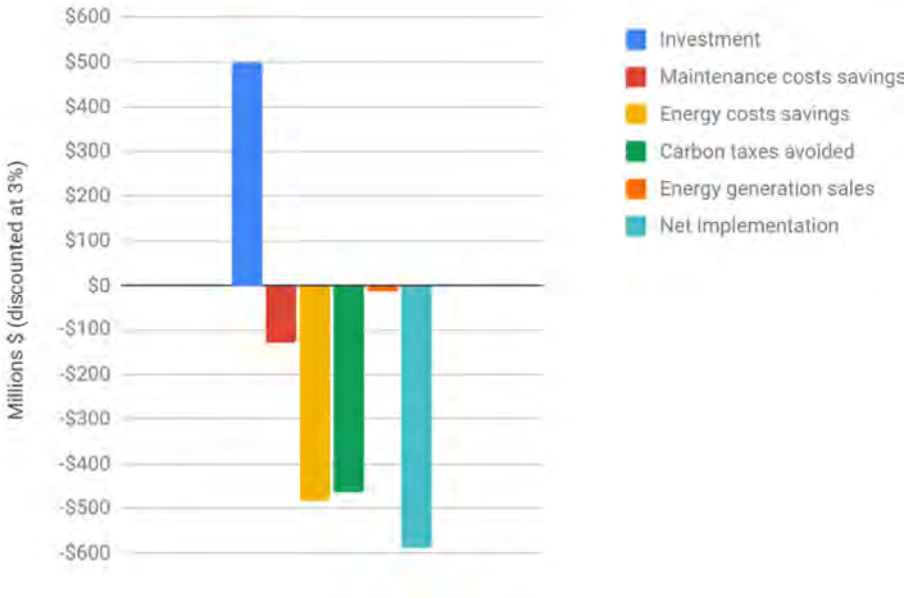


Table 7: Summary of low-carbon scenario costs and savings.

	Net Present Value (NPV)	NPV Amortized
Costs	$499,266,000	$515,873,000
O&M savings	-$128,555,000	-$128,555,000
Energy cost savings	-$482,085,000	-$482,085,000
Carbon price credit	-$463,361,000	-$463,361,000
Local generationrevenues	-$12,919,000	-$12,919,000
Net annual cost / (saving)	-$587,654,000	-$571,047,000

Marginal Abatement Costs

The marginal abatement cost (MAC) graph (Figure 21) provides at-a-glance emissions reductions versus costs/savings for each emissions reduction action. It is a measure of the cumulative cost or savings of reducing emissions for a particular action over the 2020-2050 time period. The MAC divides the total costs or savings of an action, as represented by the net present value (NPV), by the total emissions reductions associated with that action over its lifetime. The result is a cost or savings per tonne of emissions reduced for each action. An action costs money overall if its cost per tonne of emissions saved is positive. An action saves money if its cost per tonne of emissions saved is negative.

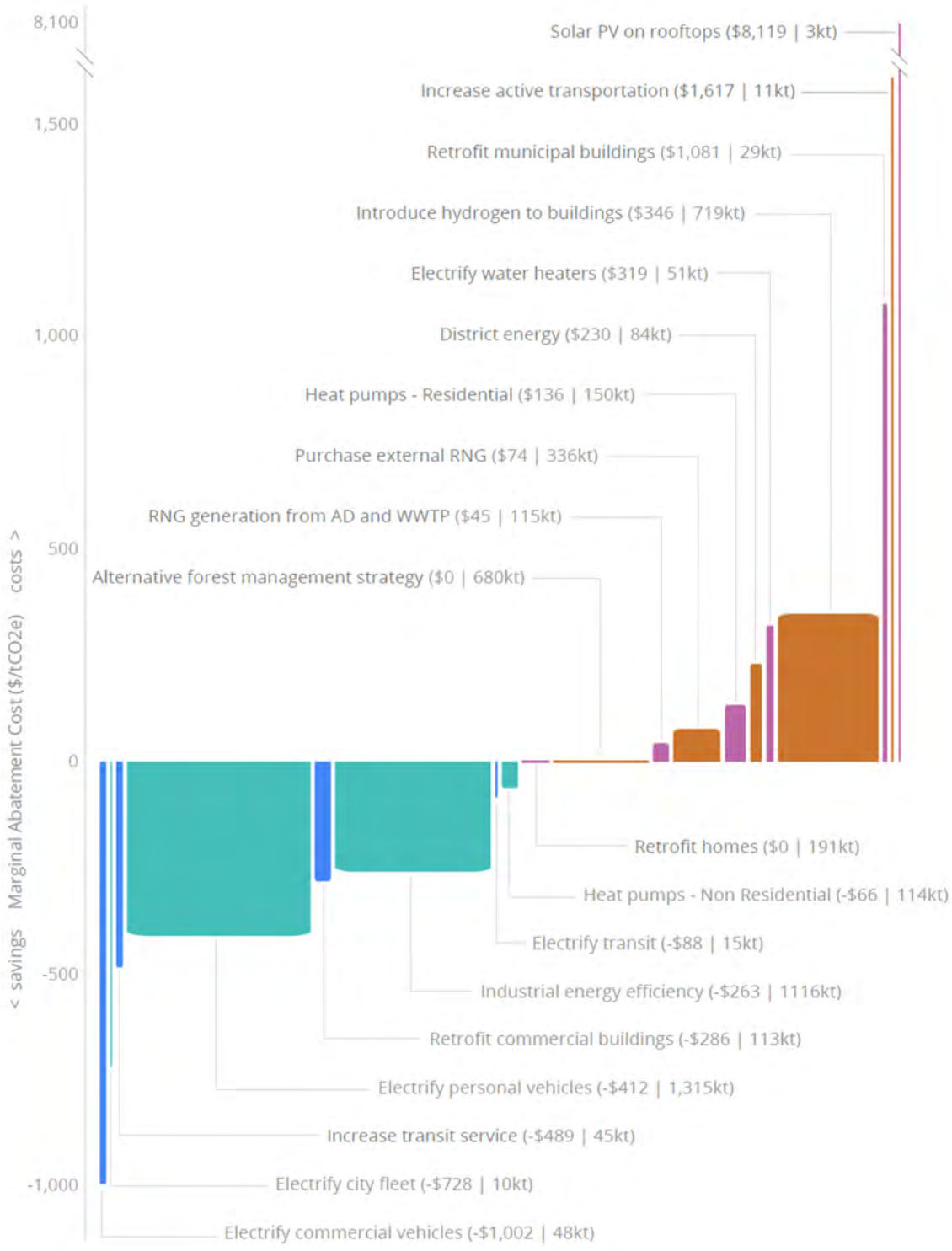


Figure 21: Marginal abatement costs of low-carbon scenario actions.

The MAC graph shows that emissions some emissions reduction actions generate savings on the emissions they reduce while others will be a net cost. Some actions have a large negative marginal abatement cost, but their emissions reductions are small relative to other actions. Other actions have less

savings but achieve great emissions reductions. It is important to remember that the MAC graph presents cost/savings and emissions savings relative to each action.

The MAC confirms that personal EVs and increasing industrial efficiency save large volumes of emissions over the next 30 years while saving money. On the other hand, purchasing RNG and hydrogen will also reduce large volumes of emissions, but at substantial cost. When making investments, a balance of actions' costs and returns across sectors need to be considered to effectively realize net savings. It is important to remember that also some actions reduce emissions and save more than others, all actions are worth considering as they all reduce emissions.

Employment

Capital expenditures are accompanied by increased employment. Employment factors for each sector were used to translate each million dollars of activity resultant from emissions reduction actions into full-time equivalent jobs (Figure 22). Actions in the CAEP Update are estimated to generate 5,200 person years of employment between 2020 and 2050 – an average of 170 annually – compared to the BAU scenario. Many jobs are in the energy sector, with solar PV, DE systems, and heat pumps to install. Many others are related to building retrofits, lasting two decades until the vast majority of the building stock is retrofit by 2040. Some automotive repair jobs are lost (2048-2050) as the requirement for maintenance of vehicles is expected to decline. Residential building jobs are slightly fewer under CAEP action implementation than in the BAU as fewer single-family homes will be built and dwellings will be smaller on average. These construction jobs could be transitioned to the renewable energy and building retrofits sectors.

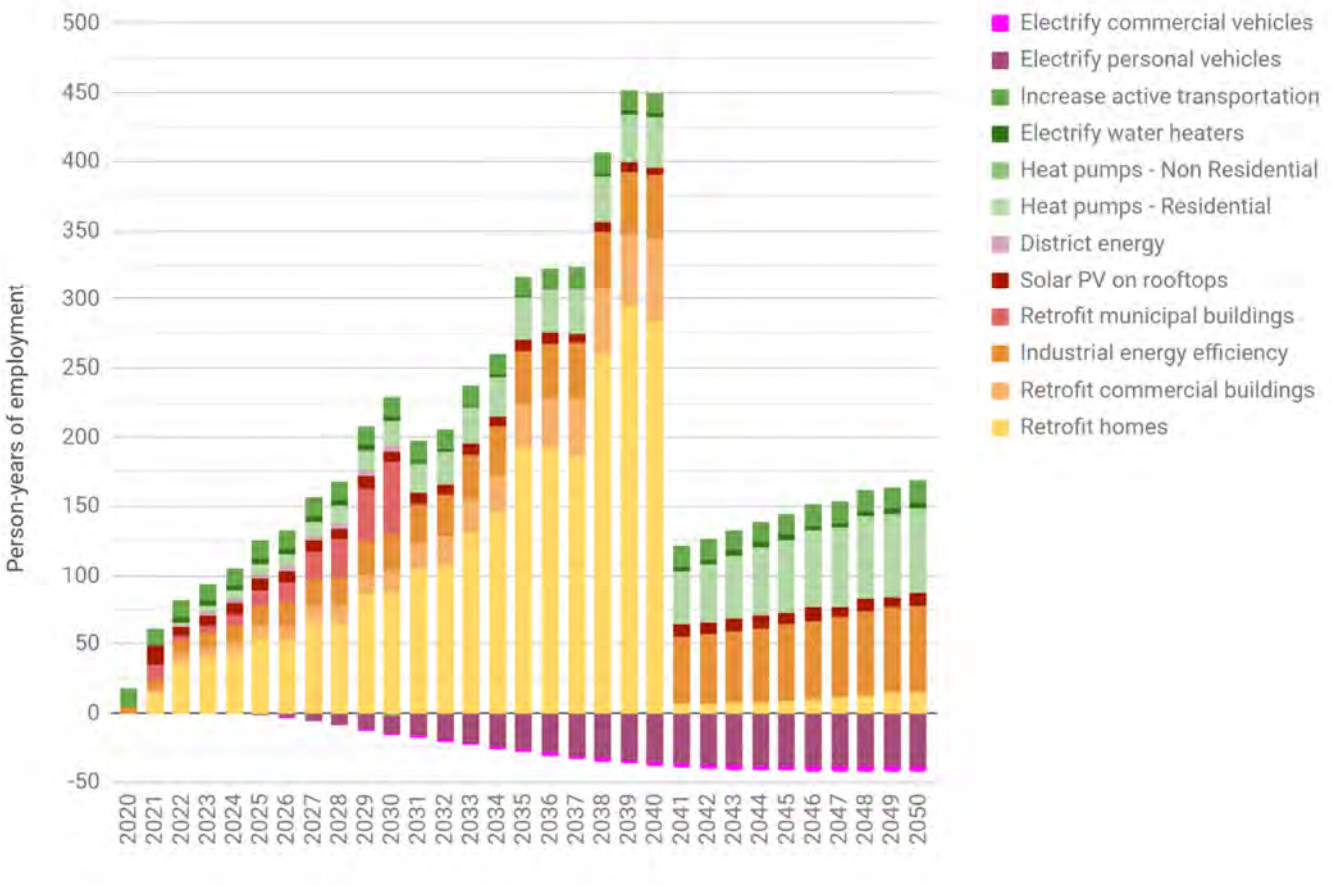


Figure 22: Employment generated by low-carbon action implementation.

Financial Analysis Summary

Implementing the actions in the CAEP Update requires major upfront investments by the City, public and non-profit institutions, residents, and the private sector. However, energy savings, operations and maintenance savings, and avoided carbon taxes far outweigh the costs, and will therefore create significant economic value for the community over the long-term. Energy costs decrease overall and go increasingly toward renewable energy sources. Local jobs can be created with the investments made and will be required to have sufficient action implementation capacity.

PART 5: Discussion

The analysis presented in the CAEP Update demonstrates what is needed to achieve North Cowichan's 80% emissions reduction under 2007 levels by 2050 target. Through strong policy and action, North Cowichan can reduce its energy use and emissions production substantially over the next 30 years, responding to the direction set by Council.

The analysis shows that there are major areas of focus to achieve the bulk of the energy and emissions reductions, but also that many efforts must be made across all sectors to achieve the emissions reduction target by 2050. The CAEP Update has 18 goals and many associated actions. These form a low-carbon pathway to achieving community-wide emissions. Major energy efficiency, natural gas replacement, and vehicle electrification actions will achieve the majority of emissions reductions. A variety of smaller actions will be critical for achieving the 2050 target.

The actions reduce 80% of 2016 emissions levels by 2050. About 61,000 tCO_2e of annual emissions is projected to remain in that year. This is equivalent to the annual emissions of about 1,900 cars or the energy use of about 1,500 Canadian homes.

If North Cowichan decides to be more ambitious and adopt a net-zero by 2050 emissions reduction target in the near future, addressing the remaining 61,000 tCO_2e of annual emissions in 2050 would involve a combination of the following approaches:

- Eliminating all commercial and agricultural vehicle fossil fuel use;
- Replacing 100% of natural gas use with RNG, hydrogen, or electric systems;
- Generating more local renewable electricity to offset the small amount of emissions from the electricity grid;
- Operating all industrial activities on biofuels or renewable electricity; and
- Increasing carbon sequestration.

Most of the remaining agricultural emissions are from livestock and are thus difficult to eliminate. Increased carbon sequestration might be possible to address these remaining emissions. It would require careful management and possibly increased area of the municipal forest reserve.

In Closing

North Cowichan has already made progress reducing emissions since the original CAEP. Major areas of focus remain but support from provincial and federal levels of government are making it easier for municipalities to reduce emissions. CAEP Update implementation will rely on municipal and staff leadership. It will also rely on industry stakeholders participating in working groups, educational institutions contributing research and development efforts, community groups contributing expertise and passion, and partnerships with First Nations. Ambitious, consistent implementation of the actions outlined in the CAEP Update will help mitigate climate change impacts while creating a more livable community with greater access, equity, and quality of life for North Cowichan residents.

Appendix 1: Summary of North Cowichan Council and Committee CAEP Resolutions

Date Group	Motion
17-Jul-19 Council	Whereas to provide clarity of Council's intention to look at all applicable decisions through a climate lens, including but not limited to: rewriting North Cowichan's Official Community Plan and reviewing the management of North Cowichan's municipal forests, as Council we resolve to:1. Officially acknowledge we are facing a climate emergency; and2. Following the hiring of an Environmental Specialist, direct staff to report to Council in 90 days with an integrated climate action strategy that merges: a. Current municipal initiatives in climate change mitigation and adaption; b. Climate change related policies and directions outlined in Council's Strategic Plan; and c. New and existing ideas and actions to implement from the remodelled Climate Action and Energy Plan and/or ones that can be adapted from other jurisdictions or emerging science.
20-Jan-20 Council	That Council direct staff to develop actions, policy options, and cost estimates based on the six strategies outlined in the Climate Action Plan and information from the Climate Action Energy Plan modelling update, to achieve an 80 percent reduction target by 2050.
16-Sep-20 COW	That Council accept the Senior Environmental Specialist's September 16, 2020 report summarizing public input on the Climate Action and Energy Plan update and outlining how the emissions modelling has been updated to reflect public in
21-Oct-20 Council	That Council direct staff to proceed with modelling the costs and benefits of various greenhouse gas emissions reduction initiatives identified to-date and report back to Council with the results.
21-Oct-20 Council	Council directs, subject to the completion of the CAEP, that the 2050emissions reductions target of 80% be changed to a target of achieving net zero by2050, and that this be reflected in the development of policy in the OCP.
2-Feb-21 Council	That Council direct staff to proceed with public engagement and the timeline described in the Senior Environmental Specialist's report dated February 2, 2021 for presenting the Climate Action and Energy Plan (CAEP) modelling of costs and benefits of carbon emissions reduction policies to the climate change engagement group, the public at large, and the Environmental Advisory Committee; and that staff be directed to report back to Council before finalization of the CAEP model update by March 31,2021.

2-Mar-21 EAC	That the Environmental Advisory Committee recommend to Council that the following actions be taken prior to finalizing the Climate Action and Energy Plan update: 1.Provide a timeline for recommendations from the EAC regarding actions and priorities2.Staff conduct a background and information workshop3.Staff conduct an appropriately scheduled prioritization workshop led by SSG using a multi-criteria analysis process4.That the Environmental Advisory Committee review the draft final report and make recommendations to Council.
4-May-21 EAC	That the Environmental Advisory Committee recommends the following High Significant CAEP Actions be given a 'Now' priority and forwarded to Council for their consideration for 2021 implementation and when developing the Environmental Business Plan in future years:
18-May-21 EAC	That the Environmental Advisory Committee recommends that Council authorize Diamond Head Consulting to provide a simple comparison of their Environmental Policy and Regulation Review report dated February 16, 2021 recommendations with the Environmental Advisory Committee (EAC) recommendations from the May 4, 2021 EAC meeting on the Climate Action Energy Plan.
16-Jun-21 Council	That Council direct staff to:(1) Incorporate the Environmental Advisory Committee's (EAC) recommended Climate Action and Energy Plan (CAEP) actions relevant to the Official Community Plan into the policy and implementation sections of the updated OCP, as appropriate; and that the wording within the infill development item, 'existing communities' be replaced with 'existing centers'. June 16, 2021 - Regular Council Minutes(2) Work with Sustainability Solutions Group to finalize the CAEP update to include the EAC recommendations as presented in the report titled 'Environmental Advisory Committee Recommended Actions from the Draft Climate and Energy Plan Update' as prepared by the Director, Engineering Projects and prioritized as described in Attachment 2 of the report; and(3) Include development of the recommended policies and targets within the2022 departmental business plans and budgets.
21-Jul-21 Council	That Council direct staff to work with: 1. Diamond Head Consulting to complete a simple comparison of the Environmental Policy Review and the draft Climate Action and Energy Plan (CAEP) actions; 2. Sustainability Solutions Group to include an Eco-lndustrial Lands Policy as an action in the final CAEP Implementation Plan; and, 3. Community Energy Association to pursue potential partnerships and grants.

Appendix 2: GPC Emissions Report

tonne / year	Table 4.3 GHG Emissions Report - pg. 42 GPC								
					in tonnes				
GPC ref No.	Scope	GHG Emissions Source	Inclusion	Reason for exclusion (if applicable)*	CO2	CH4	N2O	Total CO2e	Sector Totals
I		STATIONARY ENERGY SOURCES							
I.1		**Residential buildings**							
I.1.1	1	Emissions from fuel combustion within the city boundary	**Yes**		16,431	5,017	609	22,057	
I.1.2	2	Emissions from grid-supplied energy consumed within the city boundary	**Yes**		1,883	2	9	1,895	
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**Yes**		63	0	0	63	24,015
I.2		**Commercial and institutional buildings/facilities**							
I.2.1	1	Emissions from fuel combustion within the city boundary	**Yes**		2,073	1	20	2,094	
I.2.2	2	Emissions from grid-supplied energy consumed within the city boundary	**Yes**		3,046	4	15	3,065	
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**Yes**		101	0	1	102	5,261
I.3		**Manufacturing industry and construction**							
I.3.1	1	Emissions from fuel combustion within the city boundary	**Yes**		123,640	81	666	124,386	133,051
I.3.2	2	Emissions from grid-supplied energy consumed within the city boundary	**Yes**		8,334	11	41	8,385	Buildings
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**Yes**		277	0	1	279	**162,327**
I.4		**Energy industries**							
I.4.1	1	Emissions from energy used in power plant auxiliary operations within the city boundary	**No**	NR	0	0	0	0	
I.4.2	2	Emissions from grid-supplied energy consumed in power plant auxiliary operations within the city boundary	**No**	NR	0	0	0	0	Local energy
I.4.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption in power plant auxiliary operations	**No**	NR	0	0	0	0	**0**
I.4.4	1	Emissions from energy generation supplied to the grid	**No**	NR	0	0	0	0	
I.5		**Agriculture, forestry and fishing activities**							
I.5.1	1	Emissions from fuel combustion within the city boundary	**No**	NR	18,980	15	326	19,322	
I.5.2	2	Emissions from grid-supplied energy consumed within the city boundary	**No**	NR	0	0	0	0	
I.5.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**No**	NR	0	0	0	0	
I.6		**Non-specified sources**							
I.6.1	1	Emissions from fuel combustion within the city boundary	**No**	NR	0	0	0	0	
I.6.2	2	Emissions from grid-supplied energy consumed within the city boundary	**No**	NR	0	0	0	0	
I.6.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	**No**	NR	0	0	0	0	
I.7		**Fugitive emissions from mining, processing, storage, and transportation of coal**							
I.7.1	1	Emissions from fugitive emissions within the city boundary	**No**	NR	0	0	0	0	
I.8		**Fugitive emissions from oil and natural gas systems**							Fug. emissions
I.8.1	1	Emissions from fugitive emissions within the city boundary	**Yes**		3	15,823	0	15,826	**15,826**
II		TRANSPORTATION							
II.1		**On-road transportation**							
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the city boundary	**Yes**		77,122	148	429	77,699	
II.1.2	2	Emissions from grid-supplied energy consumed within the city boundary for on-road transportation	**Yes**		0	0	0	0	
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	**Yes**		37,917	76	143	38,136	
II.2		**Railways**							
II.2.1	1	Emissions from fuel combustion for railway transportation occurring within the city boundary	**No**	NR	0	0	0	0	
II.2.2	2	Emissions from grid-supplied energy consumed within the city boundary for railways	**No**	NR	0	0	0	0	
II.2.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	**No**	NR	0	0	0	0	
II.3		**Water-borne navigation**							
II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring within the city boundary	**No**	N/A	0	0	0	0	
II.3.2	2	Emissions from grid-supplied energy consumed within the city boundary for waterborne navigation	**No**	N/A	0	0	0	0	
II.3.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	**No**	N/A	0	0	0	0	
II.4		**Aviation**							
II.4.1	1	Emissions from fuel combustion for aviation occurring within the city boundary	**No**	N/A	0	0	0	0	

tonne / year	Table 4.3 GHG Emissions Report - pg. 42 GPC								
					in tonnes				
GPC ref No.	**Scope**	**GHG Emissions Source**	**Inclusion**	**Reason for exclusion (if applicable)***	**CO2**	**CH4**	**N2O**	**Total CO2e**	**Sector Totals**
I		**STATIONARY ENERGY SOURCES**							
I.1		**Residential buildings**							
II.4.2	2	Emissions from grid-supplied energy consumed within the city boundary for aviation	**No**	N/A	0	0	0	0	
II.4.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	**No**	N/A	0	0	0	0	
II.5		**Off-road**							
II.5.1	1	Emissions from fuel combustion for off-road transportation occurring within the city boundary	**No**	NR	23	0	3	26	Transport
II.5.2	2	Emissions from grid-supplied energy consumed within the city boundary for off-road transportation	**No**	NR	0	0	0	0	**115,861**
III		**WASTE**							
III.1		**Solid waste disposal**							
III.1.1	1	Emissions from solid waste generated within the city boundary and disposed in landfills or open dumps within the city boundary	**Yes**		0	0	0	0	
III.1.2	3	Emissions from solid waste generated within the city boundary but disposed in landfills or open dumps outside the city boundary	**Yes**		0	0	0	0	
III.1.3	1	Emissions from waste generated outside the city boundary and disposed in landfills or open dumps within the city boundary	**No**	N/A	0	0	0	0	
III.2		**Biological treatment of waste**							
III.2.1	1	Emissions from solid waste generated within the city boundary that is treated biologically within the city boundary	**Yes**		0	511	336	846	
III.2.2	3	Emissions from solid waste generated within the city boundary but treated biologically outside of the city boundary	**No**	N/A	0	0	0	0	
III.2.3	1	Emissions from waste generated outside the city boundary but treated biologically within the city boundary	**No**	N/A	0	0	0	0	
III.3		**Incineration and open burning**							
III.3.1	1	Emissions from solid waste generated and treated within the city boundary	**No**	N/A	0	0	0	0	
III.3.2	3	Emissions from solid waste generated within the city boundary but treated outside of the city boundary	**No**	N/A	0	0	0	0	
III.3.3	1	Emissions from waste generated outside the city boundary but treated within the city boundary	**No**	N/A	0	0	0	0	
III.4		**Wastewater treatment and discharge**							
III.4.1	1	Emissions from wastewater generated and treated within the city boundary	**Yes**		0	557	132	689	
III.4.2	3	Emissions from wastewater generated within the city boundary but treated outside of the city boundary	**No**	NR	0	0	0	0	Waste & WW
III.4.3	1	Emissions from wastewater generated outside the city boundary	**No**	N/A	0	0	0	0	**1,535**
IV		**INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)**							
IV.1	1	Emissions from industrial processes occurring within the city boundary	**No**	ID	0	0	0	0	
IV.2	1	Emissions from product use occurring within the city boundary	**No**	ID	0	0	0	0	
V		**AGRICULTURE, FORESTRY AND LAND USE (AFOLU)**							
V.1	1	Emissions from livestock within the city boundary	**No**	NR	0	22,950	0	22,950	
V.2	1	Emissions from land within the city boundary	**No**	NR	0	0	0	0	agriculture
V.3	1	Emissions from aggregate sources and non-CO2 emission sources on land within the city boundary	**No**	NR	0	0	0	0	**42,272**
VI		**OTHER SCOPE 3**							
VI.1	3	Other Scope 3	**No**	N/A	0	0	0	0	
							TOTAL	**337,822**	

***Reason for exclusion:**	
N/A	Not applicable; Not included in scope
ID	Insufficient data
NR	No relevant or limited activities identified
Other	Reason provided under Comments

Appendix 3: BAU Scenario Modelling Assumptions

	2016				2051				Units
Population	29,676				39,470				people
Employment	31,618				43,976				jobs
Households	12,686				16,386				homes
Average building efficiency	Follows BC Step Code adoption								%/year
Solid waste (annual)	1,535				2,017				tonnes
Wastewater (central & septic)	3,687,050				5,160,235				m^3/year
Personal VKT	335,013,000				417,205,000				km/year
Transportation mode split	v	t	w	b	v	t	w	b	%
Internal trips	88	2	8	3	88	2	8	3	v = vehicle
External outbound trips	100	-	-	-	100	-	-	-	t = transit
External inbound trips	100	-	-	-	100	-	-	-	w = walking b = bicycling
Electric vehicle uptake rate	30% of new sales by 2030, 80% by 2050								%/year
Fuels GHG intensity**	CO_2		CH_4		N_2O				
Grid electricity	10.67		0.000403		0.0000175				gCO2e/kWh
Gasoline	2316		0.32		0.66				G/L
Natural gas	49								kgCO2e/GJ
Diesel	2690		0.07		0.21				G/L
Fuel oil – residential	2560		0.03		0.01				G/L
Wood – residential	299.8		0.72		0.007				kg/GJ
Wood – industrial	466.8		0.0052		0.0036				kg/GJ