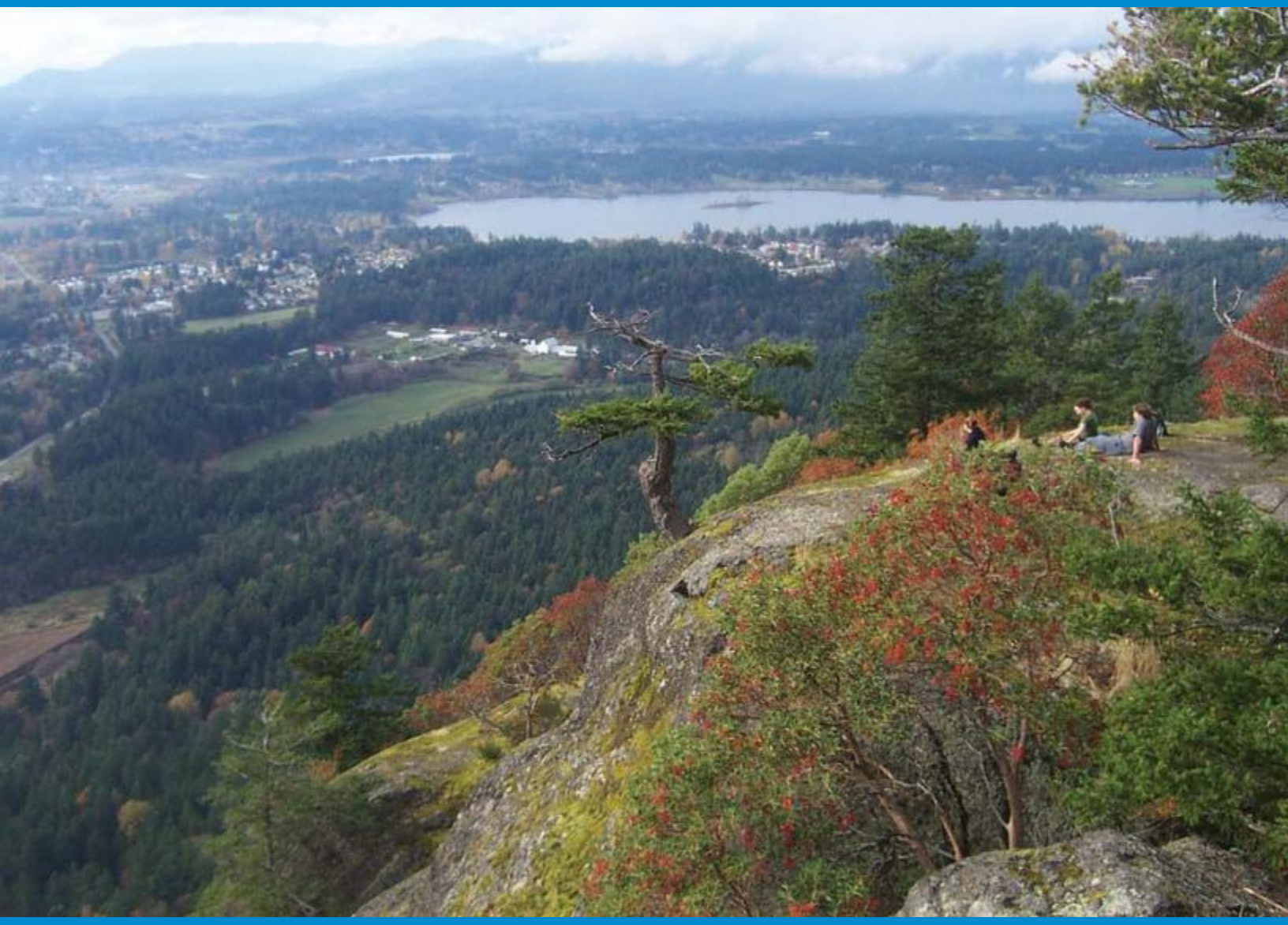
Municipality of

North Cowichan

Climate Action & Energy Plan



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Prepared by:

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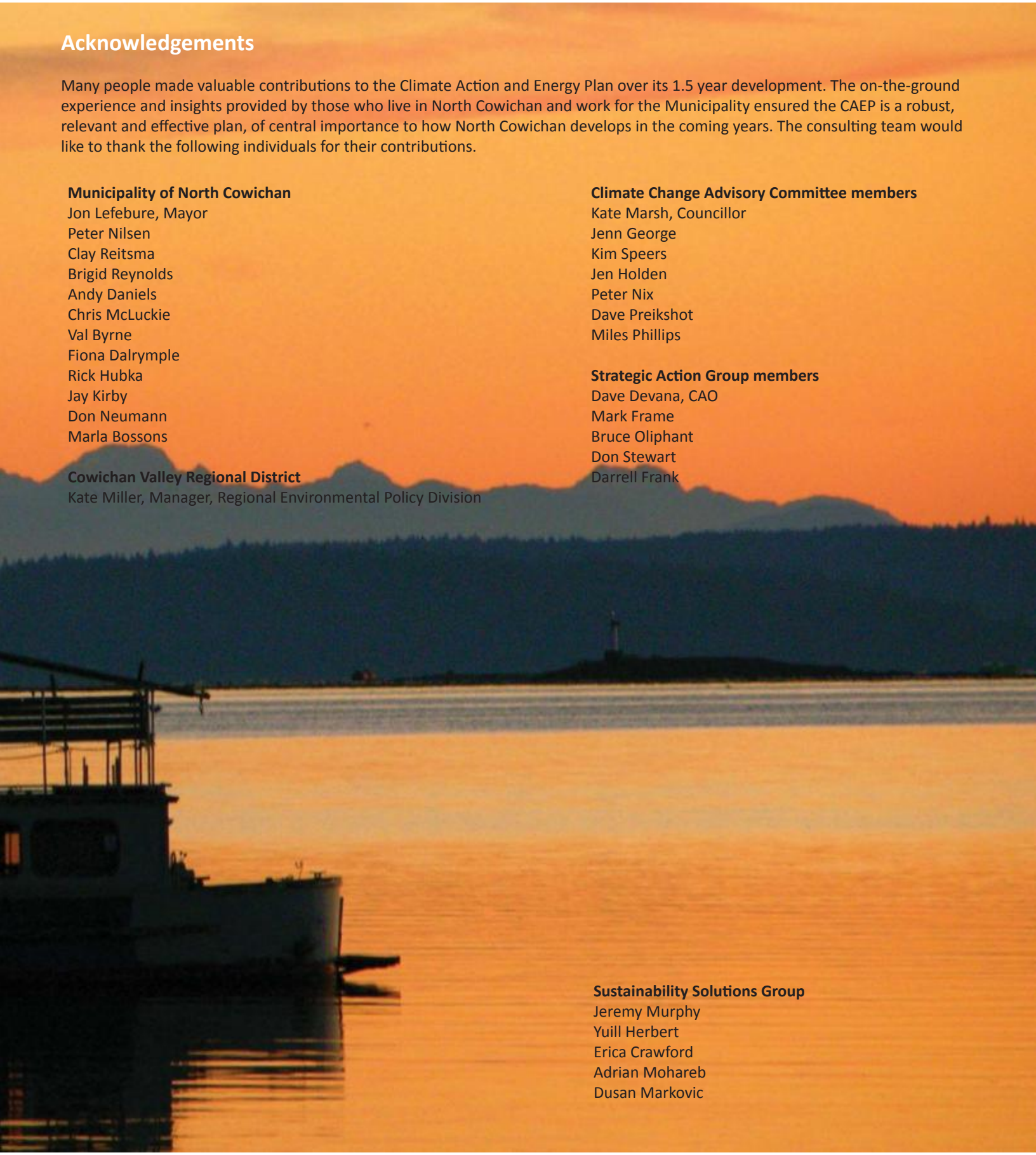

Acknowledgements

Many people made valuable contributions to the Climate Action and Energy Plan over its 1.5 year development. The on-the-ground experience and insights provided by those who live in North Cowichan and work for the Municipality ensured the CAEP is a robust, relevant and effective plan, of central importance to how North Cowichan develops in the coming years. The consulting team would like to thank the following individuals for their contributions.

Municipality of North Cowichan
Jon Lefebure, Mayor
Peter Nilsen
Clay Reitsma
Brigid Reynolds
Andy Daniels
Chris McLuckie
Val Byrne
Fiona Dalrymple
Rick Hubka
Jay Kirby
Don Neumann
Marla Bossons

Cowichan Valley Regional District
Kate Miller, Manager, Regional Environmental Policy Division

Climate Change Advisory Committee members
Kate Marsh, Councillor
Jenn George
Kim Speers
Jen Holden
Peter Nix
Dave Preikshot
Miles Phillips

Strategic Action Group members
Dave Devana, CAO
Mark Frame
Bruce Oliphant
Don Stewart
Darrell Frank

Sustainability Solutions Group
Jeremy Murphy
Yuill Herbert
Erica Crawford
Adrian Mohareb
Dusan Markovic

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Statement of Problem

Scientific evidence shows that the climate is changing. The overwhelming majority of scientists agree that this is due to rising concentrations of heat-trapping greenhouse gases in the atmosphere. The scientific community has also concluded that some climate change is inevitable even if action is taken to reduce greenhouse gas emissions. Therefore it is important that North Cowichan act to conserve energy, reduce greenhouse gas emissions, and adapt to the effects of climate change that are expected to occur.

North Cowichan has already been undertaking some initiatives that will reduce greenhouse gas emissions. However, it is important that North Cowichan have a coordinated, comprehensive, and practical plan to continue its' efforts to conserve energy, reduce greenhouse gas emissions, and deal with the effects of climate change that are expected to occur no matter what is done to reduce greenhouse gas emissions. The Climate Action and Energy Plan maps a path forward to address these issues.

Project description

The District Municipality of North Cowichan, with the funding support of BC Hydro, has developed a Climate Action and Energy Plan (CAEP). The CAEP inventories the community's existing energy use and greenhouse gas (GHG) emissions, and identifies future trends in energy and GHG emissions based on population, land-use, technology and other factors. It also identifies opportunities to reduce energy consumption and emissions through policy and other municipal mechanisms. The plan includes analysis of the social, environmental and economic impacts of the strategies and has incorporated wide participation from the community in the development and implementation of the plan. The plan is a response to local, regional and global concerns about human-caused climate change and its current and potential effects.

Justification for a Climate Action and Energy Plan

The District of North Cowichan requires a systematic approach to energy efficiency and to mitigating and adapting to climate change. This will ensure the municipality is on a path to achieve its greenhouse gas (GHG) and energy targets while maximizing social and economic benefits. There are two key Provincial drivers for municipal action: the BC Climate Action Charter and the Green Communities Act (Bill 27). The BC Climate Action Charter, to which North Cowichan is a signatory, is a commitment to:

1. Being carbon neutral with respect to operations by 2012;
2. Measuring and reporting on community GHG emissions; and
3. Creating complete, compact, more energy efficient rural and urban communities.

The Green Communities Act includes legal obligations for municipalities to include GHG targets, actions and policies.

Method

The CAEP is a comprehensive plan. Its recommended actions seek to reduce GHG emissions and alter how energy is produced and used while advocating the adaptation measures needed to lessen climate change impacts in the community - impacts that are projected to occur despite preventative measures that could presently be initiated. Both approaches are necessary to avoid increasing risk of negative local climate impacts: climate change mitigation efforts (i.e.: actions that reduce emissions) will help lessen increasingly severe climate change impacts, and climate change adaptation efforts will reduce the local impacts of climate change-related events. This plan addresses both approaches.

The CAEP takes a common-sense approach to GHG emissions reductions. It does not rely on unsubstantiated actions, future technologies, or hopeful practices. It includes cost-benefit and payback analyses in the vetting of the recommended actions. There are local and global scientific, local economic and local social impetuses for each recommendation. The CAEP is uniquely tailored to the North Cowichan context and does not rely on any previous projects of this sort.

The CAEP sought input from the public, the Climate Change Action Committee of Council (CCAC), the Strategic Action Group (SAG: a collection of municipal staff representatives), municipal staff project team members, and other agencies and municipalities. The process involved three public consultation events, a public workshop, online engagement strategies, three meetings with council and staff interviews. More than 400 people participated. A crowd-sourced Green Economy Map revealed almost 200 projects and organizations in North Cowichan in the corporate, business, not for profit and citizen realms. 200 community members contributed 165 distinct ideas for sustainability in North Cowichan to an online platform for community idea sharing and discussion. Members of the CCAC, SAG, representatives of the business community, the not for profit community, and municipal staff worked together to create a combination of 'wedges' that might best meet North Cowichan's goal of reducing emissions 33% by 2020.

According to the BC Government Community Energy and Emissions Inventory (CEEI) data in 2007, seventy-six percent of North Cowichan's emissions come from on-road transportation, significantly higher than the BC average of 59%. Conversely, the emissions produced by buildings are well below the BC average: 24% compared to 35%. Since North Cowichan disposes its solid waste off -Island, the BC Government reports that landfill emissions are 0%. The analysis in this project expanded the scope beyond the CEEI to include emissions from solid and liquid waste, agricultural production and forests. This broader scope reflects a fuller picture of the GHG emissions in North Cowichan and results in more opportunities for North Cowichan to achieve reductions. Not included are emissions from small engines (lawnmowers, etc.), boats, planes and major industry because of data limitations or because these emissions are captured by other jurisdictions. SSG's model, GHGProof, was used to undertake the analysis. GHGProof has been used to model more than twenty communities in BC.

Summary of Findings

Achieving significant GHG emissions reductions in North Cowichan represents a major challenge. If land use practices, transportation and energy production and use continue in a business as usual projection, GHG emissions will continue to climb to 15% over 2007 levels by 2020 and to 27% over 2007 levels by 2050. The projected population increase, with its demand for more dwellings, more vehicles and more food, counters reductions achieved by federal and provincial fuel efficiency and low carbon fuels policies.

Based on detailed modelling and scenarios testing, it is recommended that the official OCP target be modified from a 33% emissions reduction under 2007 levels by 2020 to a 33% reduction under 2007 levels by 2025. Taking this emissions reductions trajectory will result in a 57% reduction by 2040 and an 80% reduction by 2050, the same target as the Government of BC. In addition, a suite of actions to reduce the impacts of climate change on the community is recommended.

Minimising electricity demand (or maximising demand reduction) is critical to North Cowichan's GHG target. If BC Hydro runs out of sufficient electricity provision capacity and needs to purchase additional supply from higher GHG intensity sources (i.e.: fossil fuel generated electricity), the resulting increased emissions from electricity produced this way has the potential to undermine or minimise the GHG reductions resulting from CAEP actions. Some recommendations will result in fuel switching from GHG intensive fuels to cleaner, electric sources. While this will result in increased electricity use in the short term, electricity use over the long term is projected to decrease compared to the business as usual projections for North Cowichan. Fuel switching combined with increasingly efficient use of hydro electricity is critical to the success of this plan.

Some GHG reduction strategies result in net financial savings whereas others require investment. A method called the Marginal Abatement Curve was used to analyze the cost or saving per tonne of GHG emissions reduced by each strategy. For example, increased density leads to lower transportation costs and lower household energy costs, which results in both GHG reductions and net financial savings to the community. On the other hand, increasing renewable energy provision results in a net cost to the community for each tonne of GHG emissions reduction. This type of analysis helps to prioritize efforts. In order to capture additional benefits such as employment, reduced air pollution, health benefits and quality of life improvements, an additional analysis of the Social Cost of Carbon (SCC) was performed. This study translates the estimated damages caused by climate change globally into a local dollar value. Annual damages resulting from community GHG emissions are estimated to be between $4 million and $32 million.

The estimated collective investment required to achieve the emissions reduction targets was modelled. Based on the recommended actions, total community investment reaches $25 million a year by 2050. This includes reforestation costs of $1,000/hectare, agricultural production costs of $15,000/hectare, renewable energy generation at $36/GJ, home energy retrofit costs of $10/GJ, recycling costs of $50/tonne, and district energy costs of $7/GJ. Much of this investment would come from private sector investments in new development activities.

Achieving GHG emissions reductions targets will also require the efforts of many people. By 2050, it is estimated that there will be 613 annual jobs created, including 200 jobs in construction, 242 in renewable energy, 48 in retrofits, 7 in district energy, 25 in recycling, 20 in waste management, 63 in agriculture and 8 in forestry.

Many of the recommendations ultimately result in cost savings for citizens. CAEP actions taken by the municipality and community organizations will directly translate to reductions in home heating, energy use and transportation costs.

Summary of Recommendations

The community engagement process and modelling analysis identified actions that reduce GHG emissions (mitigate) and improve resiliency in the face of a changing climate (adapt) while simultaneously addressing community priorities.

Table a) Mitigation Actions

Recommended action	Description
1. Create a Transportation Planning Program with Dedicated Staff	Create a staff position that oversees transportation planning in North Cowichan.
1a. Implement a Smarter Travel Choices Program	A comprehensive program for transportation behaviour change.
1b. Establish a Taxi-bus Rural Public Transit System	Low-cost and effective transit system for low-density areas.
1c. Increase Community Biodiesel Purchases and Require Municipal Fleet Biodiesel Use	Enhance the existing biodiesel operation through procurement.
1d. Join Project Get Ready and Transition the Municipal Fleet to Electric Vehicles	Program to support electric vehicle deployment.
2. Ensure Strict Implementation of OCP Development Guidelines	Enforce Urban Containment boundaries and increase housing density.
3. Employ Municipal Energy Policy Mechanisms	Use new powers under Bill 27 to support renewable energy.
4. Implement a Community Solar Energy Program	Create a mechanism for a large scale solar energy deployment.
5. Establish a Municipal Energy Utility	Create a municipally-owned subsidiary with a mandate to reduce energy consumption and generate renewable energy.
6. Reduce Municipal Building Energy Use	Increase the energy efficiency of municipal buildings.
7. Create an Agricultural Development Centre	Establish an entity that trains farmers, makes farmland available and produces and sells local food.
8. Increase North Cowichan's Forest Area	Establish partnerships to increase North Cowichan's tree cover.
9. Establish a Green Revolving Loan Fund	The fund will create a financing vehicle to overcome barriers to energy efficiency.

Table b) Adaptation Actions

Action	Summary
1. Establish a climate change adaptation working group.	An internal multi-departmental committee that would spearhead education, planning and activities on climate change adaptation.
2. Mainstream adaptation into existing planning, operations and decision-making processes.	Include climate change adaptation in staff reports, infrastructure planning and community planning.
3. Identify high priority risks and opportunities to define and prioritize actions.	Undertake further research on high priority areas of ecosystem restoration, aquifer vulnerability, hazard maps, coastal and intertidal zones and infrastructure.
4. Engage stakeholders and citizens.	Involve stakeholders and citizens in developing adaptation options and in reporting and outreach.
5. Establish and maintain partnerships and networks.	Request that CVRD and CRD create a regional roundtable on climate change adaptation. Establish partnerships with Vancouver Island University, Vancouver Island Health Authority and others.
6. Identify funding opportunities and strategies.	Pursue pilot funding from Natural Resources Canada for adaptation efforts.
7. Commit to monitoring, reporting and revision of strategies.	Use new powers under Bill 27 to support renewable energy.

Path Forward

An implementation plan identifies the actions necessary to place the community on a path to achieve its energy and emissions targets. Municipal leadership will result in a range of new and innovative partnerships with existing and new community organizations and enterprises. Initial municipal impetuous and support provides a hub for the community effort required to achieve the CAEP goals while maximizing social and economic benefits.

The use of local and provincial indicators, updated Community Energy and Emissions Inventory and continuing use of the GHGProof open source model will facilitate tracking of progress towards the targets. CAEP progress will be measured through qualitative and quantitative means. Surveys completed by those participating in CAEP implementation will indicate progress on all community initiatives while staff reporting will keep CAEP partners and Council up to date. Increasing the accuracy of transportation data will aid in tracking the effectiveness of CAEP transportation actions. Tracking of energy, housing, transportation and local climate indicators will ensure CAEP actions are having the desired effects, allowing evaluation and changes to the approach as necessary.


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TO
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1 Climate Action and Energy Plan Background

1.1 Project Purpose

The Municipality of North Cowichan, with the funding support of BC Hydro, has developed a Climate Action and Energy Plan (CAEP). The CAEP inventories the community's existing energy use and greenhouse gas (GHG) emissions, and identifies future trends in energy and GHG emissions based on population, land-use, technology and other factors. It also identifies opportunities to reduce energy consumption and emissions through policy and other municipal mechanisms. The plan includes analysis of the social, environmental and economic impacts of the strategies and has incorporated wide participation from the community in the development and implementation of the plan. The plan is a response to local, regional and global concerns about human-caused climate change and its current and potential effects.

Sustainability Solutions Group (SSG) was hired by the Municipality of North Cowichan to produce the Climate Action and Energy Plan. SSG has developed an open source model that facilitates the analysis of land-use scenarios called GHGProof. SSG has worked with more than ten municipalities and regions in BC to model their future land-use decisions.

North Cowichan has two obligations related to addressing climate change. The first is the BC Climate Action Charter, to which North Cowichan is a signatory. It commits municipalities to three actions:

1. Being carbon neutral with respect to operations by 2012;
2. Measuring and reporting on community GHG emissions; and
3. Creating complete, compact, more energy efficient rural and urban communities.

The second requirement comes from the provincially-legislated Green Communities Act (Bill 27). In May 2008 this act amended the Local Government Act and Community Charter to include legal obligations to include GHG targets, and actions and policies for achieving those targets, in Official Community Plans (OCPs) by 2010. New powers are also assigned to municipalities to support mechanisms to reduce energy, personal vehicle trips and water consumption. North Cowichan's OCP was updated in 2011 and includes three emissions-related objectives:

1. Achieving carbon neutrality as soon as possible.
2. Achieving a 33% reduction in GHG emissions by 2020.
3. Sequestering more carbon than we produce.

The CAEP used an approach that integrated community, corporate (Municipal) and professional ideas and expertise to generate recommendations for actions that will achieve corporate carbon neutrality, community GHG emissions reductions, and carbon sequestration opportunities.

The CAEP process was guided throughout by the five principles established by the Municipality:

4. Sustainability;
5. Economic Opportunity;
6. Smart Growth;
7. Healthy and Safe Community; and
8. Community Engagement.

The Municipality set out to achieve four central goals with the plan, which closely reflect the OCP targets and BC Climate Action Charter agreements:

1. Reducing GHG emissions for both municipal operations and the wider community based on targets outlined in the OCP;
2. Identifying carbon sequestration opportunities;
3. Developing adaptation measures; and
4. Educating and engaging the public.

Applying the five principles in pursuing the goals helped to ensure a holistic planning approach was taken and that the plan would have tangible community benefits. The outcome is a robust plan of recommended actions, implementation steps and evaluation mechanisms that will help North Cowichan meet its targets for energy and emissions reductions while bolstering the local green economy and fostering a sustainable, high quality of life for residents and visitors.

1.2 Plan Structure

This plan is presented in eight sections:

1. Climate Action and Energy Plan Background
2. Project Methodology
3. Project Context
4. CAEP Strategies Exploration
5. Future Land-use Scenario Modelling and Analysis
6. Recommended Actions and Implementation Plan for Community Energy and Emissions
7. Recommended Actions for North Cowichan Corporate Energy and Emissions
8. Climate Change Adaptation Action and Monitoring Strategy

The Climate Action and Energy Plan Background and Project Methodology sections describe the political setting for the project and the approach used to achieve the project's goals. The Project Context describes the impetus for developing a Climate Action and Energy Plan, globally and locally. The CAEP Strategies Exploration section documents ideas for potential actions and strategies to address energy, emissions and climate change effects. The Future Land-use Scenario Modelling and Analysis section takes some of these ideas and models them using future land-use scenarios and municipal policies to achieve GHG reduction targets. The CAEP Recommendations section takes the culmination of the project work and presents a suite of recommended energy and emissions actions. These actions are then reviewed for their broader effects in the Community Economic Development Impacts section. The Implementation section details the steps required to put the CAEP into sustained motion.

1.3 Project Impetus: Planning for Change Through Land-use Decisions

Land-use decisions determine transportation patterns, building design, public infrastructure and energy supply systems for fifty to hundreds of years into the future. This effect is known as 'path dependence': one decision significantly influences future decisions. Once a municipality permits a major investment in buildings or infrastructure, it cannot easily back away from that investment, even if serious disadvantages develop downstream. Designing compact, complete communities can enhance future opportunities. Dense, compact communities make it more possible to consider new transit routes or district energy systems. For example, the long distances and distributed destinations associated with sprawled development creates a dependence on personal automobiles. It is very costly for public transit to service dwellings spread out over a large area.[1] Alternatively, designing for compact, complete communities enhances future opportunities.

Land-use decisions that result in energy intensive neighbourhoods constrict society's ability to fund the transformation to low carbon communities in two ways. They increase the costs of mitigation and adaptation because they require reconfiguring public and private infrastructure. Secondly, higher energy costs and stranded capital investments reduce the availability of funds to finance the transformation. Recognizing this, researchers have proposed a simple maxim for community planning: 'Whatever lasts longest is most important.'[2]

1 Liebowitz, S., & Margolis, S. (2009). Path Dependence, Lock-in and History. Journal of Law, Economics and Organisation, 11(1), 205-226.

2 Jaccard, M.,et al. (1997). From equipment to infrastructure: community energy management and GHG emission reduction. Energy Policy, 25(13), 1065-1074.

1.4 The Case for Greenhouse Gas Emissions Reductions

As Figure 1 illustrates, the most critical element of community energy and emissions planning is land-use. Land-use planning determines the long-term characteristics of a community, such as the way people move around and the types of dwellings built. Thoughtful land-use planning not only reduces GHG emissions, it also lays the framework for significant reductions into the future. It also improves health outcomes, facilitates development of district energy systems, reduces household energy costs and improves quality of life. It is a win-win-win solution.

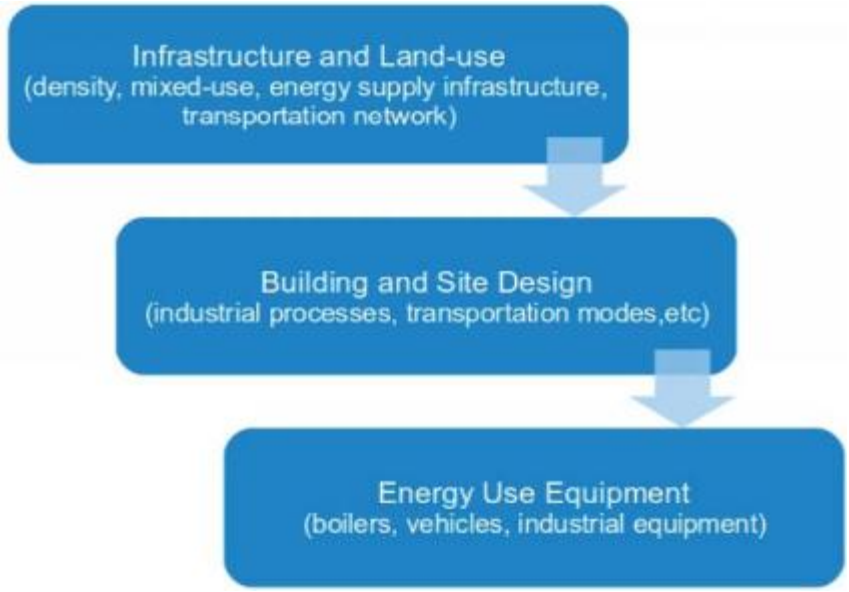


Figure 1: Hierarchy of effective energy and emissions mitigation strategies.

Reducing household costs

Using the GHGProof modelling tool, the consulting team analyzed potential household savings for land-use scenarios that achieve municipal GHG targets. A land-use scenario that achieved a 33% reduction by 2020 (from 2007 levels) would save North Cowichan households $277 million in fuel and gasoline costs - an average per household of $1,468 per year.[3]

Reducing municipal costs

Municipal costs are significantly lower in a community with low GHG emissions. A study for the City of Calgary compared a scenario of continuing current policies (the 'dispersed' scenario) with one that intensifies population and jobs in existing areas (the 'dense' scenario). The 'dense' scenario, it turned out, would cost 25% less to build, and would be cheaper to operate and maintain. Its water and wastewater systems would cost 55% less than in the 'dispersed' scenario. Similar savings were found for road construction, transit costs, fire stations, recreation centres and schools.[4]

Improving health outcomes

Land-use planning that reduces GHG emissions will also improve public health outcomes by:

- Supporting higher levels of physical activity;
- Increasing public transit use;
- Improving traffic safety;
- Reducing overall air pollution;
- Reducing noise pollution;
- Enhancing social interactions; and
- Improving mental health outcomes.

Health conditions which can be positively influenced by land-use planning include heart disease, hypertension, stroke, diabetes, obesity, osteoporosis and depression.[5]

3 BC Hydro forecasts essentially a doubling of electricity prices by 2020. BC Hydro Directive 17, 2006 IEP/LTAP Long Term Rate Increase Forecast filed with BC Utilities Commission. This result is calculated by modelling vehicle kilometres travelled (VKT) for each household in the land-use scenario. The total VKT is divided by the average fuel efficiency of vehicles in the region to identify total fuel volume. The cost of the total fuel volume is calculated and divided by the number of households for each of the land-use scenarios. A similar approach is applied to household heating and cooling costs which are calculated according to the energy intensity of dwelling types and the mix of dwelling types in each of the scenarios. Other in-direct savings also occur, such as reduced commuting time.

4 Study performed by IBI Group for the City of Calgary.

5 Frank, L., Kavage, S., and Litman, T. (2008). Promoting public health through Smart Growth. Prepared for Smart Growth BC. Available at: http://www.smartgrowth.bc.ca/Portals/0/Downloads/SGBC_Health_Report_FINAL.pdf

Building a Green Economy

The idea of a green economy has grown in prominence as a solution to both the economic slowdown and environmental challenges. The United Nations Environment Program (UNEP) defines the Green Economy as "a system of economic activities related to the production, distribution and consumption of goods and services that result in improved human well-being over the long term, while not exposing future generations to significant environmental risks and ecological scarcities".[6] A report by UNEP estimated that 2.3 million people are employed in jobs related to renewable energy worldwide.[7]

In British Columbia a study assigned 10.2% of the Province's GDP - or $15.3 billion dollars - to the green economy, accounting for 166,000 jobs in 2010.[8] Efforts to reduce GHG emissions stimulate innovation in:

- Renewable energy development;
- Manufacturing and installation;
- Energy efficiency retrofits;
- Green building;
- Energy efficient technologies;
- Local agriculture activities; and
- New infrastructure for public transit and cycling.

6 UNEP (2008). Green jobs: towards decent work in a sustainable, low-carbon world. Produced by Worldwatch Institute. Available at: http :// www . unep . org / labour _ environment / PDFs / Greenjobs / UNEP - Green - Jobs - Report . pdf

7 Ibid.

8 Globe Foundation (2010). British Columbia's Green Economy. Building a strong low carbon future. Available at: http :// www . globe . ca / media /3887/ bcge _ report _ feb _2010. pdf

2 Project Methodology

The Climate Action and Energy Project is a culmination of five major areas of public and professional contributions resulting in a suite of recommended actions.

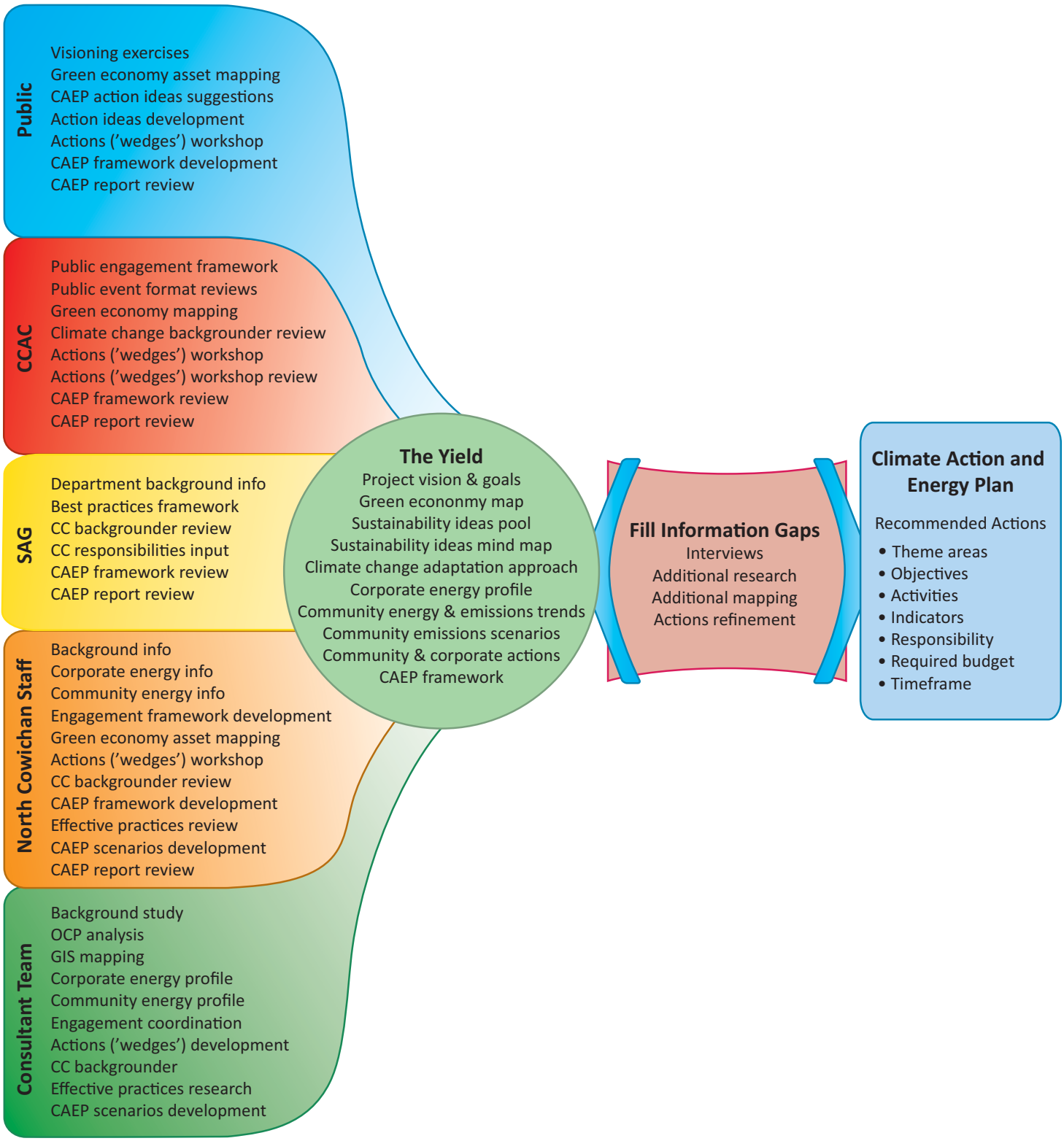


Figure 2: CAEP methodology summary.

The Climate Action and Energy Project was conducted in three phases, as summarized in Table 1.

Table 1: Project Description by Phase

1. Setting the Context	2. Desired Future State	3. Flushing out the Plan
• Establishing community & corporate energy profile baselines • Background mapping • Public event #1: Green economy mapping • Collecting sustainability ideas • Creating a business as usual energy & emissions scenario	• Producing a best practices review paper • Additional mapping • Producing a climate change background paper • Establishing action 'wedges' development & hosting a workshop • Collecting sustainability ideas • Public event #2:Developing the CAEP actions framework	• Developing future scenarios • Final mapping • Creating a climate change mitigation and adaptation framework • Developing a corporate energy & emissions plan • Performing CAEP framework CED and policy analysis • Developing an implementation plan • Publishing the final CAEP report • Public event #3: Presenting the CAEP

Phase 1: Setting the Context

In the first phase of North Cowichan's Climate Action and Energy Plan (CAEP) project, we set out to determine the energy and emissions context for the community. Figure 2 depicts the project inputs and outputs. We sought input from five major areas of focus: the public, the Climate Change Action Committee (CCAC) of Council, the Strategic Action Group (SAG), municipal staff and the consulting team. We also conducted three public consultation events, a public workshop and staff interviews. These helped yield important elements for municipal staff and the consulting team to review and refine.

The CCAC had eight volunteer members of the public and was led by a Council member. They refined the public engagement methodology, reviewed research outputs and refined the CAEP draft. The SAG consisted of members of each municipal department and were key to directing research and our creation of land-use scenarios. Three municipal staff members supported the CCAC, SAG and consulting team throughout the process, contributing to each component of the project.

The consulting team performed a background study on corporate and community energy use and emissions production using municipal information, as well as Community Energy and Emissions Inventory (CEEI) data from 2007 and 2010. The team calibrated the CEEI data by including other energy and emissions data sources such as agricultural land-use, liquid waste and forest cover. Analyzing this data with the GHGProof modelling tool, we developed both a Baseline of community energy use and emissions, and a 'Business-as-Usual' (BAU) Scenario of future land use. The BAU Scenario depicts energy and emissions outcomes that would result from land development patterns as dictated by the official community plan (OCP).

Table 2 shows the information included in the Baseline and the BAU Scenario. Analyzing them helped us to identify the major challenges North Cowichan faces in achieving its energy-efficiency and emissions-reduction goals. We also developed future scenarios using alternate land-use policies, to examine whether different development options might lower community energy use and emissions.

The first public event was held December 8, 2011. Participants worked in groups to develop a Green Economy Map of the community. The Map served to inform the public, municipal staff and consulting team of North Cowichan's sustainability offerings in the corporate, business, not for profit and citizen realms. Map elements were used in developing the CAEP framework. For example: organizations were identified that could be responsible for championing the implementation of a sustainability action or supporting an action championed by another entity.

We also created a platform for community idea sharing and discussion, using IdeaScale, an online public forum. Over 4 months, 200 community members contributed 165 distinct ideas for sustainability actions North Cowichan and its residents might undertake.

Phase 2: Desired Future State

In the second phase, we focused on developing future land-use scenarios, the Climate Change Adaptation Plan, and the draft CAEP. The consulting team reviewed energy and emissions policies in jurisdictions around the world, identifying 13 'best practices' in 6 areas - transportation, buildings, development, financing, energy, and land-use planning - that are most relevant to North Cowichan's challenges. The consulting team recommended how these practices might be translated into the North Cowichan context.

The climate change background research the consulting team performed for the North Cowichan region established expected future climate change impacts. Municipal department representatives were consulted as to how potential climate change impacts would be experienced and dealt with in their departmental jurisdiction. This backgrounder, reviews of relevant municipal plans and interviews with key municipal staff formed the Climate Change Adaptation Plan portion of the CAEP.

We held an action 'wedges' workshop February 21, 2012 with members of the CCAC, SAG, business community, not for profit community, and municipal staff participating. The consulting team had selected 14 of the actions identified by community members on IdeaScale, and used GHGProof to project each one's possible impact on energy efficiency and emissions reduction. These actions were represented as pie-slice 'wedges', their sizes proportionate to their GHG emissions. Participants worked in small groups, each group deciding on a combination of 'wedges' that might best meet North Cowichan's goal of reducing emissions 33% by 2020. Later, the consulting team considered all the wedges and combinations in developing the CAEP.

We hosted a second public event May 29, 2012 in which participants from the community further developed these ideas, many of which ultimately became 'action items' in the CAEP framework. They looked in particular at:

- Actions required to implement the ideas (e.g.: revise bylaw, create program, engage volunteers);
- Timeline (immediate, short term, mid-term, long term);
- Priority level (low, medium, high);
- Champion organization (e.g.: Municipality, citizens group, BC Hydro);
- Support organizations (e.g.: citizens groups);
- Desired outcomes (measurable products of the actions);
- Funding sources (e.g.: Community Futures, Provincial Government, credit union); and
- Measures of success (e.g.: increase in... by x amount, decrease in... by y amount)

Participants also augmented the 'sustainability ideas' with information from IdeaScale suggestions and comments, the Green Economy Map and the 'wedges' workshop.

Phase 3: Developing the Plan

In Phase 3, we collected inputs from Phases 1 and 2 and organized them into a framework for drafting the CAEP. The consulting team also developed two more future scenarios, to demonstrate the estimated effects of alternate energy and emission goals and land-use policies. We based the scenarios on all the data from Phases 1 and 2 - the Baseline of energy use and emissions, the Business-as-Usual Scenario, the Best Practices inventory, and the 'sustainability actions' and 'wedges' developed in the workshops. Scenario maps were developed to visually demonstrate energy options, desirable land-use strategies and transportation options.

The corporate energy and emissions plan was developed based on corporate policies and intentions. Actions to achieve greater energy efficiency and reduce emissions were determined and assigned to responsible parties. A reporting framework was established to monitor progress towards the corporate goals.

We evaluated the Draft CAEP using a 'triple bottom line' approach, taking into account social, environmental and economic benefits. This helped us to see what collateral effects might result from actions aimed at reducing energy use and emissions. Working with municipal staff, the consulting team also created an Implementation Schedule for the CAEP, with a timeline and sequence for priority actions. Finally, we presented the CAEP and implementation plan to the public and Council for review. We made modifications based on feedback and this, the Final Climate Action and Energy Plan, was produced.

3 Project Context

3.1 General Climate Context

The Earth's climate is determined by its ability to both trap and reflect heat from the sun and to circulate it through the atmosphere and the oceans. When this capacity is altered, the Earth's climate can change. The term "climate change" refers to a change in the average state of the climate. Annual climate data has shown noticeable temperature highs and lows, but over longer periods of time there has been a discernible warming trend across the globe. The global average temperature over the first decade of the 21st century was significantly warmer than any preceding decade on record over the past 160 years.[9] The overwhelming majority of scientists agree that this is due to rising concentrations of heat-trapping greenhouse gases in the atmosphere caused by human activities.[10] The increase in these gases alter the Earth's ability to naturally regulate the climate.

The impacts of climate change are becoming more apparent. Two thousand species are moving away from the equator at an average rate of more than 15 feet per day to avoid increasing temperatures, a rate two to three times faster than previously reported.[11] The impacts of weather events on the built environment are another climate change indicator, particularly relevant to municipalities. Munich Re, a large re-insurance company, reported that 2010 brought the second-highest number, after 2007, of loss-related weather catastrophes since their records began in 1980.[12]

The Stern Review: Economics of Climate Change was released in 2006.[13] The review analyzes the economic impacts of climate change, drawing on extensive climate change science, and determines that climate change is the largest market failure ever seen. The report stresses that the benefits of strong and early action on climate change (i.e.: mitigation efforts) far outweigh the economic costs of inaction. The Review estimates that if action is not taken, base climate change costs and risks will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, damage estimates could rise to 20% of GDP or more. In contrast, the costs of action – reducing greenhouse gas emissions to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year.

Recognizing this, some nearby jurisdictions have passed laws requiring municipal plans to include GHG emissions targets (e.g.: California, Washington and BC). This reflects a growing awareness that urban density and land-use patterns affect many GHG emission factors, such as:

- Automobile and service vehicle distances travelled,
- Modes of travel chosen;
- Building typology; and
- Possibilities for community energy systems.

Land-use decisions result in durable infrastructure and resilient communities, ensuring we can adapt to climate change, and therefore should be the first priority in efforts to reduce energy consumption and GHG emissions.

There are a range of climate change impacts that are particularly relevant to North Cowichan. In BC, forest fire records show that the wildfire season has been increasing in length by one to two days a year since at least 1980.[14] Lightning-caused fires are projected to increase globally by 44% by 2100.[15] In the Cowichan Valley average temperatures are predicted to increase by 1.6°C by 2050 over

9 Hadley Centre (2011). Evidence: the state of the climate. UK Met Office. Available at: http :// www . metoffice . gov . uk / media / pdf / m /6/ evidence . pdf

10 Intergovernmental Panel on Climate Change (2007). Climate Change Synthesis Report: 2007.

11 Chen et al. (2011). Rapid Range Shifts of Species Associated with High Levels of Climate Warming. Science 19 August 2011: 1024-1026.

12 Munich Re (2011). Topics Geo. Natural catastrophes 2010- analyses, assessments, positions. Available at: http://www.munichre.com/publications/302-06735_en.pdf

13 Stern, N. (2006). "Stern Review on The Economics of Climate Change (pre-publication edition). Executive Summary". HM Treasury, London. Archived from the original on 31 January 2010. Retrieved 31 January 2010.

14 BC Ministry of Forests and Range Wildfire Management Branch (2009).. Climate change and fire management research strategy. Available at: http://bcwildfire.ca/weather/Climate/docs/Climate%20change%20forum%20report_final.pdf

15 Bruce, J (2011). Climate change information for adaptation. Climate trends and projected values for Canada from 2010 to 2050. Published by Institute for Catastrophic Loss Reduction.

2010 levels and while overall precipitation is projected to increase by 6%, summer precipitation may be reduced by as much as 30%.[16]

In 2008, BC's "Green Communities" legislation (Bill 27) amended the Local Government Act and Community Charter. It required local and regional governments to adopt GHG emission reduction targets, and actions and policies for achieving those targets. The amendment also gives municipalities new land-use powers to address climate change and sustainable development.

3.2 General Local Context

Geography

The Municipality of North Cowichan is located on the southeast coast of Vancouver Island, one hour's drive north of Victoria. The area encompasses 20,430 hectares of lowland coastal and mountainous terrain with several fresh water lakes.[17] Within the North Cowichan municipal boundaries are the communities of Chemainus, Crofton and Maple Bay, where the majority of North Cowichan's population is collected. The boundary abuts north Duncan. North Cowichan and Duncan share some infrastructure.

Climate

North Cowichan's coastal setting provides a temperate climate moderated by the ocean and resulting sea-breeze. Microclimates vary in the area depending on local topography changes and distance from the coast, with inland areas much warmer in the summer. The valley has an average of 274 frost-free days and boasts one of the warmest average annual temperatures in Canada.[18] Certain areas of North Cowichan have experienced flooding in the past due to combinations of heavy rainfall and high tides. Increasing storm intensity, attributed to climate change effects, has threatened stable electricity provision in the past few years.

Land

One quarter of the area in the Municipality is privately owned forest. Since establishing the Forest Advisory Committee in 1981, loggers have practiced patch cut and green tree retention, and planted all harvested areas. The forest supports several uses such as harvesting, education, water resource management and recreation. Portions of the Mt. Provost, Mt. Tzouhalem and Maple Mountain areas have been designated as ecological reserves.[19] A Coastal Douglas-fir biogeoclimactic zone, with red and blue listed species, runs along the coast of North Cowichan. This uncommon forestry zone is home to diverse and provincially rare plant species. One quarter of the Municipality's land area is dedicated to the Agriculture Land Reserve (ALR). Of the 6,250 hectares in the ALR, 75% is actively farmed.[20] The rich ALR soil provides a productive setting for agricultural practices including dairy, poultry, vegetable, and berry production. The surrounding wetlands and coastline areas provide ideal habitats for waterfowl, wildlife and aquatic species.

Ecology

North Cowichan lies in the Coastal Douglas-fir biogeoclimatic zone and contains a wide diversity of ecosystem types, many of which are currently listed as critically imperilled in a global context. The municipality has more than 40 kilometres of oceanfront that has competing values for recreation, commerce and conservation purposes. The coast is vulnerable to the forces of nature including sea level rise due to climate change. Two major rivers flow through North Cowichan, Chemainus and Cowichan, with the latter designated as a heritage river. The estuaries of these river systems, the most productive ecosystem on earth, are also identified as two of the province's most important due to size, habitat, vegetation, water bird use and herring spawn. Many of these ecosystems will be adversely impacted by climate change.

Demographics

The Municipality occupies the northeastern tip of the Cowichan Valley Regional District (CVRD) and is the most populous of the

16 Ibid.

17 Municipality of North Cowichan (2011). North Cowichan Official Community Plan.

18 From the Ground Up Resource Consultants Inc., Ehrler Limousin and Associates, BMC Business Management Consultants (2010). Cowichan Region Area Agricultural Plan. Prepared for Cowichan Region Economic Development Commission.

19 Municipality of North Cowichan (2012). Municipal Hall Forestry. Retrieved from http://www.northcowichan.ca/siteengine/ActivePage.asp?PageID=93

20 Westland Resources Group, Groundworks Strategic Marketing Solutions (2001). Strategic Agricultural Plan. Prepared for the Municipality of North Cowichan.

CVRD's four incorporated communities. It supports a growing population of 30,125 (BC Stats, 2011), with an annual growth rate of 1.34% (North Cowichan OCP average rate between anticipated local and anticipated provincial growth rates).[21] In 2010-2015, growth is projected in all age groups except 15-24 year olds (as the "Baby Boom Echo" generation ages out of this group).[22] Population reports performed as part of the 2011 OCP review indicate that the population is aging at a faster rate than anticipated. These reports also confirm the decrease in young demographics.

Economics

Agriculture, forestry, tourism, and land development drive North Cowichan's economy. The area has a rich farming history, including the first dairy co-op in BC, founded in 1895. Agricultural sector growth has increased over the last 20 years by 14.5% (farm gate sales, adjusted for inflation) while over the same period the area farmed has decreased.[23] A recent State of the Industry Report indicates a trend towards smaller, more intensive and organic farms along with a livestock industry in decline (due to rising input costs, reduced processing capacity and increased regulations).

21 Municipality of North Cowichan (2011). North Cowichan Official Community Plan Review.

22 Municipality of North Cowichan (2011). North Cowichan Official Community Plan.

23 From the Ground Up Resource Consultants Inc., Ehrler Limousin and Associates, BMC Business Management Consultants (2010). Cowichan Region Area Agricultural Plan. Prepared for Cowichan Region Economic Development Commission.

3.3 Local Energy Profile

3.3.1 North Cowichan Energy Profile

BC's Community Energy and Emissions Inventory (CEEI) lists energy and emissions data for each municipality. It includes GHG emissions from residential and commercial buildings, private and commercial transportation, and solid waste, but not from agriculture, deforestation, liquid waste, industry, agricultural transportation, marine or air travel.[24, 25] The following graphs depict North Cowichan's emissions factors in 2007.[26] Emissions are presented in tonnes (t) of carbon dioxide equivalent (CO_2e). CO_2e measures the global warming potential of a given gas (e.g., methane) in terms of the amount of CO_2 that produces the same global warming effect. Solid waste generates no emissions due to it being disposed of outside of municipal boundaries, in Washington state.

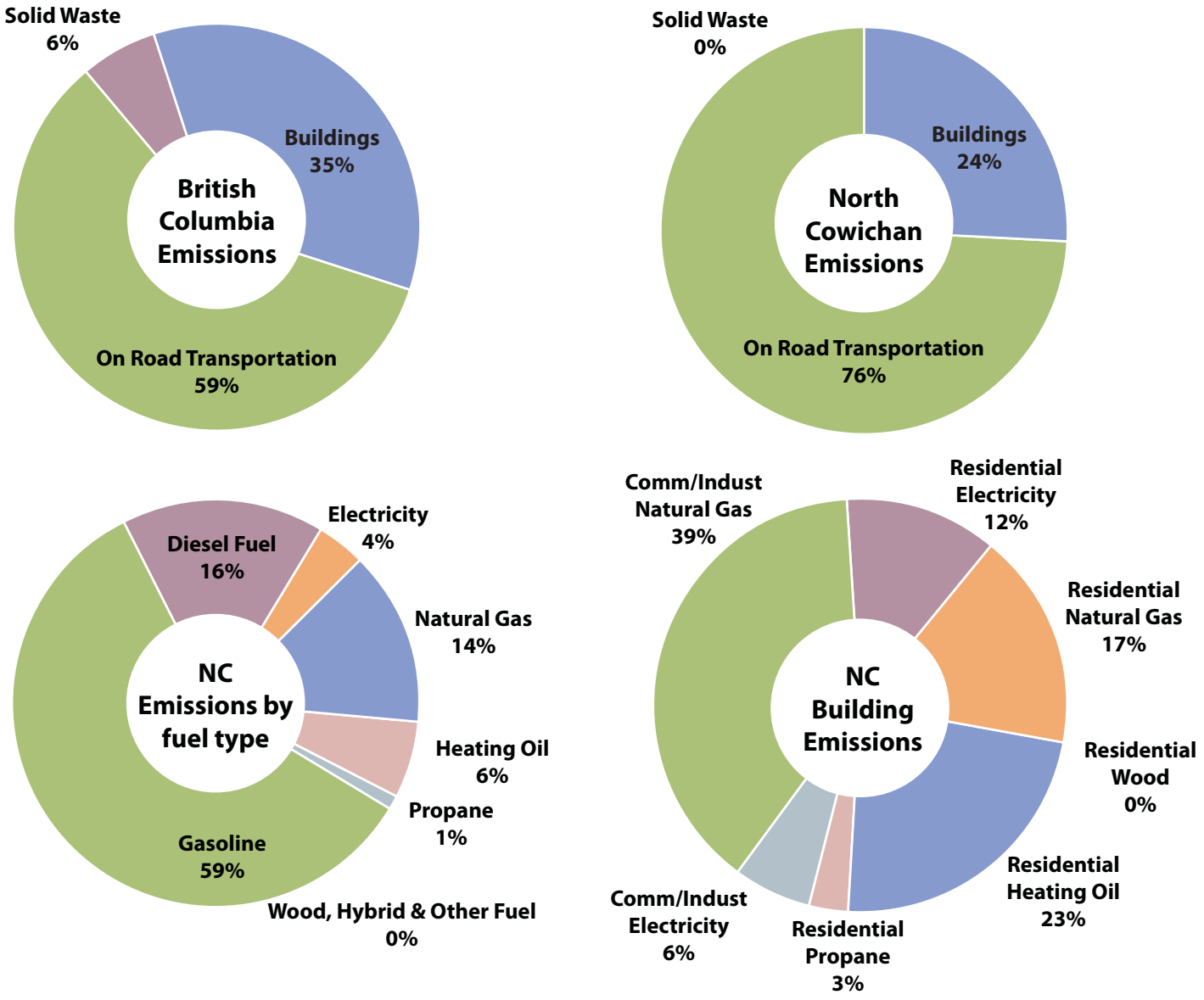


Figure 3: North Cowichan energy and emissions CEEI data.

24 BC Ministry of Environment CEEI. http://www.env.gov.bc.ca/cas/mitigation/ceei/index.html

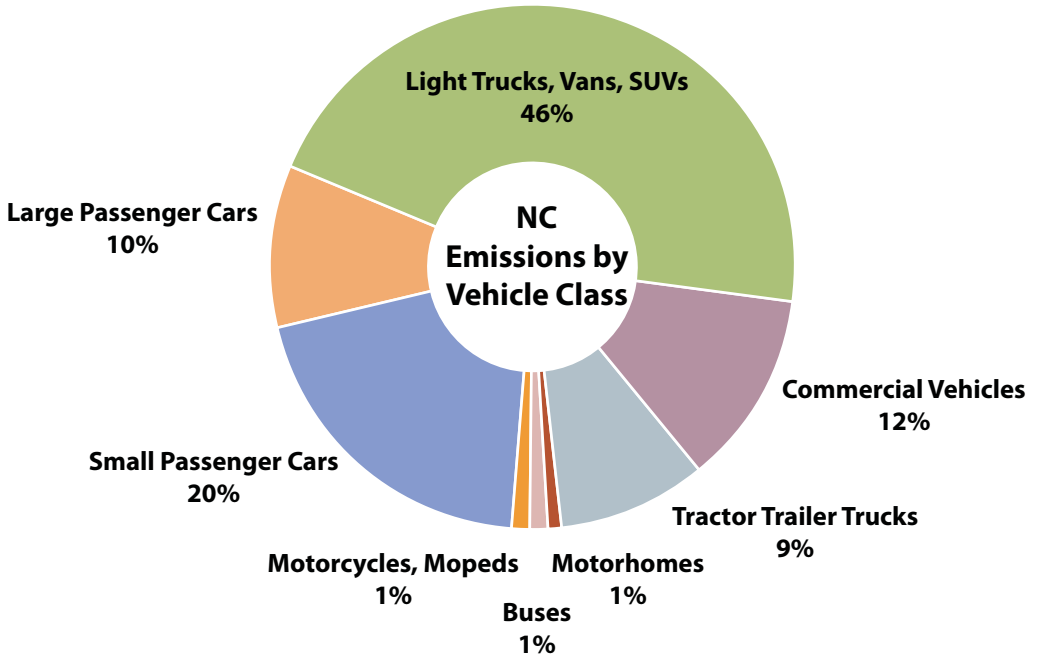
25 GHG emissions from deforestation and agriculture are provided for information only as memo items and are not counted in the total emissions in CEEIs for regional districts. The Government of BC indicates that this information should not be used for decision-making purposes. CEEI uses actual data from energy utilities for buildings but estimates GHG emissions from vehicles and solid waste. CEEI vehicle emissions are estimated using vehicle registrations and a model developed by calibrating Air Care mileage readings from the Lower Mainland . It is not known how accurate these estimates are.

26 At the time of report submission, draft CEEI data for 2010 had been released. Due to the data's draft nature and containing known errors, it is not used here.

Seventy six percent of North Cowcihan's emissions come from on-road transportation, significantly higher than the BC average of 59%. Conversely, the emissions produced by buildings is well below the BC average: 24% compared to 35%. Since North Cowichan disposes its solid waste off-Island, its landfill emissions are 0%. A new kitchen waste collection program has begun in North Cowichan. Due to its infancy, there is no emissions data yet available.

In keeping with the high proportion of vehicle emissions, gasoline and diesel account for 75% of North Cowichan's emissions by fuel type. A large portion of its building emissions come from commercial and industrial use of natural gas. Residential energy use - mostly for heating - makes up most of the remainder, with significant emissions from electricity, natural gas and heating oil.

Consistent with many other largely rural BC areas, light trucks, vans and sport utility vehicles (SUVs) produce a large share (46%) of the total vehicle emissions. Other personal vehicle travel accounts for another 31%. The remaining vehicle related emissions come from commercial vehicles and transport trucks, largely due to the freight traffic on the Trans Canada highway.



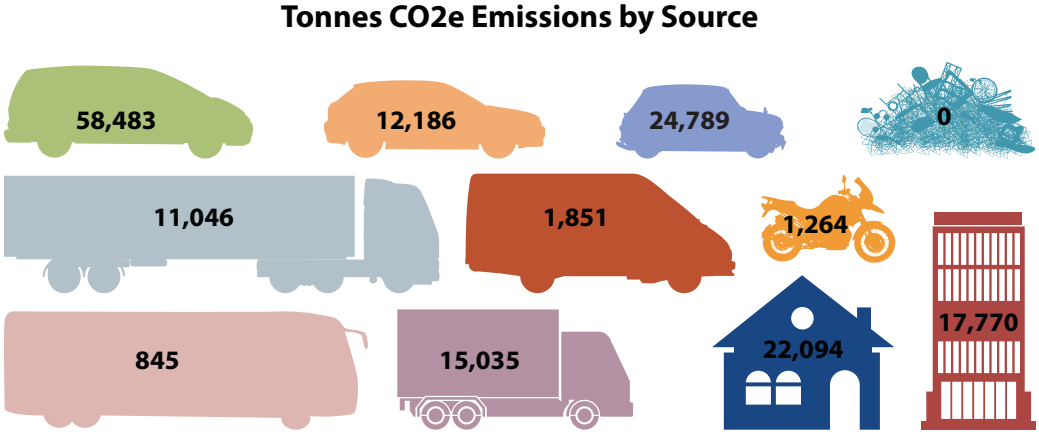


Figure 4: Emissions by vehicle type.

3.3.2 North Cowichan Energy and Emissions as Compared to Other BC Municipalities

The consulting team compared North Cowichan's GHG emissions results with those of other BC municipalities. Investigating these differences can reveal opportunities for reducing emissions. The per-capita numbers facilitate comparison between municipalities with different populations.

For example, if North Cowichan were to pursue the provincial target of a 33% reduction by 2020, its per-capita emissions would need to fall from 5.4 tCO2e to 3.6 tCO2e. To understand what 3.6 tCO2e might mean, we can look at other municipalities already at that level, such as Oak Bay, at 3.2 tCO2e per capita. Oak Bay also has higher per capita use of public transit, cycling and walking. What practices might we adapt from a place like Oak Bay to achieve our emissions goals?

The following infographics depict comparisons between different elements of chosen BC communities.

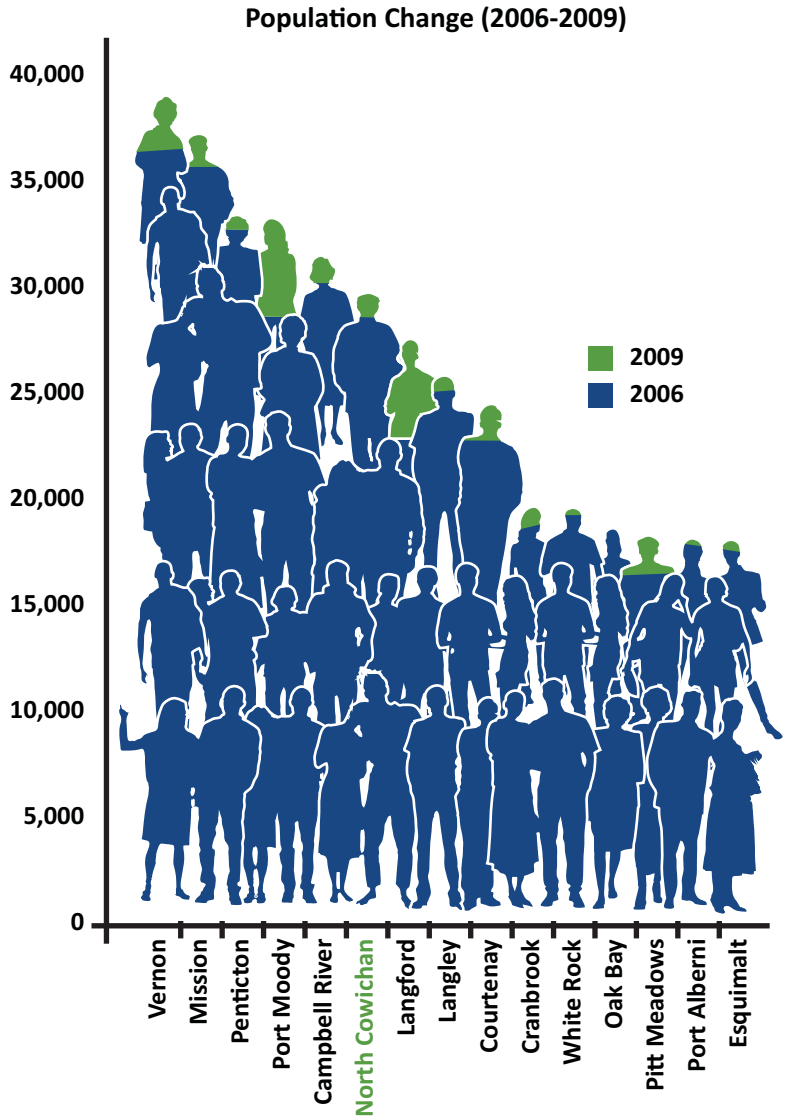


Figure 5: Population Change Comparison. North Cowichan's population changed by 1,085 people between 2006 and 2009. This is a similar growth to Langley's, Mission's and Penticton's. Oak Bay, on the other hand, declined slightly in population (28 people) over the same period.

North Cowichan has a high percentage of single detached homes which typically have high energy use and emissions compared to other housing types, such as apartments or row homes. Esquimalt, Langley and White Rock have notable low percentages of single detached homes and high percentages of apartment buildings.

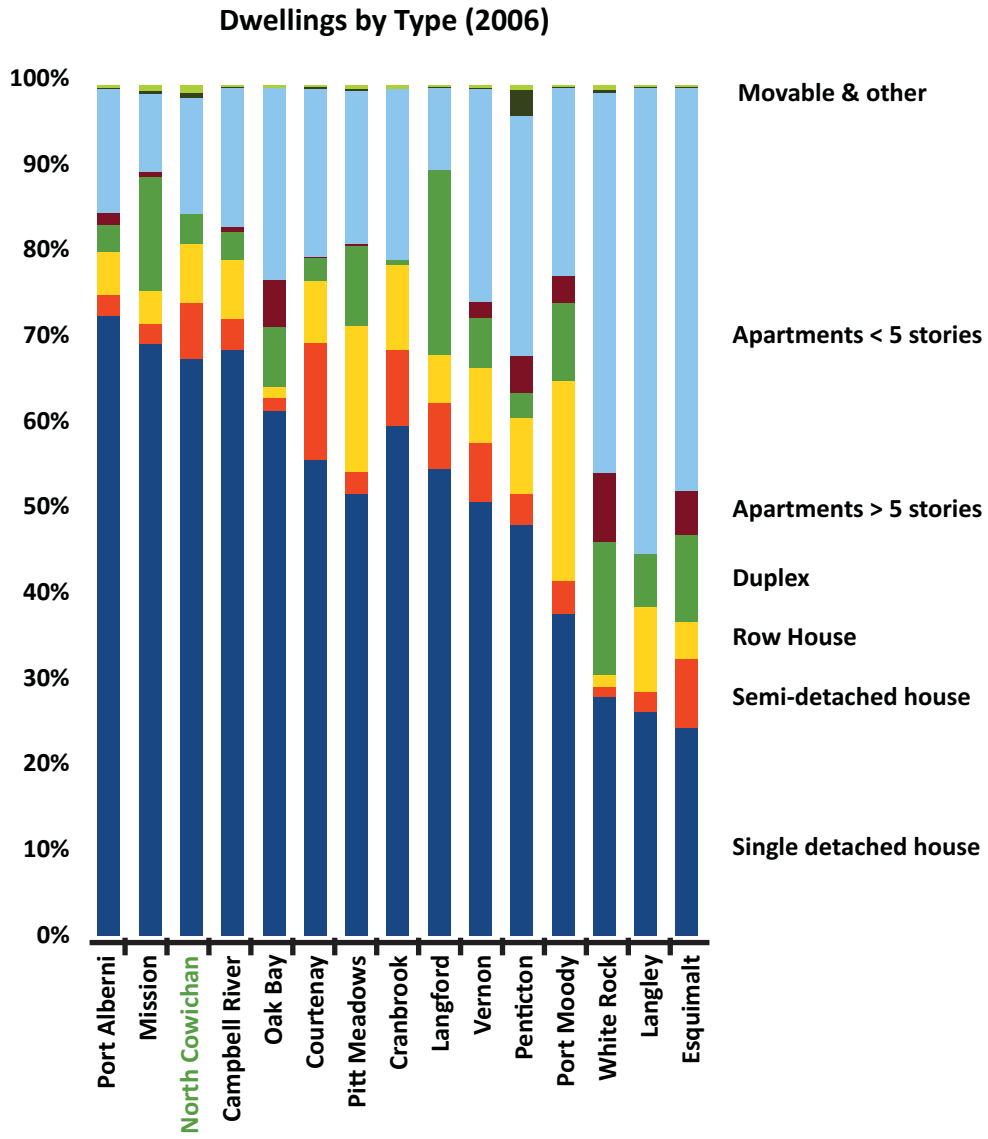


Figure 6: Dwelling type comparison.

Of all communities studied, North Cowichan has the highest percentage of trips taken by vehicle. Esquimalt, Oak Bay, Pitt Meadows, Port Moody and White Rock have noticeably higher levels of public transit use, walking and cycling. In most cases, the difference is due to greater housing and amenity densities allowing for more trips by walking and cycling, as well as offering greater opportunity for public transit options.

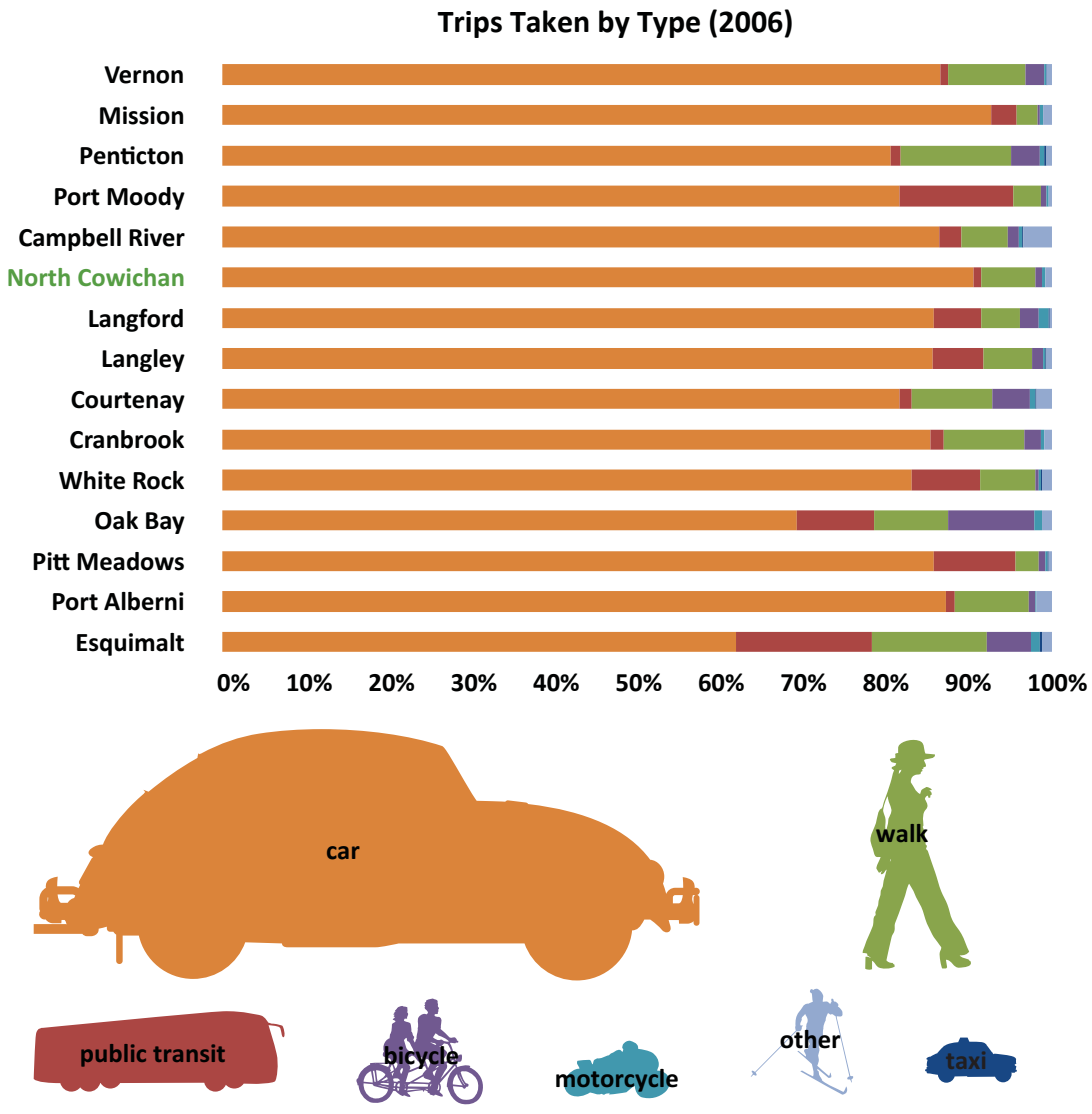
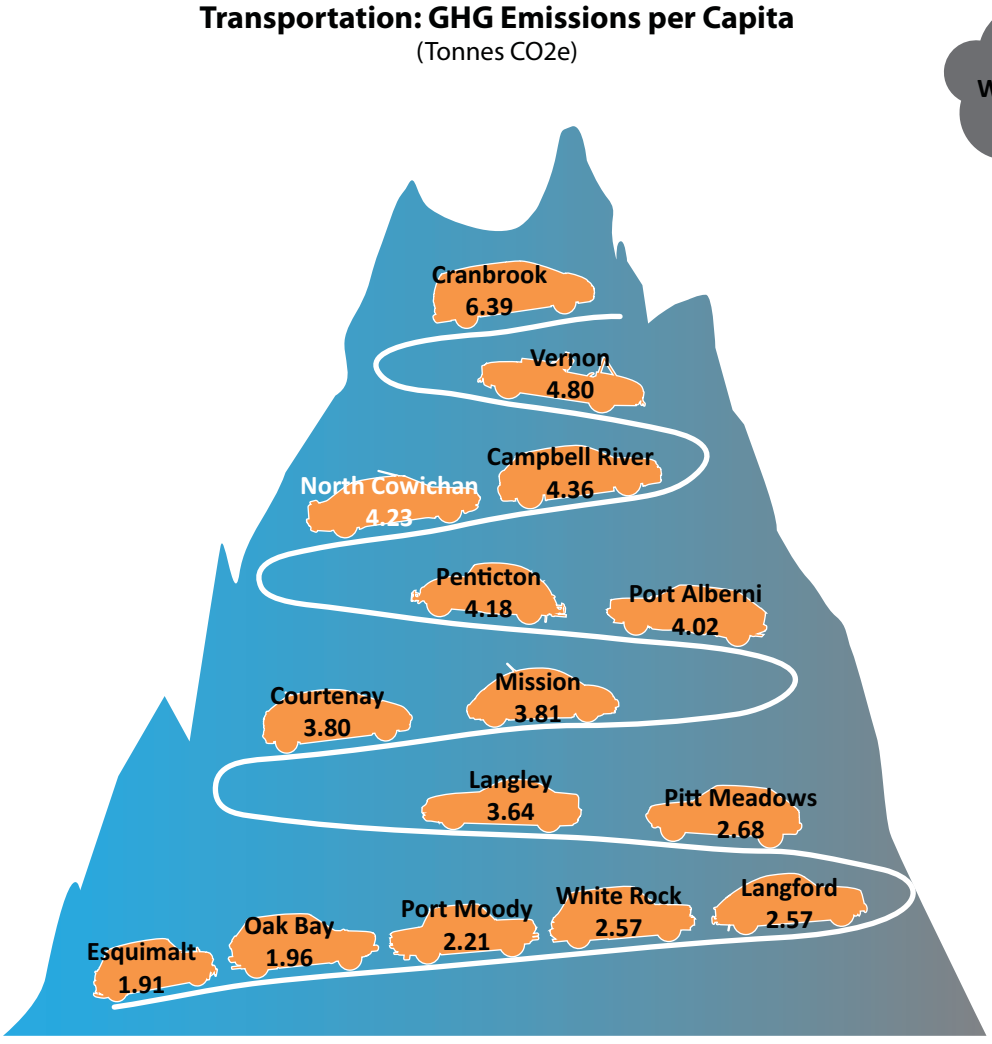
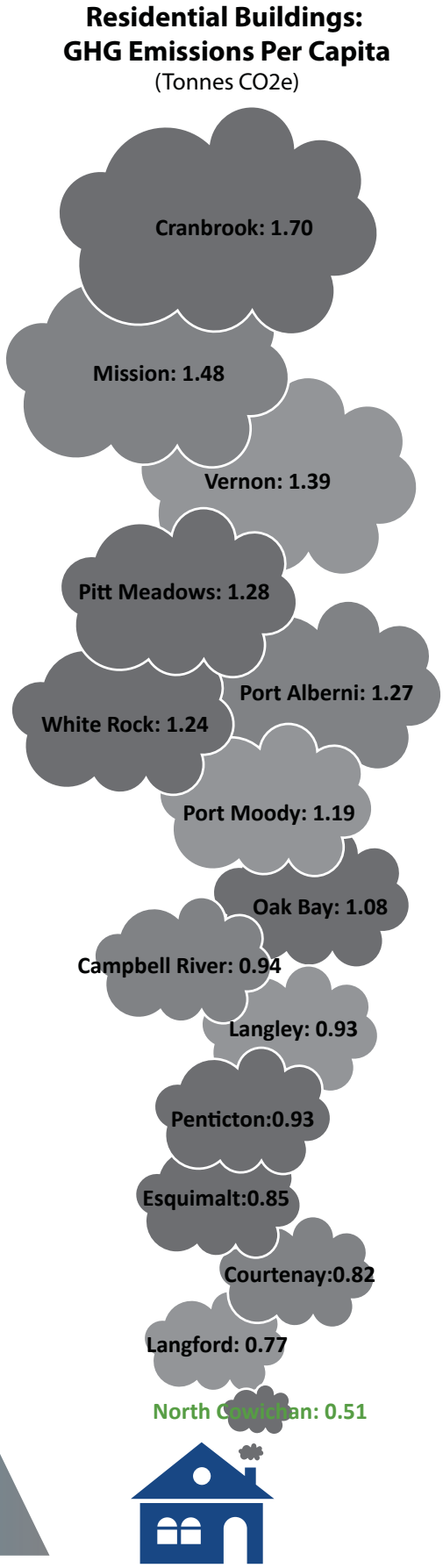


Figure 7: Trip mode comparison.

Figure 8: Per capita residential building emissions comparison.
North Cowichan's residential emissions are remarkably low because many residences use electricity generated by hydro power for heating and cooling. Residences in other communities rely more on heating oil and natural gas. Wood heating is not included in the CEEI data calculations, estimating wood's burning as being equivalent in its carbon emissions to its natural decomposition. However, it is estimated that North Cowichan consumes 154,568 GJ of energy through wood heating, about 30,000 GJ more than the community's heating oil use.[27] >

Figure 9: Per capita vehicle emissions comparison.
North Cowichan's transportation emissions are high. Esquimalt, Oak Bay and Port Moody have low per-capita transportation emissions - less than half that of North Cowichan. ᵛ





27 Enerficiency Consulting, May 2010. Residential Heating Oil, Propane, and Wood Heat Estimates for BC Communities. Retrived from http://www.env.gov.bc.ca/cas/mitigation/ceei/pdf/Residential_Heat_Estimates.pdf

At 5.4 tCO2e per capita, North Cowichan ranks in the middle of this list of 15 compared communities in total per capita emissions. Like the other communities, it produces most of its emissions from personal vehicle travel.

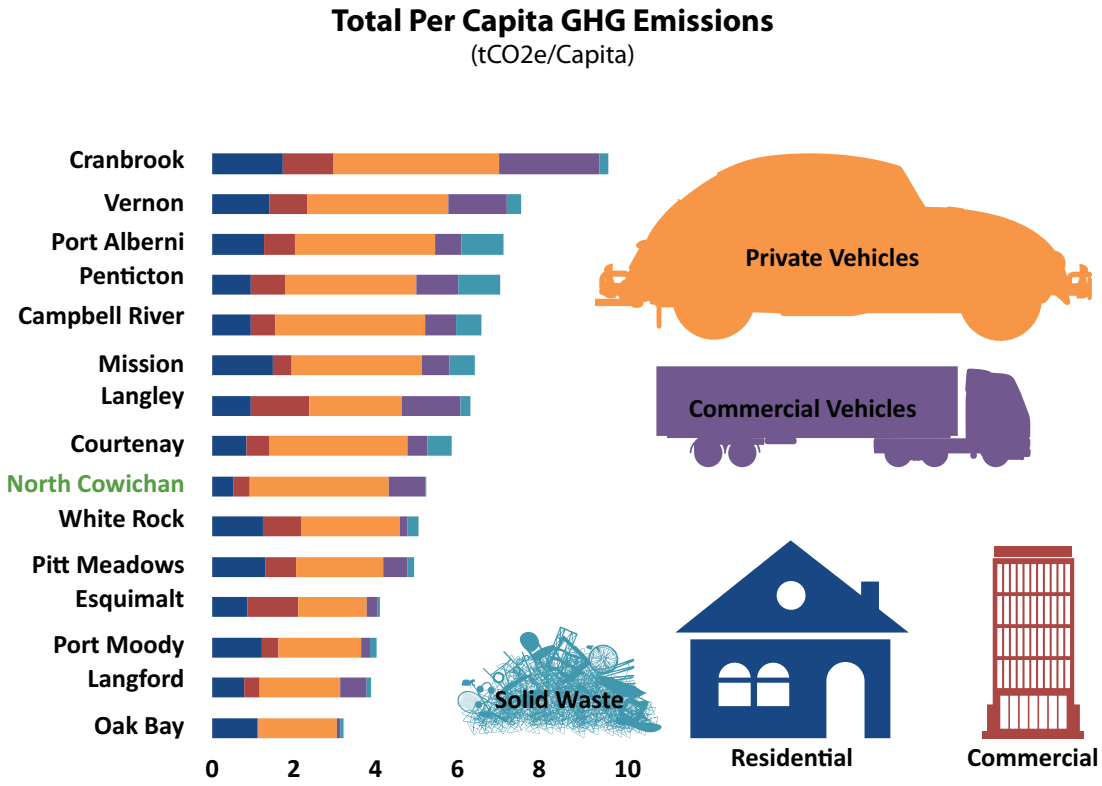


Figure 10: Total per capita GHG emissions comparison.

The objective of comparing different municipalities is to understand why municipalities' emissions differ and what lessons can be learned from different land-use patterns, climate, population or other variables.

On a per capita basis, North Cowichan's GHG emissions are high relative to other communities, most likely due to the geographic extent of the community but also indicating that there is scope for reductions in this area. The mode share comparison (Trips taken by type illustration, Figure 8) indicates that walking and cycling rates are very low relative to other communities; land-use and distances are likely barriers to walking or cycling, which is not the case for some of the municipalities around Victoria.

On the other hand, per capita GHG emissions from residential buildings are the lowest of any municipality in the comparators set, despite having one of the highest shares of single family dwellings (Dwellings by Type illustration, Figure 7). There is no immediately apparent reason why emissions from residential buildings are so low relative to other communities on Vancouver Island and in the lower mainland in particular.

In summary, North Cowichan's per capita GHG emissions are in the middle of the municipalities compared, and those that have lower emissions are all more urban than North Cowichan. This essentially demonstrates that higher density land-use results in greater opportunity for emissions reductions.

3.4 Climate Change Risk

3.4.1 Climate Change Projections in North Cowichan

In 1990, the First Assessment Report of the Intergovernmental Panel on Climate Change was produced. A consensus of thousands of climate scientist the world over, it contained a prediction of the global mean temperature trend over the 1990–2030 period. Currently, halfway through that period, the predictions are proving to be accurate to the changes observed in the climate, including a warming trend of 0.55 degrees over the past 20 years.[28]

Climate change mitigation (actions that reduce changes to the climate) and adaptation (actions that adapt our way of living to climate change impacts) are both necessary components of effective risk management. It is essential to continue to prioritize greenhouse gas emissions reduction to avoid the worst impacts of climate change. At the same time, the level of greenhouse gases already in the atmosphere (in addition to future emissions) will translate into significant ongoing climate change and related impacts for decades to come. Climate change planning offers yet another compelling reason to build smarter, more resilient communities. Most climate-change strategies also deliver sustainable, more livable, healthier and resilient communities.

Much of the following information is drawn from the Pacific Climate Impacts Consortium's (PCIC)'s research, and augmented with other scientific studies focusing on BC and the south coast in particular. PCIC is based at the University of Victoria and performs sub-regional climate change analysis, making its information and analysis available to other organizations.

Temperature

Over the past century, British Columbia temperatures have been warming and in the second half of the century its temperature change exceeded the global average. But BC's low temperatures are rising faster than its high temperatures, which means the province is getting less cold, rather than more hot.[29]

Projections show the Cowichan Valley warming at or slightly below the BC average. This will produce more new 'growing degree days' here than in the rest of the province. Warming will be greater in inland areas than in coastal areas, and greater in winter than in summer. The annual number of frost-free days is also projected to increase.[30] To illustrate the magnitude of these changes, BC's average annual temperature is projected to increase by 2.8°C by the 2080s. This means that an average year in that decade will be as hot as the hottest years we experienced in the past century.[31]

Precipitation

Over the last century, precipitation increased an average of 22% across the province, but the change in the Cowichan Valley was only between -5% and +10%. These increases occurred mainly during the summer months.[32] On average, BC has been experiencing more days out of the year with precipitation, and fewer consecutive dry days.[33] For the coming decades, projections show North Cowichan's annual precipitation continuing to increase slightly, but with notable decreases in the summer - decreases larger than the provincial average.

Since 1989, BC has been in a 'cool' phase of the Pacific Decadal Oscillation cycle, a phase characterized by wetter conditions and cooler winters. A study in the Greater Vancouver area found that the number of high-intensity rainfall events has risen in this period, compared with the last cool phase (1947-1976). It also found rainfall intensity in April, May and June increasing significantly, with shorter events (up to 2 hours) particularly more intense.[34]

28 Frame, David J and Stone, Daithi A. Assessment of the first consensus prediction on climate change. Nature Clim. Change, 2012, vol. 2, issue 12.

29 Rodenhuis et al 2009.

30 Ibid.

31 Ibid.

32 Ibid.

33 Vincent and Mekis 2006.

34 Murdock et al 2007.

Table 2: 1971-2000 Mean Temperature and Precipitation (Saanichton Weather Station)		
	Temperature (°C)	Precipitation (mm)
Annual	10.0	907.7
Winter	4.5	395.4
Spring	9.2	162.0
Summer	16.0	83.4
Autumn	10.3	266.9

Table 3: Climate Projections, 2020 and 2050: Cowichan Valley vs. BC average					
Source: Pacific Climate Impacts Consortium, www.Plan2Adapt.ca		Projected Change from 1961-1990 Baseline			
		BC Average (and Range)		Cowichan Valley Average (and Range)	
Weather Element	**Time of Year**	**2020**	**2050**	**2020**	**2050**
Temperature	Annual	+ 1.0 °C (+0.5°C to +1.6 °C)	+ 1.8 °C (+1.3°C to +2.7°C)	+0.9 °C (+0.4 °C to +1.2 °C)	+1.6 °C (+0.9 °C to +2.3 °C)
Precipitation	Annual	+4% (0% to +8%)	+6% (+2% to +13%)	+3% (-2% to +7%)	+6% (-2% to +12%)
	Summer	0% (-4% to +5%)	- 1% (-8% to +7%)	-10% (-21% to +2%)	-19% (-30% to +2%)
	Winter	+4% (+1% to +8%)	+8% (-2% to +15%)	+1% (-3% to +8%)	+5% (-3% to +14%)
Snowfall	Winter	-2% (-12% to +4%)	-10% (-17% to +2%)	-24% (-44% to -7%)	-39% (-58% to -24%)
	Spring	-30% (-56% to +1%)	-58% (-71% to -11%)	-31% (-60% to -8%)	-53% (-70% to -20%)
Heating Degree Days	Annual	-358 (-588 to -169)	-648 (-955 to -454)	-327 (-445 to -156)	-567 (-802 to -346)
Growing Degree Days	Annual	+163 (+70 to +238)	+283 (+177 to +429)	+267 (+132 to +353)	+476 (+273 to +697)
Frost-free days	Annual	+10 (+5 to +20)	+20 (+12 to +29)	+9 (+4 to +13)	+15 (+10 to +21)

Hydrology

Trends for annual streamflow in streams along the south coast are mixed, some increasing and others decreasing, while low flow levels have decreased.[35] As current warming continues, more precipitation will come as rain, less as snow. This will occur primarily in winter, when the portion falling as snow on Vancouver Island is projected to decrease much more sharply than elsewhere in BC.

In the Cowichan Valley, warmer and wetter winters will increase the likelihood for winter flood events as winter flows increase. Peak flows in the spring will decline and continue to occur earlier, while total flows in summer and fall will continue to decline. Together with rising temperatures and evaporation rates this mean a lengthening dry season and low flow period between May and October, with a rise in the occurrence of drought conditions.[36]

35 Rodenhuis et al 2007.

36 Ibid. 28

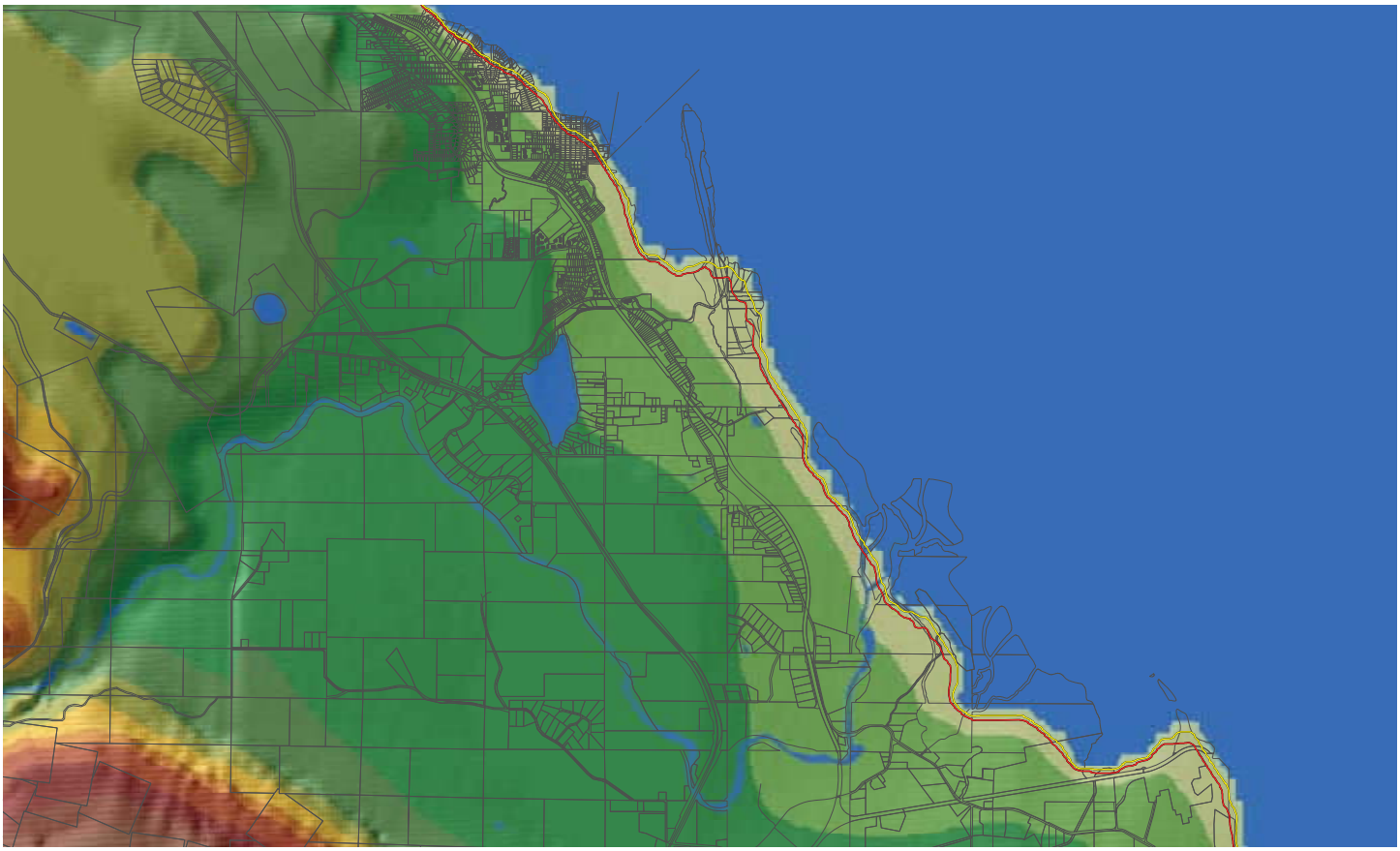
Extremes

BC's century-long pattern of increasing extreme hot temperatures, and fewer extreme cold temperatures, is projected to continue. Extreme weather events - both wet and dry - are expected to become more frequent. Already, studies show an increase in heavy rainfall events in the spring, and an increase in both extreme wet and extreme dry conditions in summer.[37, 38] The intensity and magnitude of precipitation events are projected to increase. In the US Pacific Northwest models predict similar changes with more frequent extreme heat events, less frequent extreme cold events, increased extreme precipitation in the winter, and increasing rain-on-snow events accompanied by more severe flooding.[39] Other studies link high intensity rain events to an increasing risk of landslides in southwestern BC.[40] South coast of BC projections show a decrease in storm frequency, but an increase in severe winter storm intensity.[41] The trend of more frequent and severe forest fires is expected to continue in western North America.[42]

Sea Level Rise

Global sea level has risen more than 20 cm since 1899,[43] though this varies significantly by location due to land movement (rising or falling) and climate and weather variability. Projections show this trend will continue. Estimates for the BC coast over the next century suggest a minimum sea level rise of 80 cm for the east coast of Vancouver Island.[44] Currently, a combination of a severe storm event at high tide during an El Nino year could overwhelm coastal flood protection infrastructure even without additional sea level rise. In coastal areas, potential decreases in groundwater recharge rates together with rising sea level could lead to salination of groundwater supplies.[45] The effect of sea level rise on North Cowichan shorelines is shown in Map 1. Certain areas are submerged, many are private properties with homes on them - further rationale as to the need for adaptation measures now rather than later.

Map 1a: Projected Sea Level Rise of 1 and 2 Metres Inset



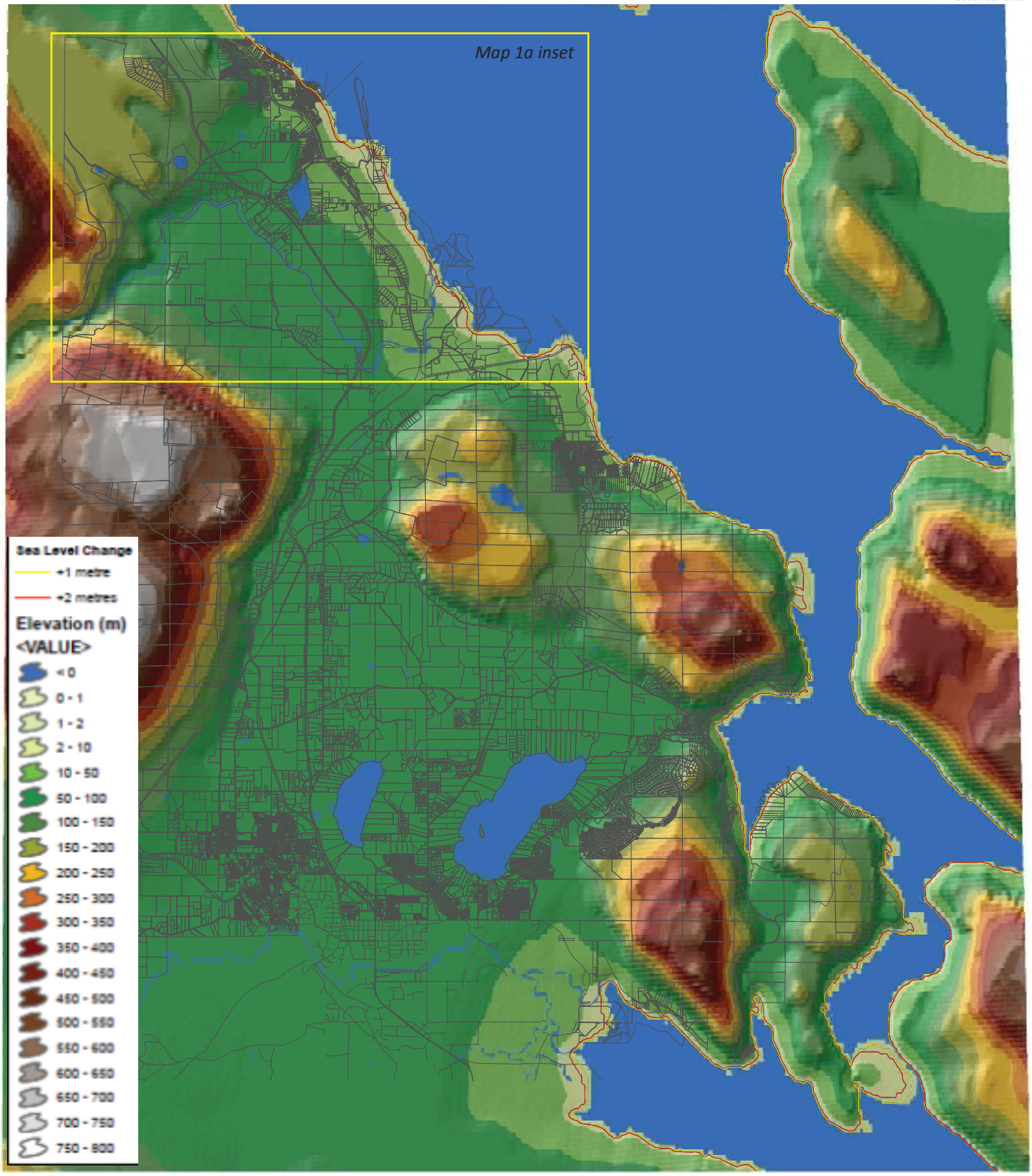
42 Walker and Sydneysmith 2008.

43 Mazzotti et al 2008.

44 Ausenco Sandwell 2011.

45 Pike et al 2010.

Map 1: Projected Sea Level Rise of 1 and 2 Metres



3.4.2 Current Approaches to Climate Change Effect Mitigation and Adaptation, and Potential Climate Change Impacts

North Cowichan climate change impacts can be categorized in nine thematic areas:

1. Land Use and Built Form
2. Parks, Ecosystems, Biodiversity
3. Forests
4. Transportation and Energy Infrastructure
5. Water Resource Management and Infrastructure
6. Agriculture and Food Security
7. Economic Development
8. Health
9. Emergency Management

Each category is explored below in terms of what practices are currently implemented in North Cowichan and the region, as well as prioritized estimated climate change impacts.[46]

1. Land-use and Built Form[47]

Current approaches to managing risks

The region's **Integrated Flood Management Plan** (IFMP) outlines a watershed-level, holistic and forward-looking approach to managing flood risk for the Cowichan-Koksilah basin. The study found that under a 1.5m sea level rise scenario,[48] the lower end of the Cowichan River suffered flood risk. An increase in peak flow events (due to an increase in high intensity rainfall events), could affect a larger portion of the region. Log jams or debris in the river can turn these effects into something on the scale of an extreme rainfall event. The IFMP advocates an adaptive management approach to flood risk, incorporating both structural and planning measures to mitigate risk. Specific measures that have been implemented include:

- Improving dikes and prioritizing higher density areas and critical infrastructure.
- Amending bylaws to reflect new flood construction levels.
- Designating floodplains as a development permit area in the OCP, with accompanying guidelines to mitigate risk.
- Discouraging new development in the floodplain through land use policies in the OCP.

The **Cowichan Basin Water Management Plan** has further suggestions to enhance capacity to adapt to changing hydrological conditions.

A **Community Wildfire Protection Plan** was developed in response to North Cowichan's vulnerability to interface fires. Measures that have been implemented include:

- Mapping wildfire hazards.
- Identifying areas of high and extreme wildfire risk in the OCP.
- Using covenants on land title, together with **Wildfire Interface Guidelines** for new developments in areas at risk.
- Discouraging development in at-risk areas through policy (e.g.: down-zoning some private forested lands to prevent development).
- Upgrading equipment and managing fuel.
- Controlling access to forested areas during high risk periods.
- Locating a Municipal Forester in the main North Cowichan office, enabling wider integration of forest and wildfire management considerations into policies and programming.

46 Priority ratings for potential impacts are based on risk assessment (severity and/or frequency where possible) together with consideration of the degree to which the issue is/could be managed within North Cowichan's current capacity and context.

47 A key resource for potential impacts across thematic areas, is Walker and Sydney Smith (2008)"From Impacts to Adaptation: Canada in a Changing Climate," British Columbia chapter. The City of Saanich's Climate Change Adaptation Plan (2011) informed the list of impacts for "Land Use and Built Form"

48 Scenarios are not predictions, rather they are based on plausible future conditions and serve to illustrate the potential changes to inform decision-making.

The **Official Community Plan** demonstrates North Cowichan's efforts to manage competing values and interests around land use decisions, for example by avoiding development in hazardous areas by promoting densification. The OCP identifies ecologically sensitive and hazardous areas, designating these as Development Permit Areas subject to specific approval guideline. The OCP also makes specific mention of the need to develop waterfront development guidelines that take climate change projections into account, and states that new developments will be required to incorporate adaptations to changing climatic conditions.

Impacts	Priority
Damage to infrastructure, buildings, residential property, agricultural land from increasing river flood risk, interface wildfire risk.	High
Increasing pressure on municipal zoning and bylaws to balance competing demands and manage land uses effectively.	High
Increasing pressure on municipal services such as water supply and stormwater management across land parcels and land use types has implications for the region.	High
Increasing pressure on floodplain management and infrastructure development due to sea level rise, storm surge and winter rain-driven flood events.	Medium
Increased risk of building damage due to extreme weather, winds and storms will increase costs of insurance and have impacts on existing building and development standards.	Low
Increase in hazard risks may limit uses, development, and/or property values in areas of North Cowichan.	Low
Rising pressures due to climate change and other factors (economic, population growth and migration, etc) will increase competition for land use.	Low
Increasing landslide risk for steep slopes.	Low
Increasing need for cooling of indoor environments, and shading/cover in outdoor environments.	Low

2. Parks, Ecosystems and Biodiversity

Current approaches to managing risks

The CVRD's 2010 **State of the Environment** report is a helpful baseline which identifies the need for better information on climate change and adaptation implications in the region. It also reviews the state of the natural environment, and human interaction with it. The **Integrated Flood Management** and **Water Management** indicate sensitive ecological areas, habitats and features in the region.

The **OCP** commits to making decisions based on the best available information about the natural environment, and to connecting ecologically sensitive lands and green spaces. The importance of protecting the integrity of the Coastal Douglas Fir ecosystem is acknowledged and maintaining public access to the waterfront is a priority.

Finally, North Cowichan's **Community Wildfire Plan** and associated guidelines take significant steps to mitigate wildfire risk to the community, with consideration of environmental damage due to wildfires.

Impacts	Priority
Shifting terrestrial and marine species ranges and ecosystem composition.	High
Increased risk of pests, diseases and other invasives.	High
Increasing river water temperatures are very likely to contribute to decreasing salmon population health and survival.[49]	High
Increased risk to marine areas and shorelines due to storm surge flooding, wave action, coastal erosion, and accelerated changes to intertidal ecosystems.	High
Increasing natural hazard risks (e.g.: flooding, storms, wildfires, landslides) causing damage and degradation of ecosystems and requiring greater management.	Medium
Increasing dry and drought conditions in summer and fall causing damage to wetland ecosystems (e.g.: Somenos marsh).	Medium
Increased water temperatures negatively impacting water quality, ecosystems and fish habitat.	Medium
Changes to water quality and quantity, scouring and erosion, and associated maintenance, placing stress on aquatic ecosystems and fisheries habitat in particular.	Medium
Threats to coastal archaeological sites due to erosion and wave damage.	Medium
Improved suitability for Coastal Douglas Fir ecosystem.	Low
Increasing natural hazard risks (e.g.: flooding, storms, wildfires, landslides, droughts) impacting maintenance, access and safety of park infrastructure and services.	Low

3. Forests

Current approaches to managing risks

North Cowichan employs a Municipal Forester and takes a proactive approach to forest and fire management - the **Community Wildfire Protection Plan** being an outstanding example. An invasive species removal program is being initiated for the **Forest** Reserve. Actions taken with respect to managing the wildfire risk to municipal and public forests in the region include:

- Ongoing management of fuel risk in forests.
- Measures to reduce the number of fire starts.
- Public education.
- Firefighting equipment upgrades.

Impacts	Priority
Increase in wildfire activity.	High
Increased risk of pests, diseases and other invasives.	High
Shifting tree species range, impeded growth rates and increasing competition from better suited species.	Medium
Road maintenance and design affected by increase in extreme rainfall events.	Medium
Declining climate suitability for Western Red Cedar.	Low
Better suitability of Coastal Douglas Fir ecosystems (including Garry Oak) to warmer, drier weather and wildfire activity.	Low
Increasing damage due to intense storm events and winds.	Low
Effects on rotation ages, wood quality, wood volume and size of logs.	Low
Access limited during warmer, wetter winters and due to elevated fire risk in summer.	Low
Increased probability of landslides and debris flows.	Low

49 Hinch, S.G. and E.G. Martins. 2011. A review of potential climate change effects on survival of Fraser River sockeye salmon and an analysis of interannual trends in en route loss and pre-spawn mortality. Cohen Commission Tech. Rept. 9: 134p. Vancouver, B.C. www.cohencommission.ca

50 Wilson, S.J. and R. Hebda. 2008. Mitigating and adapting to climate change through the conservation of nature. The Land Trust Alliance of BC. Salt Spring Island, BC. p.68.

4. Transportation and Energy Infrastructure

Current approaches to managing risks

In some ways, living on an island enhances resilience to weather impacts, as people and businesses on Vancouver Island are accustomed to periodic interruptions in transportation links and power due to severe weather. The CVRD-coordinated **emergency management program** promotes household preparedness through public education and a preparedness workbook.

The **Integrated Flood Management Plan** identifies risks to some existing bridges due to increases in peak flow.

Impacts	Priority
Will lead to changes in current design standards.	High
Increasing height of peak flows could threaten structural integrity of existing bridges, or contribute to debris jams where clearance is inadequate.	High
Increased maintenance and insurance costs.	Medium
More frequent road washouts due to flooding, landslides.	Medium
Increased need for maintenance and upgrades of municipally operated harbour infrastructure.	Medium
Increasing frequency of power outages due to impacts of storms, wind.	Medium
Potential limitations on provincial hydroelectric generation capacity due to decreasing water supplies at certain times of the year.	Medium
More frequent disruption of critical economic links to processing facilities, markets, suppliers.	Low
More extreme weather may be a deterrent to use of active transportation options.	Low
Interruption of marine transportation of goods and people.	Low
Increased demand and costs for cooling, decreasing demand and costs for heating.	Low

5. Water Resource Management and Infrastructure

Current approaches to managing risks

The **Cowichan Basin Water Management Plan** provides a comprehensive range of goals, objectives and actions promoting sustainable management of this important resource. Overall, this is supportive of climate change adaptation needs, and a useful guide in providing some focus on key issues such as water conservation, effective governance, land use & development policies and public education, all part of enhancing adaptive capacity as climate change alters the hydrological system. The report acknowledges future climate change impacts as one of the drivers for developing such a comprehensive plan, and includes consideration of climate change at various points throughout the objectives and actions.

The **OCP** includes various related policies with a focus on green infrastructure, as well as promotion of water conservation and reuse, support for no net increase in run-off and the requirement that new developments comply with provincial standards for water quality and stormwater management. The OCP also aims to improve stormwater management, and calls for coordination between park design and stormwater management plans, to support stormwater management objectives.

The **Vancouver Island Water Resources Vulnerability Mapping Project** recently evaluated the intrinsic vulnerability of aquifers on the island to contamination. This is a helpful baseline for further work that could be conducted, incorporating climate change impacts for groundwater resources.

Impacts	Priority
Reduced water supplies in summer, a time of peak demand.	High
Low flows in summer may lead to water restrictions on public and private use to protect in-stream flow needs.	High
River low flows may limit ability to achieve adequate outflow dilution levels of municipally treated wastewater.	High
Potential for reduced groundwater recharge rates and salination of groundwater in some areas (further research needed), could reduce the supply available for consumption.	High
Will lead to changes in current design standards.	High
Increased pressure on existing stormwater infrastructure to handle intense rainfall events and an overall increase in precipitation and runoff in winter.	Medium
Power outages associated with storms could simultaneously compromise pumping capacity.	Low
Greater pressure on water treatment systems and monitoring, due to water quality impacts arising from increased temperature in standing water sources.	Low

6. Agriculture & Food Security[51]

Current approaches to managing risks

As described previously, North Cowichan is taking measures to manage wildfire risk. North Cowichan's promotion of water conservation lessens the overall pressure on available water supply in the area. The **Economic Development Strategy** includes plans to explore irrigation infrastructure for agriculture in the region. North Cowichan's Urban Containment Boundaries, identified in the **OCP,** may help to reduce the pressure on converting agricultural land to other uses.

Impacts	Priority
Impacts on coastal habitat and species abundance will affect commercial and subsistence fisheries. Salmon populations are very likely to be negatively impacted by climate change.[52]	High
Ocean acidification will affect marine species and have cascading effects along the food chain.[53]	High
Increased probability of food and agricultural input supply shortages due critical infrastructure damage.	High
More frequent flooding of fields and inadequate drainage.	High
Increasing pressure to convert agricultural land to other uses.	High
Increasing competition for limited water resources, particularly in the summer and fall.	High
Potential water deficit in the summer and fall.	High
More frequent algal blooms negatively affect seafood supply.	Medium
Interruptions, delays and damage to crops, land, infrastructure, due to extreme weather events.	Medium
Wildfire damage to crops, land and infrastructure.	Medium
Changes in types, prevalence and timing of pests, diseases and weeds.	Medium
Potential for longer seasons and/or new crop types to be grown.	Medium
Possibility of increased public support for local agricultural production in light of more frequent disruptions to food supply.	Low

51 The list of impacts for "Agriculture and Food Security" is informed by the Vancouver Island report of the *BC Agriculture Climate Change Adaptation Risk + Opportunity Assessment* (Crawford and MacNair, 2012).

52 Ibid. 45.

53 Retrieved from CBC news: http://www.cbc.ca/news/canada/british-columbia/story/2012/07/16/bc-ocean-acidification.html?cmp=rss

7. Economic Development

Current approaches to managing risks

North Cowichan recognizes the value and importance of building a local, diversified economy, outlining a range of policies in the **OCP** to support an economy that is increasingly knowledge-based and taking advantage of growing green or clean technology opportunities. Building on existing assets such as the natural environment is part of this vision.

Pursuit of "smart growth" land use patterns helps to concentrate development and economic activity, maintaining space for other functions to be filled by the land base. Restrictions and clear policies around development in hazardous areas reduces the risk to people, capital and economic activity in the case of extreme events.

The region's commitment to integrated flood management and water management is building the capacity to manage the relationship to water from a whole system perspective. Cooperation between industry (Crofton Pulp & Paper Mill), local governments and provincial and federal agencies around river levels is a valuable asset as the need for more coordinated and collaborative management approaches grows due to the interconnected challenges of climate change.

Impacts	Priority
Increasing risk of disruptions to critical infrastructure improve the case for investing in a regionalized, sustainable economy.	High
Potential to leverage Coastal Douglas Fir ecosystem as an economic asset (tourism, sustainable forestry, carbon sequestration).	Medium
Limitations to land development, and appropriate uses, due to increasing natural hazard risk.	Medium
Increasing frequency of low river flows may restrict development of some types of industrial or other commercial uses.	Medium

8. Health

Current approaches to managing risks

The **OCP** points to policies for building a safe and healthy community. Enhancing community resilience by actively nourishing social bonds and networks is a core requirement for effective adaptation to a variety of stressors, including climate change impacts. The OCP supports building this connectedness within the community through a focus on elements such as community emergency preparedness, local food growing and forging relationships across climate-sensitive or marginalized groups (e.g.: elderly, children, socially isolated, lower income, limited mobility).

Impacts	Priority
Increased risk of illness and death due to effects of more frequent, intense, or long-lasting heat waves on climate-sensitive populations.	Medium
Air quality impacts of more frequent wildfire activity increases potential for respiratory illnesses.	Medium
Increased risk of exposure to existing and new air-, water- and vector-borne diseases.	Medium
Increasing need for cooling of indoor environments, and shading/cover in outdoor environments.	Low
Increased risk of absenteeism, hospitalization, injury, illness or death due to extreme weather conditions and natural hazards.	Low
Mental health impacts of more frequent extreme events and disasters.	Low

9. Emergency Management

Current approaches to managing risks

North Cowichan works in cooperation with the CVRD and other partner local governments to regionally manage emergency responses. The region takes an all-hazards approach, pooling resources and capacity to support emergency preparation, response and recovery. In addition to specific hazard plans, the region is also prepared with a community disaster recovery plan, which was implemented in response to widespread flooding in 2009 that impacted four jurisdictions in the region. Emergency response is integrated provincially through the BC Emergency Response Management System, run through Emergency Management BC.

Impacts	Priority
Greater demand on emergency planning and response capacity of the Municipality, other organizations and businesses in the area, including investments in improving public awareness.	Medium
Increasing need for integrated emergency management functions regionally and provincially to deal with larger disaster events.	Medium
More frequent/extensive use of public infrastructure to deal with emergency response and recovery.	Low

A review of current approaches to managing identified risks, a list of suggested actions, further guidance on extending this initial assessment into a full climate change adaptation plan, and a climate change adaptation action and monitoring strategy is presented in Section 8.

3.5 Corporate GHG Inventory

In addition to the ambition to reduce community energy use and emissions, North Cowichan has also made commitments to reduce its municipal-side energy and emissions. This 'corporate' effort includes municipal building energy, municipal fleet, and energy used for municipal operations serving the community (e.g.: street lighting, paving, emergency services, garbage collection).

Overview

North Cowichan has signed on to the BC Climate Action Charter, committing to three actions:

- Being carbon neutral in respect to operations by 2012;
- Measuring and reporting on the community's GHG emissions profile; and
- Creating complete, compact, more energy efficient rural and urban communities.

The Provincial Government and the Union of British Columbia Municipalities created the Green Communities Committee to support local governments in planning and implementing climate change initiatives.

Methodology

The carbon neutral commitment applies to "traditional services" provided by municipalities. These include:

- Administration & governance;
- Drinking, storm and waste water;
- Transportation and diversion, roads and traffic operations;
- Arts, recreation and cultural services; and
- Fire protection.

Emissions relating to new construction, employee commuting and materials are not included.

SSG analysed the Municipality of North Cowichan's corporate greenhouse gas emissions, according to the Government of BC's Methodology for Reporting 2011 BC Local Government Greenhouse Gas Emissions (Ministry of Environment, 2012). SSG's corporate reporting tool, GHGProof Corporate, was used for the analysis.

Limitations

SSG was provided with energy data and a corporate inventory from 2011. Costs were estimated using approximate energy costs from Vancouver Island and do not represent the actual energy costs paid by North Cowichan. As a result, the total GHG emissions provide an indication of offsets required to achieve the 2012 carbon neutral commitment but not the actual emissions reduction amount.

Results

In 2011, North Cowichan's corporate emissions totalled 1,343 tCO2e with total energy costs of $1.625 million. While two-thirds of energy consumed is electricity (Figure 12), significantly more GHG emissions result from using diesel, natural gas and gasoline, reflecting the low GHG intensity of electricity provided by BC Hydro. Offsetting these GHG emissions at the going rate of $25 per tonne would cost approximately $33,600.

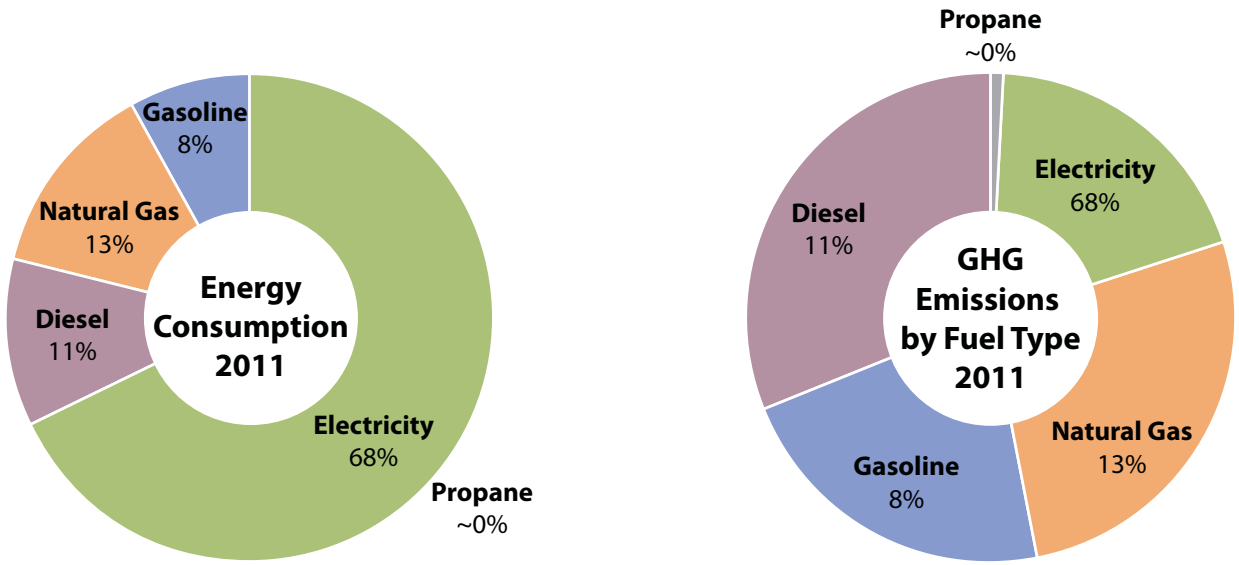


Figure 11: Corporate energy consumption and emissions by fuel type.

Fleet and contracted services produce 54% of the GHG emissions, while buildings produce 46% (Figure 12). By activity category, 30% of GHG emissions are from the Arts, Recreation, Parks and Cultural sector (mostly due to emissions from the arena), Roads and Traffic Operations account for 22%, and Drinking, Storm and Wastewater account for 17%. The remaining three categories (Solid Waste Collection, Transfer and Diversion, Administration and Governance and Fire Protection) are the source of approximately 10% each. The emissions from Solid Waste Collection, Transfer and Diversion include garbage and organics collection, but do not include recycling, as the District contracts out recycling collection.

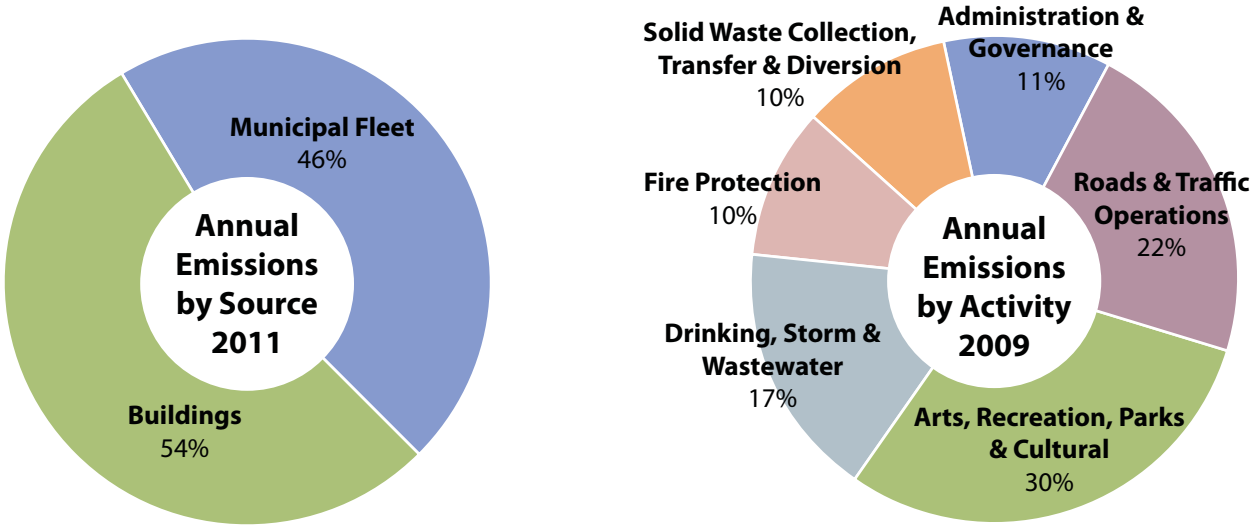


Figure 12: Annual emissions by source and activity.

North Cowchican's facilities have twelve major sources of GHG emissions which release over 10 tCO2e per year, as illustrated in Figure 13. Of these sources, the Fuller Lake Arena is the largest source of GHG emissions, accounting for almost 10% of North Cowichan's total corporate GHG emissions. The facility's emissions are from using natural gas.

Of North Cowichan's 63 properties and elements that use energy, the 12 major sources of emissions are graphed in Figure 13. These account for 87% of North Cowichan's building-related corporate GHG emissions. In facilities, GHG emissions are highest in buildings that use the most natural gas.

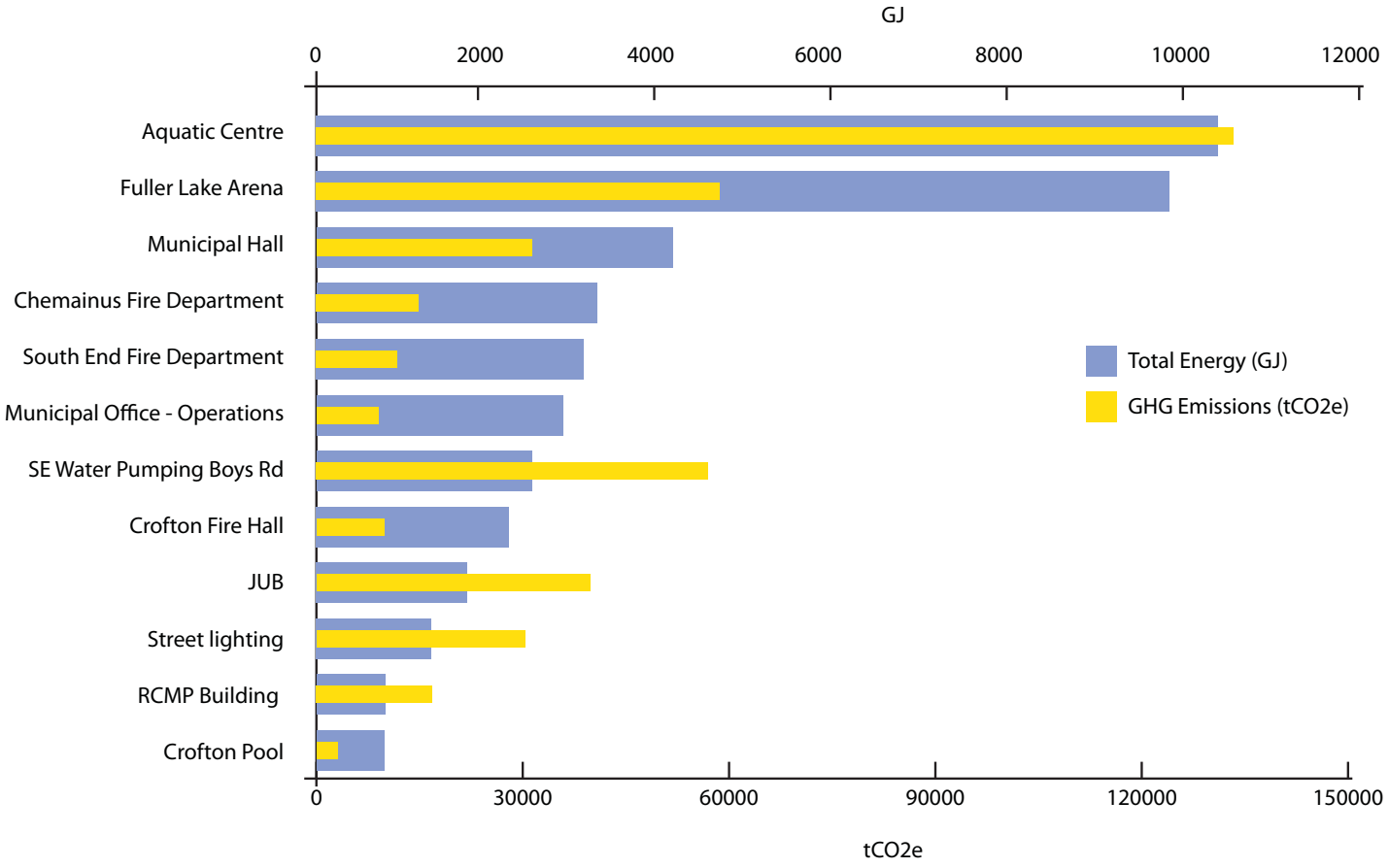


Figure 13: Public building energy use and emissions.

Unsurprisingly, the aquatic centre and arena are the greatest emitters. Focusing efforts on converting their energy systems to renewable energy sources would be prudent.

Fleet emissions totalled 727 t CO2e in 2011. Roads and traffic operations were the source of 1/3 of fleet emissions, and 18% of all North Cowichan emissions. Contractor fleet emissions are not available, as they were not legally mandated to be tracked in 2011; this will change for the 2012 report, beginning in June 2012. Figure 14 shows the relative emissions of the municipal fleet.

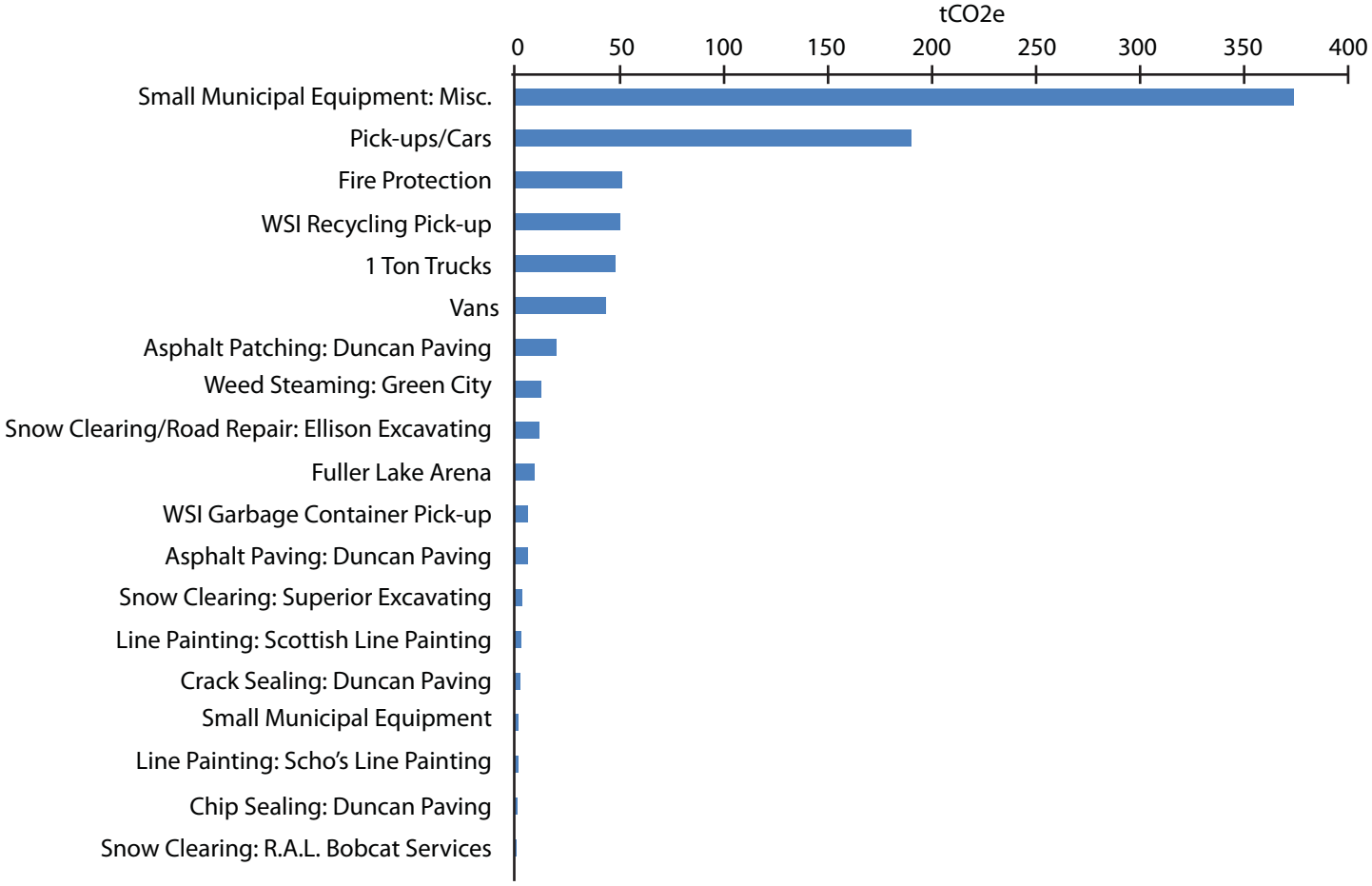


Figure 14: Municipal equipment emissions.

Figures 13 and 14 display North Cowichan's major building and fleet emissions sources - there are many others that contribute smaller annual emissions amounts. North Cowichan's total annual energy consumption is displayed in Table 4, sorted by energy consumption, emissions and cost.

Table 4: Corporate Annual Energy Consumption

Fuel Type	Energy Consumption (GJ)	GHG Emissions (tCO2e)	Annual Energy Costs ($)*
Electricity	37,105	258	$1,149,341
Natural gas	7,110	358	$127,681
Gasoline	5,214	332	$178,764
Diesel	5,876	407	$184,118
Propane	99	6	$2,734
Total	**55,404**	**1,361**	**$1,642,638**

*Estimated

Actions for corporate energy and emissions reductions are recommended in Section 7.

3.6 North Cowichan's Green Economy: Current State

To begin creating a context for the CAEP, the first public engagement event focused on mapping the local green economy. On maps of the municipality, citizens identified 185 green economy elements in North Cowichan in seven categories:

- Clean transportation;
- Sustainable land-use;
- Green building;
- Green investment;
- Renewable energy sites;
- Services; and
- Waste management.

The resulting map was uploaded to 'Crowdmap,' an interactive crowd-sourced mapping platform. The Green Economy Map is a living entity - new elements can be added and map elements can be updated or modified. Residents can add new elements 'on the spot,' using the Crowdmap GIS-enabled application on mobile devices. The map can be accessed at: https://northcowichan.crowdmap.com.

This exercise helped identify local green economic elements that could help support implementation and sustainment of CAEP actions. It also helped identify gaps in North Cowichan's green economy offerings which present challenges to certain CAEP actions. Summaries of the mapping exercise are below, while the mapped elements are collected in Appendix 1.

3.6.1 Green Economy Map Elements

Clean Transportation

North Cowichan residents are justifiably proud of the region's extensive hiking and multi-use trail systems. They also hope for the return of rail service, which could provide commuter transit up and down the Island. The striking lack of public transit infrastructure in this list suggests that few participants, if any, regularly use public transit or think highly of the services currently provided. Other items not mapped are probably omitted because they are absent in North Cowichan, or not widely known. These include: peer-to-peer automobile sharing services, car-sharing locations, bike lanes, bike-sharing systems, carpooling services and private mass transit. Taxi services also were omitted, though they can be considered part of the array of clean transportation offerings.

Sustainable Land-use

The abundance of local farms is one of the most impressive features of the entire Green Economy Map. Their number may indicate an opportunity to encourage the sale of more locally produced organic foods at local markets. Given the local talent in growing food, there is perhaps an opportunity to bolster the community and school garden programs

Residents are also proud of the region's extensive forested areas. They are a prime resource for local industry and recreation, and can contribute considerable value as 'carbon sinks.' Maintaining sustainable forests is an excellent local investment.

Green Building

The number of green building elements identified is quite low. There are over 10,000 dwellings and over 1,000 other buildings (office, retail, industrial, etc.) in North Cowichan. Either it is not known that more dwellings and other buildings have green features or there is simply low instance of green features. There is an opportunity here for encouraging green building in new development as well as green building retrofits.

Green Investment

Participants noted all of the credit unions in the region. Other green or local investment elements were not, however, including Community Futures Cowichan Region. Elements missing - from the map or from the region entirely - include family granting

foundations, not for profit granting programs, municipal sustainable investment programs, a community economic development officer or program and micro loan programs. There is an opportunity to encourage more local-investment entities, and to educate residents about what is available.

Renewable Energy Sites

North Cowichan has a variety of renewable energy sources, if not a great number. Even the sewage lagoons and the paper mill were identified as potential biofuel sources. This variety can be helpful in gauging the effectiveness and suitability of different renewable energy options for the region. There is an opportunity for policies and incentives that encourage community energy projects and renewable energy retrofits.

Green Services

The region offers a wide variety of green services. This includes an impressive array of green product retailers, repair services, second-hand stores and not-for- profit societies. Making these services more visible will enhance the local economy's sustainability.

Waste Management

At the time of the mapping exercise, North Cowichan's new curbside compost pickup program was not yet in place, although it was eagerly awaited. Notably, the region's solid waste is largely trucked off the Island, to Washington. Although some local not-for-profit services have programming related to consumption and waste, they were not mapped here, perhaps because they were mapped under other categories.

3.6.2 Green Economy Map Outcomes

The major outcomes of the green economy mapping exercise were:

- Identifying the local web of sustainability services, programs and products. These elements are important to the successful implementation of the CAEP. Certain entities could be champions or main supporters of CAEP actions, being crucial to their success;
- Engaging and educating the public on the offerings in their community; and
- Identifying gaps in, and opportunities to expand, green economic element offerings.

Many workshop participants were interested and surprised to learn of various green services, entities and programs. The 185 elements make an excellent collection from which North Cowichan residents can draw for their local green economic needs.

There are gaps and opportunities in each green economy theme. Various entities could help provide services that might fill in the gaps or capitalize on the opportunities. The Municipality could pursue community grants or a revolving loan fund, for instance. Local not for profits, such as the Bio-Diesel Co-op, could expand their offerings to serve more members. Residents could organize a community renewable energy program, renewable energy bulk buying offering or take on green home retrofits.

The major gaps exist in the clean transportation, green investment, renewable energy and green building areas. More ideas for addressing these gaps are considered further on in this report.

4 Exploring CAEP Strategies

4.1 Community-Sourced Ideas

Building on the success of the 'green economy' mapping exercise, we used the IdeaScale online public forum to collect 'sustainability action' ideas from the community. Residents were invited to post their ideas for actions that could help North Cowichan achieve a more sustainable future. They could also leave comments on any posted idea, and cast votes for their favourites, or against .The summary of participation is represented in Figure 15.

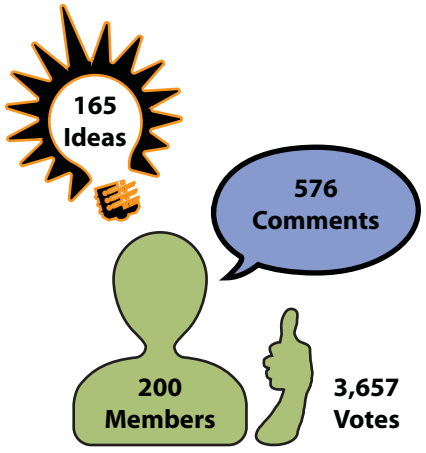


Figure 15: Online public participation summary.

The online forum achieved six main objectives:

- Community members unable to participate at in person events were able to participate via IdeaScale;
- Community members engaged in a meaningful dialogue on sustainability and sustainability-related actions that could be implemented in North Cowichan;
- Ideas were sorted by popularity, yielding a sense for which ideas will have the most community interest for implementation and ongoing support;
- Ideas could be followed up with further study and/or incorporation into the future land-use scenario modelling;
- Action ideas from the forum could be used in follow up exercises at public events and workshops; and
- Community members with particularly well presented ideas, supporting information and discussion contributions were identified as sustainability champions who might lead or support implementation of the CAEP.

No matter how popular the ideas, all ideas were equally considered in the development of the CAEP framework. Many of the ideas were amenable to further analysis and consideration for the action 'wedges' workshop and the future land-use scenario modelling. Others were suitable for further consideration as policies or sustainability actions that did not require modelling. The top twenty most popular ideas were:

Table 5: Top 20 Most Popular Ideas Contributed to IdeaScale by Number of Votes

Votes	Idea Title	Votes	Idea Title
85	Encourage air drying our laundry	62	Preserve Echo Heights forest
85	Rail service	62	Tree bylaw
83	More local organic food	61	Promote local economy based on sustainable forestry
83	Curb-side pick up of compostables	61	No idling
79	Get out of the 1960's, BAN BACK Yard Burning	52	Green Buildings
78	Promote geothermal/exchange in residential housing	50	Utilize "Dutch Style" Road Design/Development
75	Maintain Municipal Forests	50	Promote the idea of reducing everyone's footprint
70	Increase public transit routes and frequency	49	Green job creation
69	Green building courses	48	Sprawl: avoid at all costs
66	Solar Panel grant	48	Consolidate all areas and look for solutions as a REGION

The top twenty most commented on ideas were:

Table 6: Top 20 Most Commented on IdeaScale Ideas			
Comments	**Idea Title**	**Comments**	**Idea Title**
35	Get out of the 1960's, BAN BACK Yard Burning	11	Promote geothermal/exchange in housing
16	Curb-side pick up of compostables	11	"Sustainable" Growth does not exist
16	Permanently Cap the population for the area	10	Encourage air drying our laundry
14	Follow UN advice to phase out log-burning heaters	10	Solar Panel grant
13	Rail service	10	Wind Power
13	No idling	9	Biofuel for our community vehicles
13	Tree bylaw	8	Get a Landfill site Established
13	Bulk purchase of heat pumps	8	Partially fund ClimateSmart measurement
12	Maintain Municipal Forests	8	Home wood heating with biochar sequestration
12	Property tax based on carbon footprint	7	More local organic food

Ten of the top 20 most commented on IdeaScale ideas also show up in the top 20 most popular ideas, highlighted in gray.

Figure 16 shows how many ideas were posted in each category.

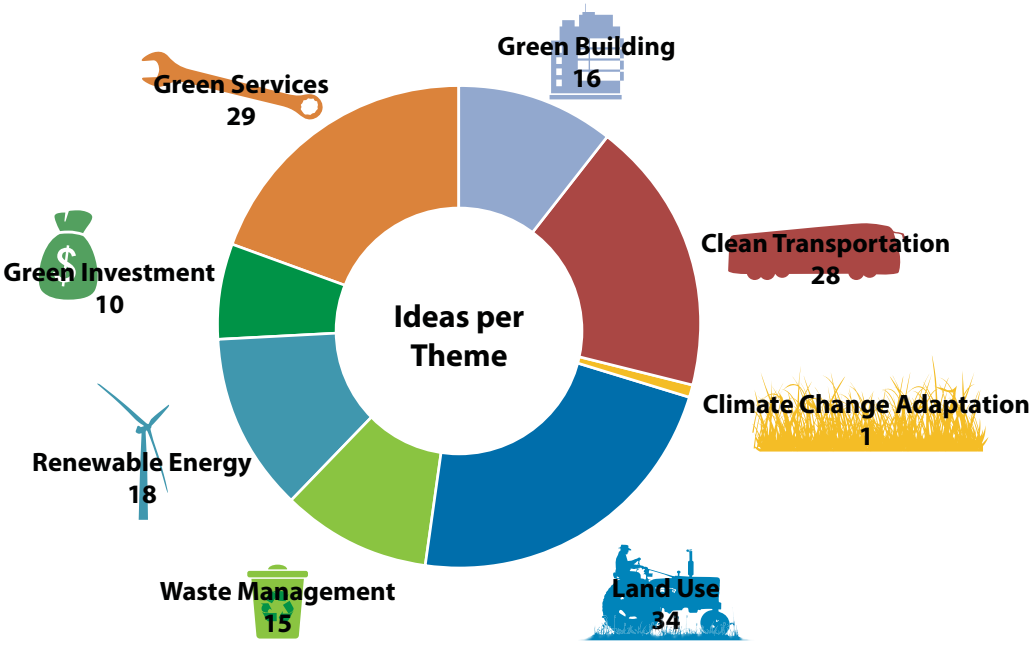


Figure 16: Ideas posted to IdeaScale by category.

4.2 Action Ideas Organization

To better understand how sustainability action ideas interrelate, and how they can be approached by the municipality, we created a 'mind map' that groups them under 14 themes.

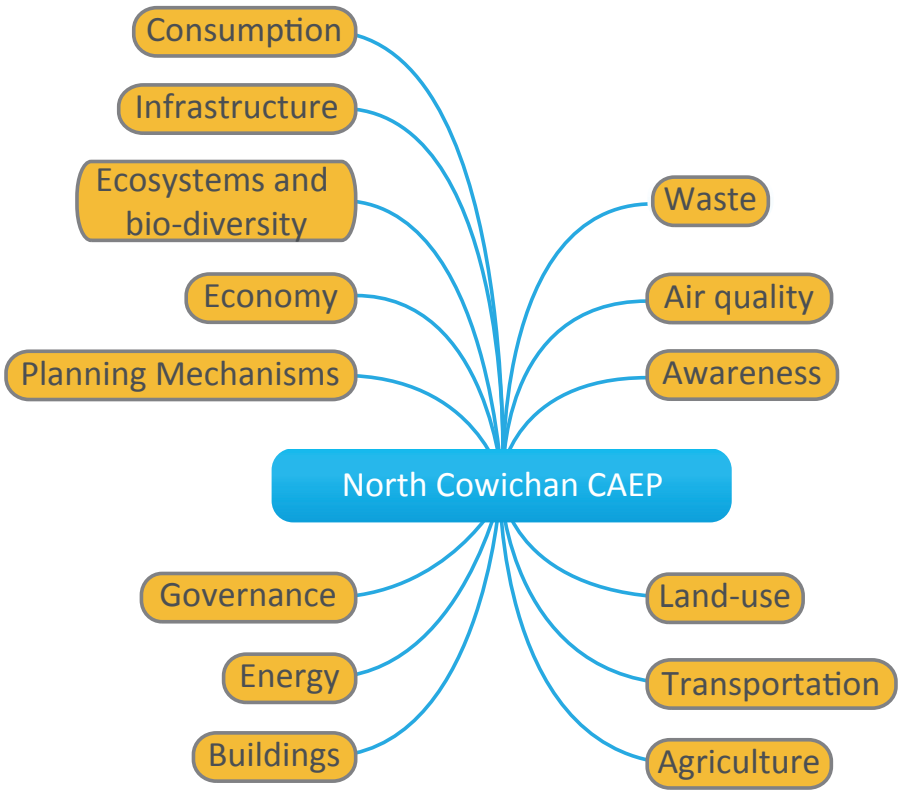


Figure 17: Mind map of sustainability action idea themes.

The collapsed mind map (Figure 17) displays the 14 themes. Each theme expands into the ideas contained within it (Appendix 2).

Summary

There are many actions that can be taken to improve the community's energy efficiency and reduce emission. Some will have more immediate impact than others; yet some with less initial impact may have a cascading effect. For example, an anti-idling bylaw may help to encourage people to drive less.

The mind map suggests the interrelation of actions within a theme. It reminds us that an integrated approach - within an area and among areas - is paramount for addressing energy and emissions issues. This requires inter-departmental communication and cooperation within the municipal government, as well as partnerships between the municipality and local businesses and organizations, in working toward goals.

This need for integration is most apparent in the area of transportation. Vehicle travel produces most of North Cowichan's emissions; the transportation segment of the mind map (Appendix 2) is correspondingly thorough with possible actions to coordinate in addressing this complex challenge.

4.3 Wedges Workshop

A workshop was held with members of the public, stakeholders from the business and not-for-profit communities, and municipal staff to discuss potential actions to achieve an emission-reduction target of 33% below 2007 levels by 2020. The consulting team prepared 14 actions, chosen from a mixture of ideas from public consultations, discussions with municipal staff and practices in other jurisdictions. The chosen actions were:

1. Establish a revolving loan fund to provide funding to local sustainability projects such as community energy production (2,689 tCO2e/year);
2. Develop district energy systems in areas of sufficient building density (1,700 tCO2e/year);
3. Create a home energy retrofits program (1,017 tCO2e/year);
4. Increase forest carbon sequestration by acquiring more municipal forest land (21,760 tCO2e/year);
5. Establish a local food initiative to encourage more organic farm and local sales (14,640 tCO2e/year);
6. Deliver a public education campaign about energy efficiency and emissions reductions (7,500 tCO2e/year);
7. Institute an anti-idling bylaw (100 tCO2e/year);
8. Expand the Cowichan Bio-diesel Co-op to serve more members (5,000 tCO2e/year);
9. Establish the E&N corridor as a commuter railway (397 tCO2e/year within the Municipality of North Cowichan);
10. Develop a program to improve active transportation infrastructure and promote active transportation modes (15,696 tCO2e/year);
11. Implement a comprehensive transportation demand management program that encourages reduced single occupancy vehicle trips while catering to diverse transportation needs (21,000 tCO2e);
12. Concentrate new housing developments in Crofton, Chemainus and the Duncan area (43,210 tCO2e/year);
13. Create a local landfill with methane capture to be used in energy production (2,139 tCO2e/year); and
14. Provide residents with a curbside compost-pickup program (3,056 tCO2e/year).

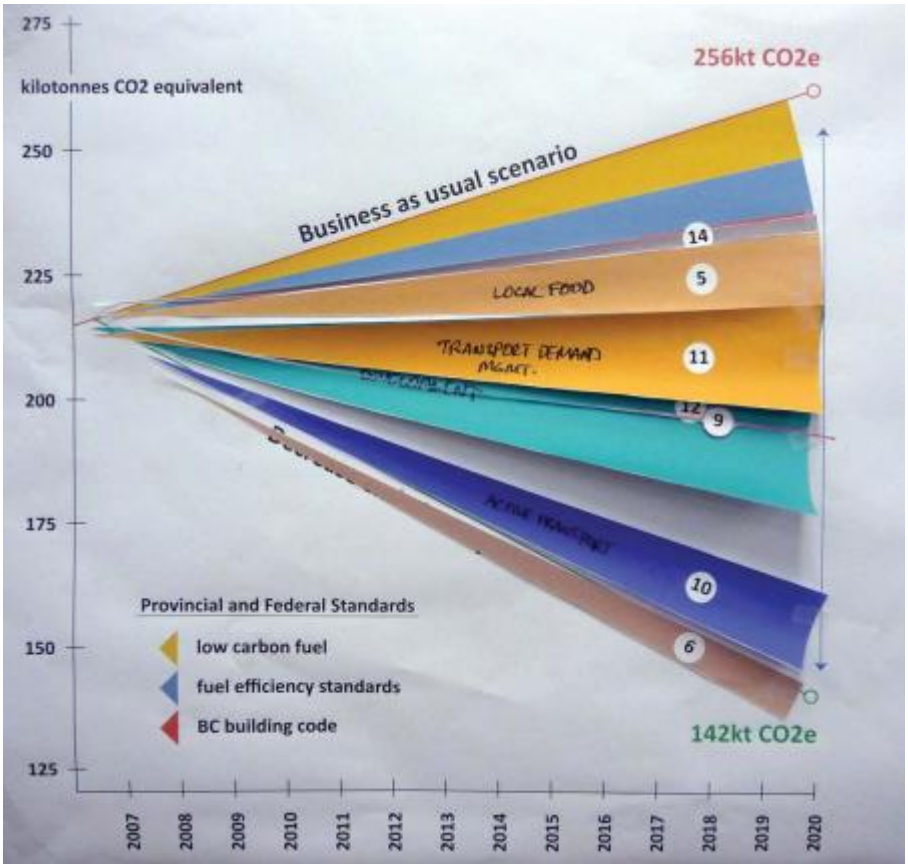
Each action resulted in an estimated emissions reduction, modelled using GHGProof. In the workshop, each action was depicted as a wedge, scaled to the magnitude of emissions reduction it would create. Each group selected an array of actions to take, based on their discussions of accuracy, viability, public appetite, etc., with the goal of achieving a 33% emissions reduction below the projected business as usual scenario. Federal and Provincial actions were included in the reductions, as well:

- Low carbon fuel requirements
- Increased fuel efficiency standards for automobiles
- Increased energy efficiency in the BC Building Code

The groups were all able to achieve the target emissions levels. Some of their efforts are illustrated in Figure 18. The major workshop outcomes were:

- A 33% emissions reduction by 2020 is very challenging;
- There is a need to focus on transportation and housing, as these areas are responsible for the majority of emissions;
- Some strategies don't have high impact, but are easy to implement or highly desirable;
- Strategies are interdependent; and
- 2020 is a short time frame – need to plan further.

The workshop outcomes influenced the choice of actions and time frames to consider in the scenario modelling (Section 5).



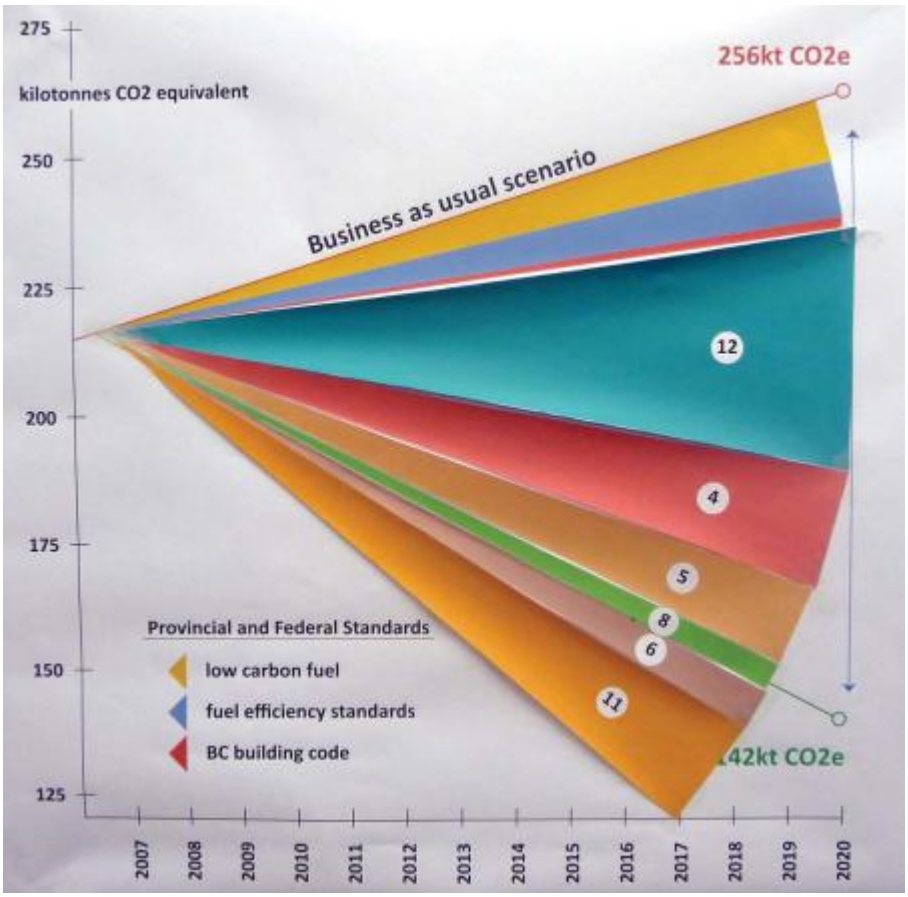


Figure 18: Samples of wedge workshop exercise results.
Wedge numbers correspond to those listed above.

4.4 Energy Supply Options

Background

To meet its energy needs sustainably, a community must pursue four approaches. BC Hydro has outlined them as 'The Four R's of Sustainable Energy Planning': [54]

1. Reduce energy demand (through energy efficient community design, green buildings, and efficient technologies);
2. Re-use waste heat (captured from industrial and commercial sources, sewers and waste, for heating buildings and water);
3. Use Renewable heat (including solar and geo-exchange); and
4. Use Renewable electricity (including biomass/biogas, micro-hydro, wind, solar, tidal and geothermal).

North Cowichan has more influence over land use-related energy demand moreso than any other of the four mechanisms, thus a major focus should be placed on the opportunities to mitigate energy use through land uses.

Renewable energy resources are those that can be regenerated relatively quickly and therefore are not exhausted. They derive either from the sun or from heat generated deep within the earth, and include electricity and heat generated from solar insolation (sunlight striking a surface), wind power, ocean energy harvested from wave and tidal power, river-based hydropower, biomass energy and geothermal energy. North Cowichan has the potential to generate renewable energy from many of these resources. This assessment takes a high-level look at opportunities available to meet the region's energy needs through renewable sources (the second, third and fourth R's).[55]

Figure 19: Hierarchy of measures in sustainable community energy planning.

Some of the content of this section informs the modelling and analysis of future land-use plans in Section 5. The modelling includes two scenarios, one in which GHG emissions are reduced by 33% by 2020, and another in which they are reduced 80% by 2050. The scenarios help to clarify which strategies and policies can be relied on to to achieve the emissions reductions by the target dates. Creating new renewable energy sources is one such strategy.

Solar Photovoltaic Electricity

Photovoltaic (PV) cells convert solar energy into electricity,[56] which can be used on-site or exported to the electricity grid. PV systems only need daylight to generate electricity. Natural Resources Canada has prepared solar resource maps for Canada,[57] covering 10 km x 10 km grids, using data from Environment Canada's National Climate Data and Information Archive.[58] According to the solar resource map (Figure 21), virtually all of the territory within North Cowichan receives between 12 and 15 megajoules per square metre (MJ/m^2) daily, averaging 13.7 MJ/m^2.[59] A properly sited PV system could generate between 1000 and 1100 kilowatt-hours per kilowatt of PV cell capacity (kWh/kW), averaging 1040 kWh/kW.

54 Community Energy Association and BC Government (2010). "Clean Energy for a Green Economy - An introduction for rural BC communities." Source: http://www.communityenergy.bc.ca/sites/default/files/Clean%20Energy%20for%20a%20Green%20Economy.pdf (retrieved July 4, 2012).

55 This assessment was undertaken independently from the EA Energy Analyses and GRAS (EAEA/GRAS) assessment of renewable energy for the Cowichan Valley Regional District. It makes some use of the EAEA/GRAS report to provide relevant background information and resources. The EAEA/GRAS assessment focuses more on energy resource and use modelling based on GIS data, while this assessment focuses on modelling based on available BC data (e.g. BC Hydro's submission to the BC Government for the Community Energy and Emissions Inventory (CEEI), the 2010 CEEI for North Cowichan and the BC Ministry of Environment's Methodology For Reporting B.C. Public Sector Greenhouse Gas Emissions) and Government of Canada data (renewable energy resource maps (geothermal, hydroelectric, marine power, biomass, solar and wind), energy end-use statistics and renewable energy deployment statistics).

56 Canadian Urban Institute (2008). "Energy Mapping Study." Prepared for the City of Calgary. Source: http://canurb.org/sites/default/files/projects/2010/405_EnrgyMpng/Calgary_EnergyMapStudy_FinalReport.pdf (retrieved July 4, 2012).

57 Natural Resources Canada (2012). "Photovoltaic potential and solar resource maps of Canada." Source: http://pv.nrcan.gc.ca/ (retrieved July 4, 2002).

58 Environment Canada (2012). "National Climate Data and Information Archive." Source: http://climate.weatheroffice.gc.ca/Welcome_e.html (retrieved July 10, 2012).

59 Natural Resources Canada (2012). "Photovoltaic potential and solar resource maps of Canada – North Cowichan." Source: http://pv.nrcan.gc.ca/index.php?n=2366&m=u&lang=e (retrieved July 4, 2012).

For comparison, the average residential unit in North Cowichan used 15,220 kWh in 2007. A 15-kilowatt system, covering 90 m^2 (or about 30 by 33 ft), would meet the year's energy demand for such a home.[60] However, more than half of North Cowichan's homes are electrically heated. This would diminish markedly in a sustainable system, as space-heating is a low-value use of electricity and other supply options (e.g., heat pumps, district energy) are more effective at providing heat. Improved energy efficiency in building construction would also reduce demand, further shrinking the size of system required to meet the home's needs.

Figure 20: North Cowichan photovoltaic potential (NRCan, 2012).
Green = 900-1000 kWh/kW. Yellow = 1000-1100 kWh/kW.

North Cowichan has about 12,600 private dwellings, of which fewer than 1,000 are apartments.[61] Unfortunately, the weak incentives offered for solar installation under the 'Livesmart BC' program make large-scale deployment of solar power anywhere in the province unlikely. Without new incentives the increase in PV-powered homes would be meagre, equal to around 1% of currently existing residences (about 110 residences) by 2020. If these homes install partial systems, averaging 3 kW in capacity (the middle of what would be expected to meet most of a household's needs[62]), North Cowichan could be producing 346,000 kWh from solar by 2020 - enough to fully meet the needs of two dozen homes.

The price of PV cells declined by 75% between 2008 and 2011,[63] making solar power far more cost effective and may encourage the shift towards solar electricity. This trend will likely continue and there is a likelihood for a period of support for solar power between 2020 and 2050. It is quite possible that the equivalent of 50% of currently existing non-apartment residences (or about 5,500 residences) could install solar power by 2050, averaging 5 kW per system (the upper range of systems). These would provide 288 gigawatt-hours (GWh), equal to the entire power demand of 1890 homes.

60 Data derived from BC Hydro's 2009 public submission to the CEEI.

61 Ibid.

62 US Department of Energy (2011). "Sizing Your Small Solar Electric System." Source: http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10840 (retrieved July 10, 2012).

63 Roston, Eric (2012). "Solar Silicon Price Drop Brings Renewable Power Closer." Bloomberg News, March 13, 2012. Source: http://go.bloomberg.com/multimedia/solar-silicon-price-drop-brings-renewable-power-closer/ (retrieved July 4, 2012).

Solar space and water heating

Solar radiation can be used passively or actively to provide heat for spaces, and actively to provide heat for water.

Solar Air

The most established form of solar space heating is passive solar heating, which involves optimizing the amount of solar radiation absorbed by buildings through windows, building orientation, dark surfaces and heat retaining materials.[64] Active solar heating involves using mechanical energy to improve solar energy transfer. A proprietary technology for actively converting solar radiation into space heat is SolarWall, designed by the Canadian company Conserval Engineering.[65] The SolarWall cladding is made of perforated collector panels, installed several inches from a wall (preferably south-facing), creating an air cavity that warms with solar radiation.

SolarWall has been installed in several buildings throughout BC, in different climatic zones, including one at Crofton Elementary School.[66] An assessment at the University of Northern British Columbia in Prince George showed that installing the technology could pay off between six to eight years for two buildings with large south-facing walls.[67] Prince George receives about the same level of solar radiation in a year (13.9 MJ/m^2) as North Cowichan (13.7 MJ/m^2).[68] A more detailed building-by-building assessment, particularly of large buildings, would be required to determine the potential for solar air heating in North Cowichan.

Solar Hot Water

On average, water heating is the second largest energy end-use in BC residences, accounting for 22% of residential energy use.[69] Solar water heating can offset energy purchases and reduce GHG emissions. Solar collectors, typically mounted on roofs, transfer solar radiation to a fluid flowing through the collectors. The system is usually twinned with a conventional water heating system, which provides top-up heat when insufficient sunlight is available, e.g. extended cloudy periods or in winter.[70]

There are three main solar hot water collector technologies. Glazed flat-plate collectors are either mounted on a roof or in a frame and are capable of heating water sufficiently for domestic hot water systems. Unglazed flat-plate collectors are typically used for low temperature applications, such as heating a swimming pool.[71] Evacuated tube collectors consist of two glass tubes. Typical models have transparent outer tubes that allows sunlight to pass through to inner tubes that have solar-absorbent coatings.[72] Heat transfer fluid flows through the inner tube. There is a vacuum in between the two tubes which acts as an insulator, minimizing heat loss in cold weather. Another version of these collectors is simpler, with a single evacuated glass chamber encasing a thermoconducting rod that transfers heat to a heat transfer fluid.

Currently, the low price of natural gas and electricity in BC and the amount of sunlight in North Cowichan result in long payback periods for solar water heating. Using an online solar payback calculator, residents currently using electric heating can expect a 17 year simple payback on switching to a solar hot water system, while those using natural gas can expect a 25 year simple payback were they to switch.[73] A significant breakthrough in solar hot water heating technologies is not expected by 2020. However, there

64 Canadian Urban Institute (2008).

65 Conserval Engineering (2012). "How the SolarWall® Technology Provides Fresh Air & Free Heat." Source: http://solarwall.com/en/products/solarwall-air-heating/how-it-works.php (retrieved July 4, 2012).

66 School District 79 (2009). "Carbon Neutral Action Report School District No. 79 (Cowichan Valley)." Source: http://www.livesmartbc.ca/attachments/carbon_neutral_action_reports/SD79.pdf (retrieved July 5, 2012).

67 de Ruiter, Geoff and Steve Helle (2012). "UNBC Solar Air Pre-heating Pre-feasibility Study."

68 NRCan (2012). "Photovoltaic potential and solar resource maps of Canada." Resource for Prince George can be found at http://pv.nrcan.gc.ca/index.php?n=2333&m=u&lang=e; resource for North Cowichan can be found at http://pv.nrcan.gc.ca/index.php?n=2366&m=u&lang=e (retrieved July 5, 2012).

69 Office of Energy Efficiency (2011). Comprehensive Energy Use Database - Residential Sector – British Columbia - Secondary Energy Use and GHG Emissions by End-Use. Source: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_bc.cfm (retrieved July 5, 2012).

70 Canadian Urban Institute (2008).

71 Ibid.

72 Apricus (2012). "What is an Evacuated Tube?" Source: http://www.apricus.com/html/evacuated_tubes.htm (retrieved July 5, 2012).

73 Velux (no date). "Calculate Solar Water Heating Energy Payback." Source: http://solar.veluxusa.com/solar/products/solar_calc_payback/ (retrieved July 5, 2012).

could be as much as 30% of current residences (about 3,800 residences) using solar hot water by 2050, as prices of solar thermal and solar PV coupled to heat pumps will likely come down. If these systems provided about 60% of the hot water for homes, this could reduce energy demand by 45,000 GJ, equal to the current total energy use of about 500 homes, and reduce emissions by about 770 tonnes per year, assuming all homes except for natural gas heated homes use electricity for water heating.

Wind Energy

Wind energy is one of the most cost effective methods of renewable power generation, if situated in areas where there is a significant wind resource. Wind turbines can be sized from micro systems designed for homes to large industrial systems that generate megawatts (MW) of power (the largest system commercially available, the Enercon E-126, has a capacity of 7.5 MW).[74] The most common design is the three blade horizontal axis wind turbine. The electricity can be used on-site or exported to the grid.[75]

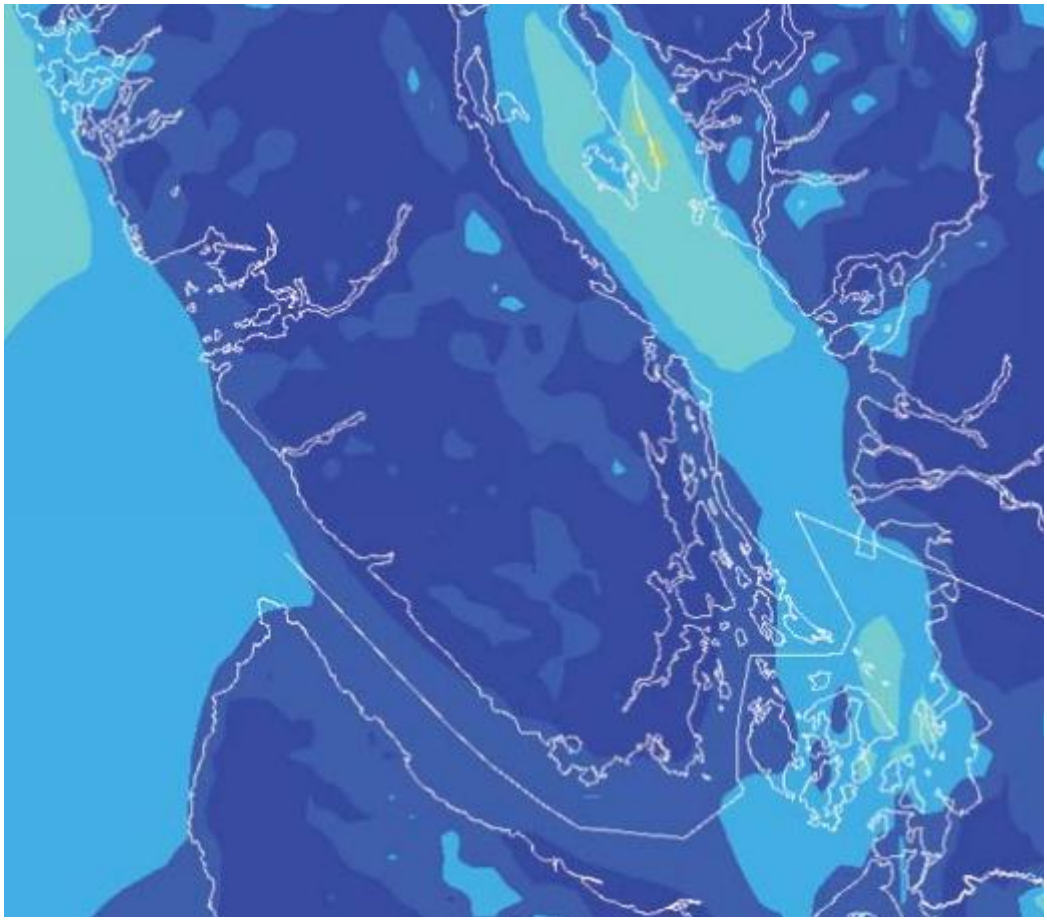


Figure 21: Wind resource for southern Vancouver Island.
The highest average wind speeds are in red, the lowest are in blue. (Environment Canada Canadian Wind Energy Atlas, 2003.)

As shown by this Wind Energy Atlas map, North Cowichan does not have good wind resources. Using the Canadian Wind Energy Atlas, it is estimated that a 2 MW Enercon-82 brand[76] wind turbine (similar to those at Bear Mountain Wind Farm near Dawson Creek) near the centre of the North Cowichan (e.g. at Hwy 1 and Mays Rd) would generate about 4.2% of its rated capacity.[77] This is less than 1/5 of what would be required for a project to be economical. Commercial wind power is not likely to contribute to the energy mix within North Cowichan, in either the 2020 or the 2050 time frame. There is a possibility, however, that the hills outside the municipal boundary 10 km west of Chemainus could be a reasonable site for wind power generation.[78]

74 Enercon (2012). "Wind Turbines - E-126 / 7,580 kW" Source: http://www.enercon.de/en-en/66.htm (retrieved July 5, 2012).

75 Canadian Urban Institute (2008).

76 Enercon (2007). "Enercon E-82 – Technical Description." Source: http://www.gov.ns.ca/nse/ea/glen.dhu.wind.farm/glen.dhu.wind.farm_VolumeII_AppendixB-Section1-ATechDescription.pdf (retrieved July 3, 2012).

77 Environment Canada (2003). "Canadian Wind Energy Atlas." Wind potential near the centre of DNC. Source: http://www.windatlas.ca/en/nav.php?field=E1&height=50&season=ANU&lat=48.84&lon=-123.66&postal=&no=64 (retrieved July 4, 2012).

78 EA Energy Analyses and GRAS (2012a). "Cowichan Valley Energy Mapping and Modelling - Report 1 – GIS Mapping of Potential Renewable Energy Resources in the CVRD."

Biomass

Any organic material can provide biomass energy. Biomass is viewed as a carbon neutral fuel, as the carbon dioxide from consuming the fuel was generated through recent photosynthesis. Biomass can be used for space or water heating, transportation fuels or for electricity generation. It can come in solid forms (wood, wood chips, yard trimmings, pellets, sawdust, municipal solid waste, manure and charcoal, amongst others), liquid forms (including ethanol, biodiesel and black liquor from pulp and paper processing), and gaseous forms (including digester gas, landfill gas (LFG) and synthetic gas, or syngas, from gasification of solid biofuels). Typically, the biomass fuel is burned directly, though it can also be gasified to produce syngas.

British Columbia has a wealth of biomass energy resources. Biodiesel is already produced in North Cowichan at the Bings Creek facility, with 365,000 litre/year production capacity.[79] Catalyst Paper in Crofton has a pilot project to capture biogas from waste sludge in its facility,[80] and already makes use of wood wastes for energy, with a facility capable of generating 39 MW of electricity and 45 MW of thermal from its wastes.[81] If this facility operates at 80% capacity, it would generate almost 1,000 TJ of electricity and 1,150 TJ of heat.

Innovation in biomass energy continues to occur. FortisBC is looking to expand its renewable natural gas offering; they are already incorporating biogas from Fraser Valley Biogas and the Columbia-Shuswap Regional District into their network.[82] A study prepared for BC Hydro's Integrated Resource Planning Process estimated that wood resources alone could provide over 800 MW on Vancouver Island, at a cost of $0.16/kWh,[83] without assessing heating outputs. Sustainably harvested biomass energy could replace about 37% of BC's fossil resources.[84] Agriculture and Agri-Food Canada have developed the Biomass Inventory Mapping and Analysis Tool (BIMAT), which provides information on the type of biomass available across Canada.[85] For North Cowichan, BIMAT calculates that as much as 302,000 tonnes of biomass will be available (Table 1).

The EAEA/GRAS analysis estimates that about half of the available, non-mill residue energy could be sustainably harvested. The analysis assumes that each hectare of forest could sustainably generate 0.608 oven dry tonnes (ODT) of forestry roadside residue annually. Each ODT contains 18 GJ of energy, so 84 terajoules (TJ), or 23 GWh, of energy would be available from forestry residues in North Cowichan,[86] half of the amount listed by the BIMAT. The CVRD's agricultural wastes are concentrated in Electoral Areas B, C, D and E, with over half of them in the North Cowichan. The EAEA report does not distinguish which resources are where, but does show that the 30 livestock farms in the area could generate 132 GJ (37 MWh) of energy from biogas. As well, the BIMAT assessment shows 2.6 TJ in potential agricultural residues.

The Catalyst mill in Crofton already uses a large proportion of the biomass energy (burning wood chips) available in North Cowichan. It is reasonable to project a 20% increase in North Cowichan's biomass energy output by 2020 and a 50% increase in biomass energy output by 2050. This would result in annual reductions of 12,600 tCO2e from current emissions by 2020 and 31,500 tCO2e by 2050.

79 Sims, Bryan (2011). "Streamlining Downstream Delivery." Biodiesel Magazine, Sept. 8, 2011. Source: http://www.biodieselmagazine.com/articles/8053/streamlining-downstream-delivery (retrieved July 6, 2012).

80 Natural Resources Canada (2010). "Government of Canada Invests in Forest Industry Transformation at Crofton Pulp and Paper Mill." Source: http://www.nrcan.gc.ca/media-room/news-release/93/2010-12/1810 (retrieved July 6, 2012).

81 Bradley, Douglas and Kendal Bradburn (2012). "Economic Impact of Bioenergy in Canada – 2011." Canadian Bioenergy Association. Source: http://www.canbio.ca/upload/documents/canbio-bioenergy-data-study-2011-jan-31a-2012.pdf , p. 12 (retrieved July 20, 2012).

82 FortisBC (2012). "Renewable Natural Gas - Current projects." Source: http://www.fortisbc.com/About/ProjectsPlanning/GasUtility/NewOngoingProjects/Biogas/Pages/Current-projects.aspx (retrieved July 6, 2012).

83 Industrial Forestry Service Ltd., M.D.T. Ltd., and Murray Hall Consulting Ltd (2010). "Wood Based Biomass Energy Potential of British Columbia." Prepared for BC Hydro. Source: http://www.bchydro.com/etc/medialib/internet/documents/planning_regulatory/iep_ltap/ror/appx_7_bc_wood_based_biomass_potential_report.Par.0001.File.DRAFT_Appendix7_BCBiomassWoodBasedPotential.pdf, pg. 17 (retrieved July 6, 2012).

84 Biocap Canada (2008). "An Information Guide on Pursuing Biomass Energy Opportunities and Technologies in British Columbia." Source: http://www.energyplan.gov.bc.ca/bioenergy/PDF/BioenergyInfoGuide.pdf, pg. 6.

85 Agriculture and Agri-Food Canada (2008). "Biomass Inventory Mapping and Analysis Tool (BIMAT)" Source: http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1226509218872&lang=eng (retrieved July 16, 2012).

86 EA Energy Analyses and GRAS (2012). "Cowichan Valley Energy Mapping and Modelling - Report 1 – GIS Mapping of Potential Renewable Energy Resources in the CVRD."

Table 7: Biomass energy available in North Cowichan by weight and energy content		
Crop Type	**Amount (oven dry tonnes)**	**Available energy (TJ)**
Barley	30	0.5
Oat	118	2.1
Herbaceous Biomass Total	148	2.6
Woody Calculation Results		
Softwood Roadside Harvest Residue	8,846	169
Hardwood Roadside Harvest Residue	0	0
Softwood Mill Residue	282,830	5,414
Hardwood Mill Residue	0	0
Urban Wood Waste	10,260	196
Woody Biomass Total	301,936	5,779
Biomass Grand Total (ODT*)	302,084	5,782

Marine Energy

Marine energy from the ocean's waves, tides, salinity, and ocean temperature differences can be harvested by an emerging set of technologies. There are five types of marine energy that could be harvested:

- Marine current power: energy obtained from ocean currents;
- Osmotic power: energy from salinity gradients;
- Ocean thermal energy: power from temperature differences at varying depths;
- Tidal power: energy from moving masses of water; and
- Wave power: energy from surface waves.

Currently, generation of marine energy is in its infancy. Tidal power is the only type that has experienced a significant amount of implementation, with seven facilities operational as of 2010. One 65kW tidal current generator was installed at Race Rocks, south of Metchosin. It was removed in 2011 at the end of its five-year test period. The trial indicated that tidal power, while effective at power production, has its challenges in terms of upkeep and maintenance of the generation and electricity transfer infrastructure. Another system has been generating 20 MW of power in Annapolis Royal, NS, since 1984.

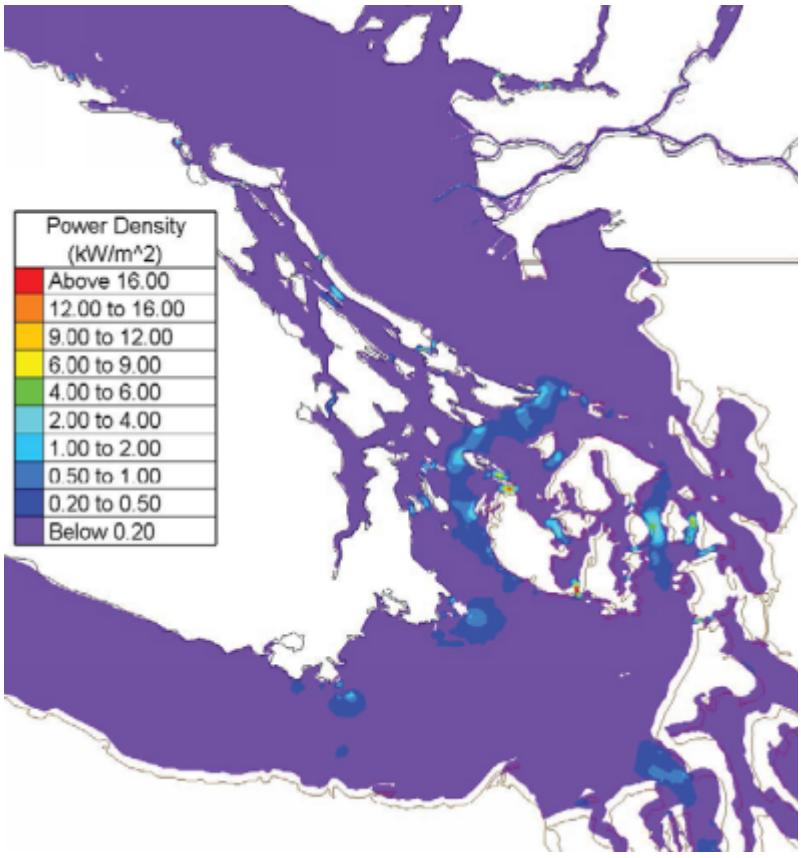


Figure 22: Mean Power Density of tidal flows, southern Vancouver Island (Cornett, 2006).

The Sansum Narrows between the southeast corner of North Cowichan and Salt Spring Island provide some of the better tidal current speeds and power density in Southern Vancouver Island and the Gulf Islands. Cornett (2006) states that the location has a potential to produce 5 MW (mean) of power from tidal energy.

River Energy

Hydroelectric power is the most common form of electricity generation in British Columbia, providing around 90% of BC's power.[87] Independent power producers provide about 1/5 of the hydroelectric power in the province. This power has kept the carbon footprint of BC lower than it might be if the grid was more dependent on fossil fuels. There are no hydroelectric power generation facilities in North Cowichan.[88, 89, 90] New projects in the region are unlikely in the near term, 2020 time frame. However, there is a possibility that the Chemainus River could be used just inside North Cowichan's western boundary. EA Energy Analyses and GRAS assess the site as capable of generating nearly 6 GWh per year, with a capacity of 670 kW.[91]

Geoexchange (ground-source heat pumps or earth energy)

The term "geoexchange energy" is interchangeable with "ground source heat pump" (GSHP) or "earth energy." The technology describes the use of energy that is absorbed and stored at or near the Earth's surface (typically, no more than 50 m below the surface) to provide space heating, through the use of a heat pump. A few metres into the ground, temperatures stay relatively constant throughout the year, providing a consistent source of heat. Heat pumps work by extracting heat from a cold source to warm a sink that is already warmer than the source, through the expansion and condensation of a heat transfer fluid (or refrigerant). Heat pumps can also be used to provide cooling in the summer. The coefficient of performance (the units of heat produced per unit of energy used to operate the system) of a GSHP is on the order of 3 to 6; each unit of electricity used results in three to six times the heat by transferring the heat from the ground to the space being heated.

The potential of geoexchange energy for reducing energy demand is significant, given that it cuts space-heating (and water heating where the system is integrated) demand by between 67 and 83%. However, installing a geoexchange system is expensive (around $30,000 per household), and the low cost of electricity and natural gas in BC are barriers to widespread implementation of the technology. In Sweden, the barriers to geoexchange system installation are far fewer, because of limited access to natural gas, carbon taxes five times greater than BC's ($150/tonne[92] vs. $30/tonne[93]) and electricity prices more than 3 times the level of BC (about $0.26/kWh[94], vs. $0.077/kWh[95]). Over 300,000 geoexchange systems had been installed in Sweden by 2008.[96] Major shifts in rates for electricity and natural gas in the near term are not anticipated. As well, because of the low carbon content of electricity in BC, geoexchange is more effective as an energy efficiency measure than a carbon mitigation measure.

It is reasonable to anticipate approximately 300 systems to be installed by 2020, and assume that homes with natural gas would not switch, as the fuel is new to the region. The 2010 Community Energy and Emissions Inventory shows that there were just over 3,000 residential natural gas connections in the region; this leaves just shy of 10,000 residences that could be connected. Calculations based on BC Hydro's submission to the BC Government for the 2007 CEEI estimate that North Cowichan homes that use electricity use about 7,400 kWh for space heating alone, and a geoexchange system in these homes would reduce that use by 2/3 (or roughly

87 BC Hydro (2012a). "BC Hydro Annual Report – 2011." Source: http://www.bchydro.com/etc/medialib/internet/documents/annual_report/2011_BCH_AnnualReport.Par.0001.File.2011-BCH-Annual-Report.pdf, pg. 35 (retrieved July 5, 2012).

88 BC Hydro (2011). "Generation – Our Facilities – Vancouver Island." Source: http://www.bchydro.com/energy_in_bc/our_system/generation/our_facilities/vancouver_island.html (retrieved July 5, 2012).

89 Natural Resources Canada (2009). "The Atlas of Canada – Hydroelectric Generating Stations, 2007." Source: http://atlas.nrcan.gc.ca/auth/english/maps/economic/energy/Dams?layers=pop_cap%20pop%20pop1%20DAMS%20DAMS1&scale=10500000.000000&mapxy=-2062599.5824417942%20492260.01663462096&mapsize=750%20666&urlappend= (retrieved July 5, 2012).

90 BC Hydro (2012b). "IPP Supply – Map." Source: http://www.bchydro.com/etc/medialib/internet/documents/planning_regulatory/acquiring_power/2012q2/20120401_ipp_supply1.Par.0001.File.20120401-IPP-Supply-Map.pdf (retrieved July 5, 2012).

91 EA Energy Analyses and GRAS (2012).

92 Government of Sweden (2012). "Energy and CO_2 Taxation." Source: http://www.sweden.gov.se/sb/d/16022/a/190032 (retrieved July 6, 2012).

93 BC Ministry of Finance (2012). "How the Carbon Tax Works." Source: http://www.fin.gov.bc.ca/tbs/tp/climate/A4.htm (retrieved July 6, 2012).

94 European Union (2011). "Retail (end-user) energy prices for households." Source: http://www.energy.eu/ (retrieved July 6, 2012).

95 BC Hydro (2012a), pg. 87.

96 Navigant Consulting, Inc. (2009). "Ground-Source Heat Pumps: Overview of Market Status, Barriers to Adoption, and Options for Overcoming Barriers." U.S. Department of Energy. Source: http://www1.eere.energy.gov/geothermal/pdfs/gshp_overview.pdf, pg. 20 (retrieved July 6, 2012).

5,000 kWh), reducing emissions by 125 kg CO2e/household. Assuming that 5% of existing households (and no new ones) that are not using natural gas transfer to geoexchange by 2020, emissions reductions of 430 tCO2e/year could be realized annually. This is a very conservative estimate, as it is likely that emission reductions would be far greater as the incentive is greatest to shift away from propane and heating fuel because of fuel costs. It could be assumed that an equivalent of a further 20% of non-natural gas households would make the shift by 2050, bringing reductions to 2,150 tCO2e/year.

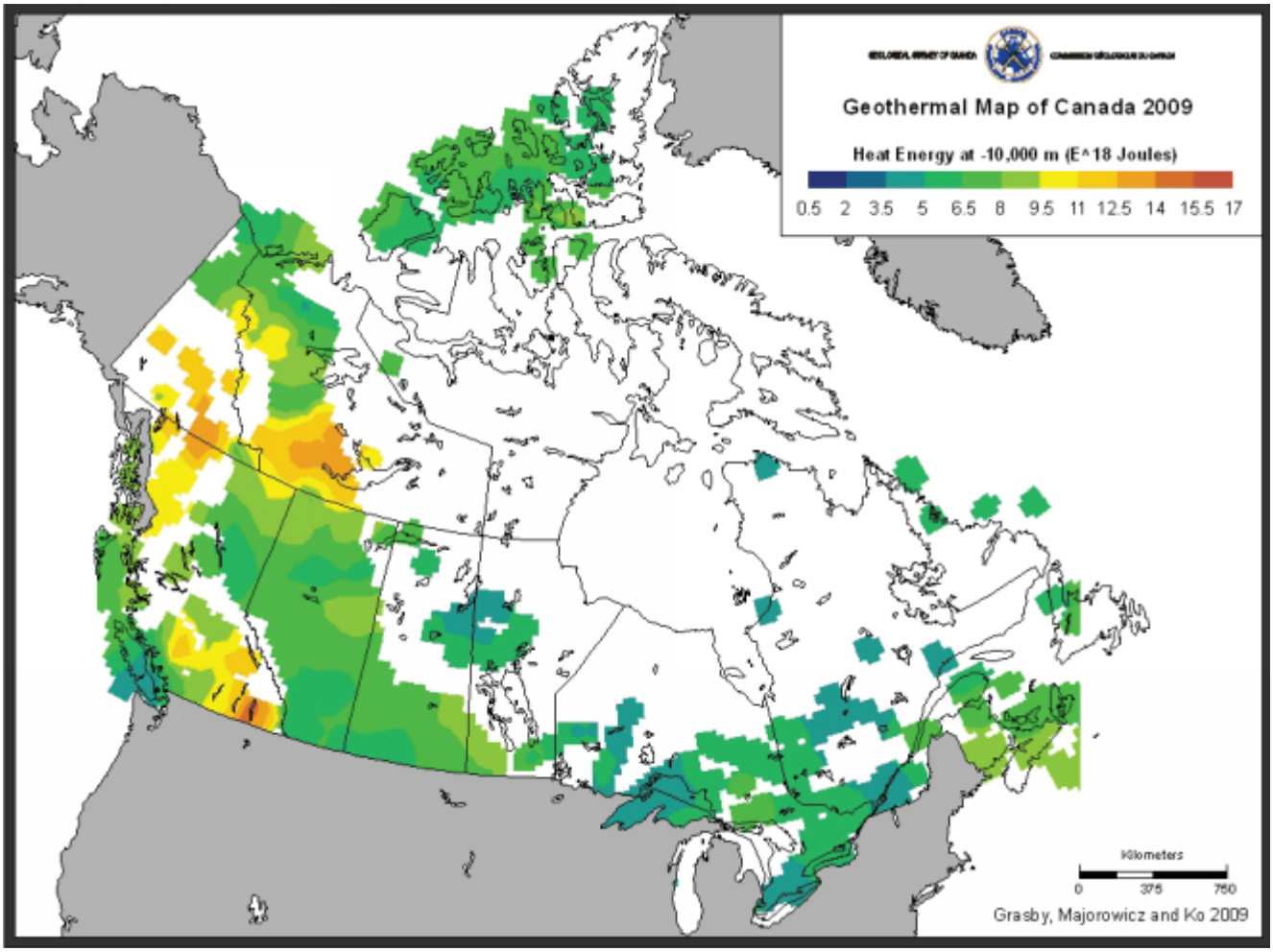


Figure 23: Geothermal energy 10km under the surface.

Geothermal Energy

Geothermal energy takes advantage of heat deep under the Earth's surface to provide electricity and/or heat. The technology is being exploited globally in areas where there are hot spots close to the surface. Water is injected into the hot spot, and is drawn back to the surface as steam. The steam is used to drive a turbine, similar to a thermal power plant.[97] Geothermal energy can also be used easily in district energy systems. Geothermal energy is used globally to produce 11 GW of power and 28 GW of heat. Iceland[98], El Salvador, the Philippines, Costa Rica, Nicaragua and Kenya all produce at least 10% of their power using geothermal energy.[99] Currently, there are no geothermal energy plants in Canada.

A study of geothermal energy has been undertaken in Canada, where the locations with generation potential have been mapped out. North Cowichan does not have sufficiently hot rock near the surface, or even at the depth of 10 km below the surface, to be

97 Geothermal Education Office (2000). "Geothermal Energy Facts Introductory Level." Source: http://www.geothermal.marin.org/pwrheat.html (retrieved July 6, 2012).

98 Orkuveita Reykjavíkur (no date). "Nesjavellir Geothermal Plant." Source: http://www.or.is/English/Projects/NesjavellirGeothermalPlant/ (retrieved July 6, 2012).

99 Wikipedia (2012). "Geothermal energy." Source: http://en.wikipedia.org/wiki/Geothermal_energy (retrieved July 6, 2012).

considered as a site for implementation of geothermal energy production (Figure 23).[100]

District Energy

District energy is the generation of heat from a centralized facility, which is then piped to other customers in the vicinity (this is different from combined heat and power production - CHP - in which a central utility produces both electricity and heat from the same energy source). District energy is very common in Europe, where several countries, including Denmark, Sweden, Iceland, Poland and Estonia provide more than half their heat through district energy.[101] It is also being used in Canada for both space heating and space cooling. In Toronto, for example, deep water from Lake Ontario is used to cool 3 million square metres of building space. In BC, district energy is being used in Vancouver, North Vancouver, Prince George, Surrey, Richmond, Gibsons, Houston, Victoria and Revelstoke, amongst other communities. District energy is flexible in that it only needs a heat source to heat water to be pumped through to customers. Wood chips, sawdust, natural gas, geoexchange and sewage heat are used in the systems listed above.

District energy systems are most likely to be successful where there are large loads that justify the installation of the piping, which costs about $1,000/m installed. Low energy costs in BC make this hurdle even more difficult to climb. A more detailed survey would need to be taken to determine where there may be resources available and loads large and dense enough to justify a system installation. At this point, district energy can be assumed to be included in the increase in output from biomass and/or geoexchange.

Summary

North Cowichan can expect to see some increases in some of the renewable energy forms available. However, not all technologies are reasonable to implement in the region; wind and geothermal do not show high probability of successful deployment in the region, for example.

100 Grasby, S.E.; J. Majorowicz; and M. Ko (2009). "Geothermal Maps of Canada." Geological Survey of Canada. Source: http://geogratis.cgdi.gc.ca/eodata/download/part6/ess_pubs/247/247765/of_6167.pdf, Figure 23 (retrieved July 6, 2012).

101 Wikipedia (2012). "District Heating." Source: http://en.wikipedia.org/wiki/District_heating (retrieved July 6, 2012).

5 Future Land-use Scenario Modelling and Analysis

5.1 Future land-use planning and modelling

As presented in Section 1, infrastructure and land-use have the most significant effects on energy use and emissions production. Therefore, land-use planning is a critical CAEP approach. Many of the potential actions presented in Section 4 relate to land-use planning. In order to estimate the collective effects of actions such as these on energy, emissions, land-use features and development in the future, SSG developed an open source land-use modelling tool, GHGProof. GHGProof can be used to analyze past and present land-use patterns, project the impact of future land-use patterns and generate land-use scenarios to achieve a set target. All of the calculations, inputs and assumptions in GHGProof are visible to the user. Key strengths of the model include:

- **Comprehensive**: Seeks to address all major land-use impacts on GHG emissions, and some public and private energy costs.
- **Adaptable:** can be used for a rigorous analysis of a large city or in a one-day workshop for a small community.
- **Affordable**: Free to use for non-profit purposes, open source.
- **Transparent**: All assumptions and calculations are visible and can be altered.
- **Scope:** Can be used at the scale of a large-scale development, a municipal plan and a regional plan
- **Policy relevant:** Allows municipalities to develop or evaluate targets to address provincial or state legislation.
- **Accessible:** Uses simple GIS analysis and an excel-based calculator; limits number of inputs to those that have greatest potential GHG impacts.

It is important to note that the model's outputs do not represent the actual outcomes; the only model that will behave, in all ways, as the original system is that system itself. In other words, GHGProof will not determine outcomes with certainty; it illustrates the effects of choosing among various outcomes. To trust a model, both the assumptions and the means of creating and presenting the model need to be fully transparent. In GHGProof, all of the calculations, inputs and assumptions are visible to the user.

A scenario is a view of what the future might turn out to be; it is not a forecast, but one possible future outcome. A good set of scenarios is both plausible and surprising, providing insight into a particular challenge. A scenario analysis is designed to enable users to make informed decisions in the context of a complex set of variables.

Here, GHGProof is used to explore:

- Alternatives: variations of housing types, locations and technologies can be expressed using different scenarios in the model.
- Consequences: the immediate and cumulative effects are expressed through the outputs of the analysis and through a GIS mapping exercise.
- Causations: causal bonds between alternatives and consequences are illustrated using transparent equations between assumptions and inputs.
- Time frames- periods of time between implementation of the alternatives and the unfolding of their consequences are indicated in the inputs spreadsheet.
- Geographical footprints: the place-oriented blueprints or alternatives are developed using a GIS methodology.

Assumptions

GHGProof uses a large number of assumptions, drawing where possible on local studies and otherwise employing provincial or national averages. All of the assumptions are adjustable in order to test different possibilities. In the baseline, assumptions are calibrated to align the model with the relevant categories from the Community Energy and Emissions Inventory data. A complete list of assumptions as well as sources is available in the assumptions tab of GHGProof, attached in Appendix 3.

Scope

The foremost aim of this analysis is to enable planners, policy- and decision-makers, and communities within local and regional governments to understand the implications of land-use decisions on greenhouse gas emissions and energy costs. Municipal governments in BC can directly influence key variables as illustrated in Table 14.

Table 8: Key variables under municipal influence	
Area of influence	**Tools**
Transportation	Municipal plans, transit plans, infrastructure provision, tax incentives
Buildings	Building codes, development management, energy efficiency incentives
Liquid waste	Infrastructure provision, restriction policies, water efficiency incentives
Solid waste	Municipal services, restriction policies, recycling and low wate incentives
Agriculture	Municipal plans
Forest area	Municipal plans, municipal services

In these spheres of influence, it has been estimated that municipalities directly or indirectly control between 44% and 52% of greenhouse gas emissions.[102] This estimate does not address the impact of land-use decisions in a systematic manner. SSG's goal is to translate the relationship between land-use and GHG emissions into a methodology that allows the quantitative evaluation of different land-use scenarios, while incorporating the influence of provincial and federal government policies.

The total greenhouse gas emissions for a community is defined as:

$$GHG_{landuse} = GHG_{transport} + GHG_{energygen} + GHG_{embody} + GHG_{waste} + GHG_{agriculture} + GHG_{forest} + GHG_{landconvert}$$

Where:

$GHG_{transport}$ is the movement of goods and people.
$GHG_{energygen}$ is the generation of heat and electricity.
GHG_{embody} is the embodied energy in materials.
GHG_{waste} is liquid and solid waste produced.
$GHG_{agriculture}$ is the production of food.
GHG_{forest} is the area of forest land.
$GHG_{landconvert}$ is the area of land that is either natural or has been modified (e.g.: farmed) conditions.

The analysis does not include GHG emissions from:

- Small engines including ATVs, motorboats, lawnmowers, etc, because of data limitations;
- Planes or boats, even if their travel originates in North Cowichan because of data limitations and limited control by municipal governments;
- Poultry, pigs and other livestock, excluding cows, because they are considered to be marginal;
- Major industrial sources which are not within the sphere of influence of municipalities.
- Extraction and manufacture of goods consumed by North Cowichan residents (embodied GHG emissions).

North Cowichan includes a number of major industrial facilities, the most significant of which is Catalyst Paper Corporation near Crofton. Industrial GHG emissions data can be withheld from the CEEI data for proprietary reasons. Catalyst's emissions data is made available to North Cowichan, but it was not available at the time of this report. Also, the transportation model did not identify Catalyst as a key destination because the number of trips to the mill per area are small relative to a gas station, for example, which is a major trip generator with a much smaller footprint.

The analysis does include emissions associated with the transportation of food (i.e.: food miles). While the concept of food miles has attracted some debate, our analysis indicates that local production and consumption of food can generate significant GHG emissions reductions. For a detailed literature review of SSG's approach see the paper titled "Greenhouse gas emissions modelling to build resilient communities". [103]

102 EnviroEconomics, 2009, prepared for FCM. Act Locally, The Municipal Role in Fighting Climate Change.

103 SSG, 2010. Greenhouse gas emissions modelling to build resilient communities: A Review of the Literature. www.sustainabilitysolutions.ca/sites/default/files/SSG%20GHG%20Model%20Literature%20review_0.pdf

5.2 Baseline Information

Baseline inputs

Following the identification of assumptions, inputs for the 2007 baseline year, including population (28,801) and households (11,800) from BC Stats, were entered into GHGProof. A transportation model of North Cowichan was created by identifying all potential destinations using BC Assessment Data. Institute of Transportation Engineers trip generation factors were then assigned to each destination. For example, according to the Institute of Transportation Engineers a 5,000 square foot financial institution is assumed to generate 741 trips each day. Each destination was assigned trip generation numbers and aggregated using GIS to identify the key destination clusters in North Cowichan (Map 2). Average trip length was then calculated using GIS by assessing the distance between each key destination cluster and each dwelling. These distances were weighted according to the percentage of total trips to that destination and then summed to generate an average trip length for North Cowichan. This average is then calibrated against fuel consumption data from CEEI to calculate an average trip length for the baseline (result: 11.6 km).

The number of dwellings by type (detached, attached, apartments < 5 storeys, apartments >5 storeys, mobile homes) was identified from BC Assessment data. GIS was used to calculate the number of dwellings at different levels of density (Map 3). Solid waste data was provided by the Cowichan Valley Regional District and GIS was used to identify the number of dwellings served by primary, secondary or tertiary waste treatment. GIS data was also used to calculate the area of land in the Agricultural Land Reserve and area of forest in the CVRD. Data on agricultural practices was provided by the Agricultural Census.

Baseline results

CEEI data reports the total GHG emissions for the Baseline year of 2007 to be 122,261 tCO2e. Using GHGProof, the total GHG emissions for the 2007 Baseline year was 181,741 tCO2e, a difference of 145% as compared to CEEI data. This difference is accounted for due to the additional emissions factors considered by GHGProof:

- Emissions from estimated solid waste totals from North Cowichan of 4,480 tonnes versus the CEEI number of 2,738 tonnes based on Cowichan Valley Regional District reported totals;
- Emissions from food transportation;
- Emissions resultant from agricultural practices; and
- Emissions absorbed by forest cover.

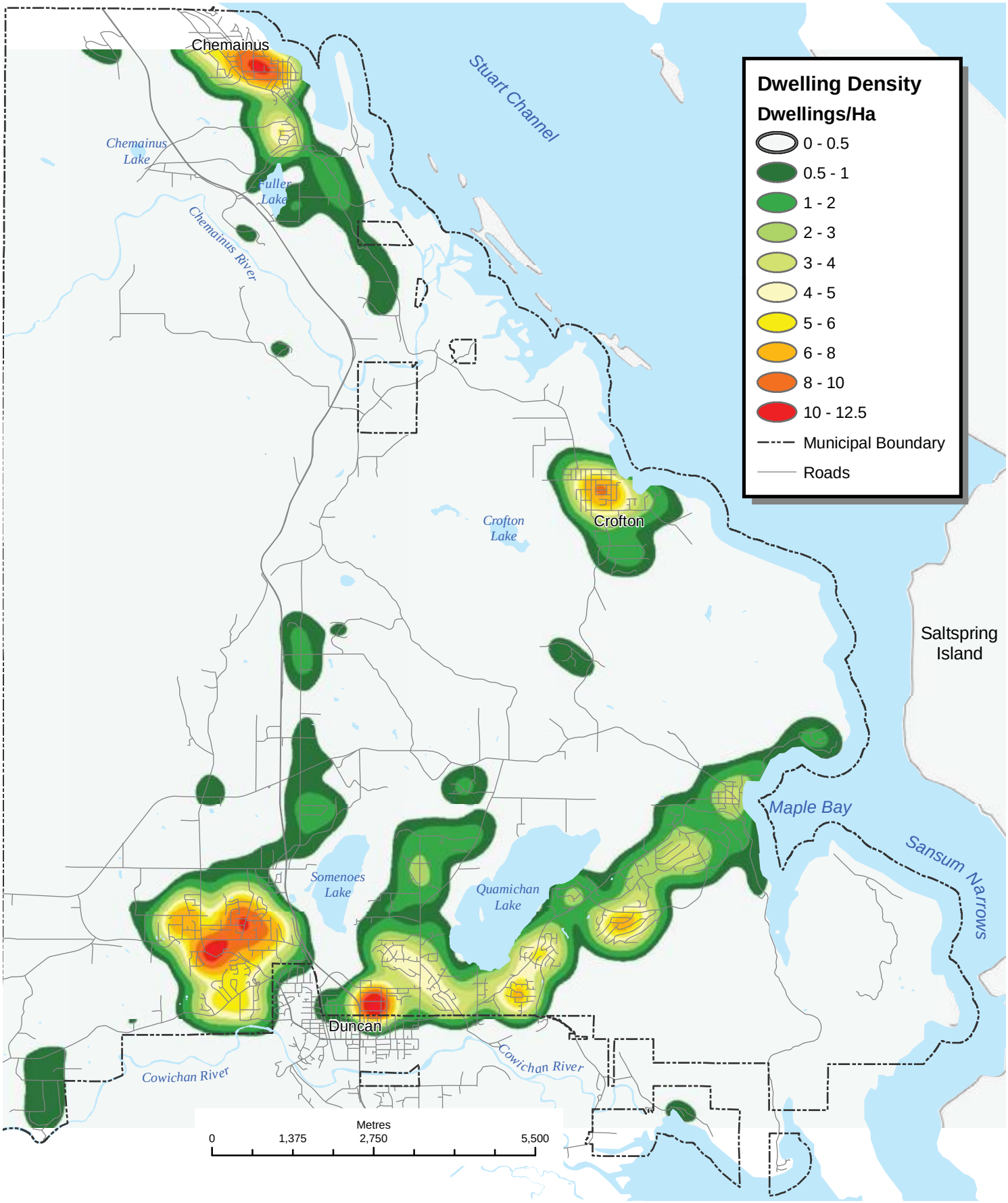
GHGProof accounts for other, smaller factors that differ from CEEI, including:

- Emissions from liquid waste;
- Differentiation between GHG amounts released from diesel versus gasoline vehicles;
- Different methodology in GHGProof for calculating emissions factors for residential and commercial buildings based on the dwelling mix; and
- Additional agricultural emissions variables.

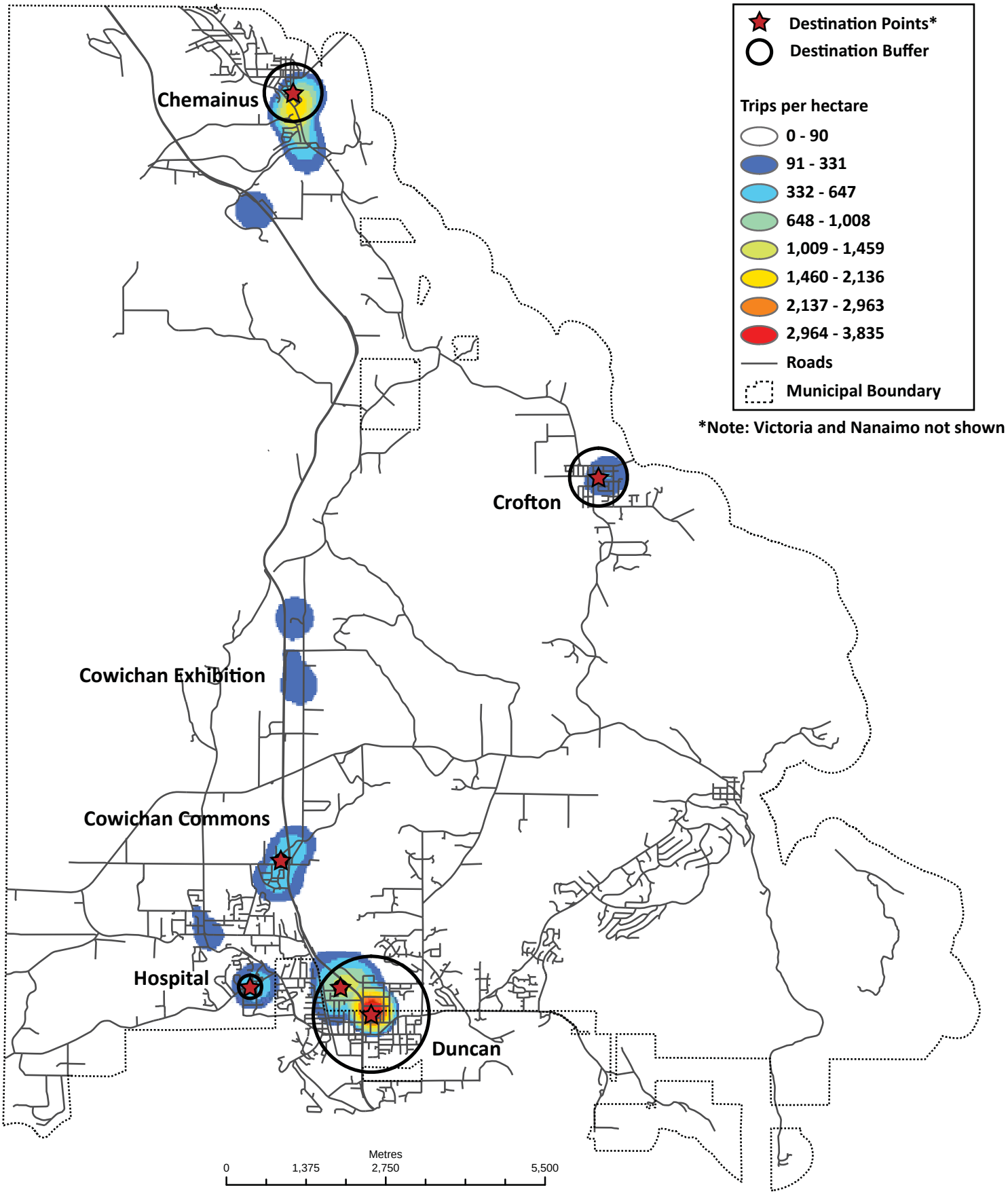
The inclusion of factors beyond CEEI is helpful for North Cowichan because the emissions inventory is more accurate, yielding more policy levers to achieve GHG reductions, including opportunities to support existing initiatives in the region. For example, the inclusion of forest cover in GHGProof directly relates to forestry practices in North Cowichan.

The maps on the following pages show some of the important factors considered for establishing the Baseline Results as well as extrapolating the Business as Usual Scenario and Scenarios 1 and 2.

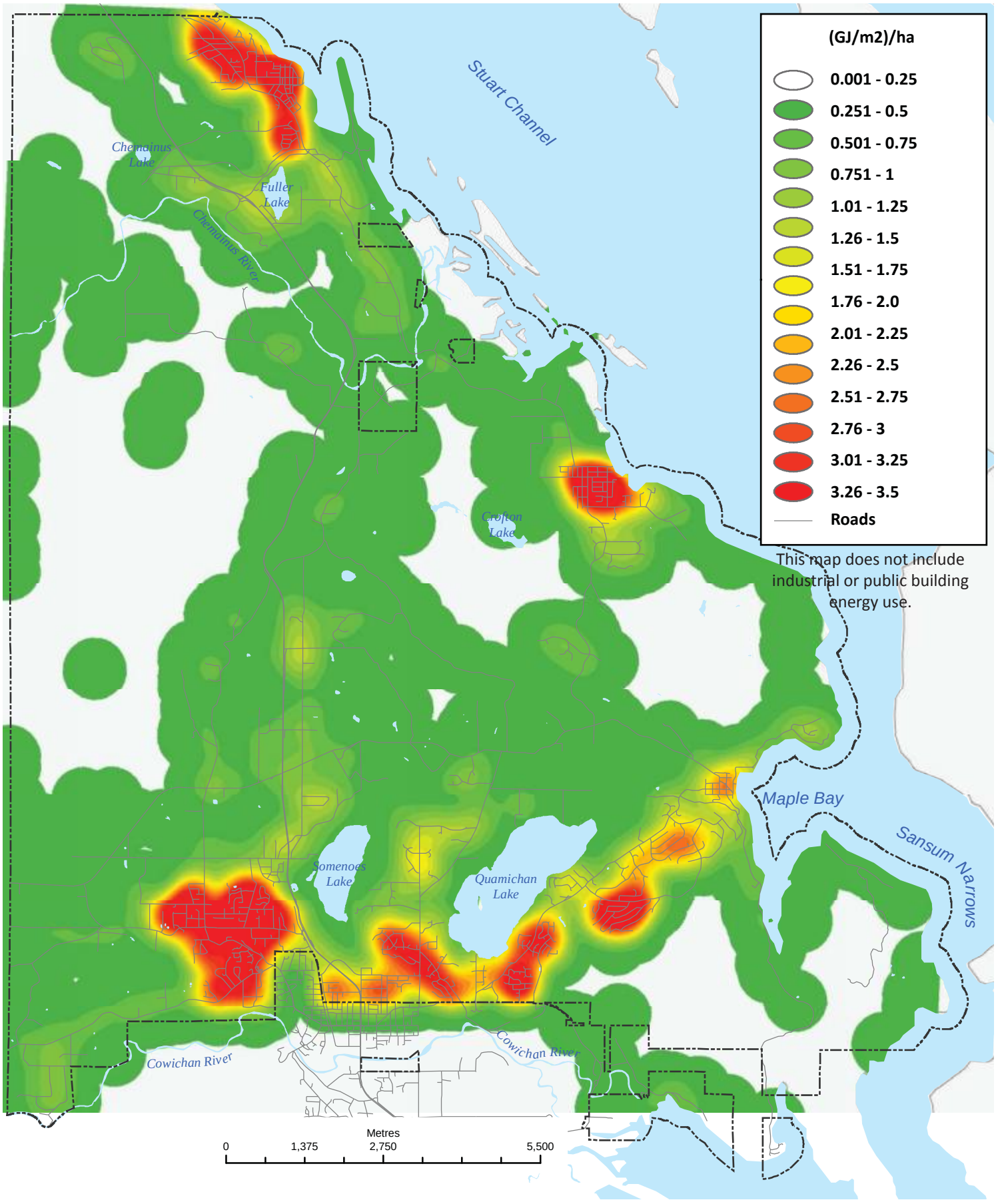
Map 2: Current Dwelling Density



Map 3: Vehicle Trips by Destination



Map 4: Current Residential/Commercial Energy Density



Maps Discussion

Map 2 shows the highest dwelling densities are west of Duncan, in north western Chemainus and in Crofton. These areas are the best candidates for future housing density and amenity development. A threshold for residential-only district energy is 50 units per hectare (Wiltshire, 2003), indicating that there are currently no areas in North Cowichan that are feasible for district energy without commercial and/or industrial demand. This map also illustrates the spread of development emerging from Duncan, emphasising the need to strengthen collaboration with that municipality. The areas of greatest existing and planned housing density correspond to those with sanitary sewer services, shown in Map 2.

People commute from the high density housing areas to the destination hot spots shown in Map 3. Most trips within the region are made to north and downtown Duncan. Crofton and Chemainus are also popular destinations. The remainder of notable trips go to the hospital and Cowichan Commons shopping plaza. People travel to access the amenities in these destination hotspots. For the purposes of modelling transportation, destinations in Nanaimo and Victoria are modelled here as well, although they are not represented on this map. While the Statistics Canada Census reports on mode share for commuting only, this map captures all trips made (e.g.: shopping trips, school trips, etc.) with the one exception of household to household trips.

The areas of greatest energy density in Map 4 correspond with the areas of greatest housing density. This map was generated using residential and commercial areas from BC Assessment data. Energy intensities were assigned according to building type, employing the same intensities as those in the EA Energy Analysis (2012). The hospital area is particularly noticeable as a region with high energy density. The energy hotspots are the best areas to start developing energy efficiency solutions. They are candidates for district energy, focusing fuel switching efforts (e.g.: trading heating oil fuel sources for renewable energy sources), and focusing energy efficiency retrofit programs. The map provides a more accurate estimate of building-related energy consumption and therefore a more sophisticated analysis of the potential for district energy. In addition to the district energy site in the centre of Duncan, there is also potential for district energy around the hospital, in Chemainus and in Crofton. A more detailed feasibility study will indicate the mix of heating and electrical demand for those locations.

5.3 Modelled Scenarios

As with other types of modeling, such as economic or demographic, it is critical that the same methodology is consistent between the baseline and the scenarios. Three different future land-use scenarios were developed and evaluated using a consistent approach with GHGProof. The Business as Usual (BAU) scenario uses forecasting to predict future energy consumption and GHG emissions extrapolated from existing land use patterns, i.e. continuing to use land in ways similar to its current use. Scenarios 1 and 2 (described below) use a technique called back-casting in which a future date at which a GHG reduction target has been set is chosen and actions to reduce emissions leading up to that date are then explored (i.e.: what needs to be done between now and the target date to achieve emissions reduction goals). The most viable combination of strategies required to achieve the targets for Scenarios 1 and 2 were modelled. Other combinations of strategies with different emphasis are also possible to achieve those same targets. Detail on the assumptions underlying the scenarios is found in Appendix 3. Scenario results are discussed in Section 5.4.

Table 9 shows a high level allocation of new dwellings to geographic areas in North Cowichan for each scenario. The number of new dwellings is based on the projected population by the target year and current average persons per household statistics. All scenarios follow existing urban containment boundary development restrictions; development is greater in Scenario 1 than the BAU Scenario, and greater again in Scenario 2. Population projections are based on BC Stats numbers.

Table 9: New dwelling allocation per scenario

	Baseline	Business as Usual (BAU)	Scenario 1	Scenario 2
Based on:	**Baseline Data**	**Official Community Plan directives**	**New Housing Densification: 33% reduction under 2007 levels**	**Mixed-use Nodes: 33% reduction under 2007 levels (80% reduction under 2007 levels by 2050)**
Target year	2007	2020	2020	2025
Population	28,801	34,932 (+6,131 people)	34,932 (+6,131 people)	37,623 (+8,822 people)
Households	11,800	17,221 (+5,421 homes)	17,221 (+5,421 homes)	18,812 (+7,012 homes)
Dwelling allocation		• 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% broadly distributed over rural areas.	• 40% to James Alexander; • 10% to Gibbins/Prevost; • 25% to Chemainus; • 20% to Crofton; • 5% broadly distributed.	• 30% to James Alexander; • 30% to Gibbins/Prevost; • 30% to Chemainus; • 5% to Crofton; • 5% broadly distributed.
Annual community GHG emissions in target year (tCO_2e)*	181,741	208,597	122,429	119,118

*GHG reduction amounts are subject to rounding in the modelling process and are within the margin of error in the modelling. Mathematically, a 33% reduction is 121,161 tCO_2e and an 80% reduction is 36,348 tCO_2e.

Business as Usual (BAU) Scenario

This scenario is designed to reflect the best understanding of GHG emission forecasts in North Cowichan if no additional strategies to reduce GHG emissions are implemented. This scenario was informed by a data review and consultation with North Cowichan staff. The BAU Scenario projects to 2020, the same time period used for the GHG targets included in North Cowichan's OCP. North Cowichan projects a total population of 34,932 in 2020, an increase of 5,421 households (46%) over 2007. This is based on the estimated growth rate used in the OCP review process, 1.34% per year.

GIS analysis was used to locate new households according to current planning applications, neighbourhood plans and OCP projections. In the BAU Scenario the average vehicle trip length is projected to increase from 12.2 km to 12.54 km as dwellings continue a pattern of spreading out over the region, even while within the urban containment boundaries. Average trip length is calculated by identifying key destinations in North Cowichan and calculating the average distance from each dwelling to those destinations. If dwellings are further away from the destinations, that number will be higher whereas if the dwellings are closer, the number will be lower. On average there are 3.44 trips per person in North Cowichan each day so even a small reduction in average trip length results in a significant overall GHG emissions reduction from vehicular emissions.

GIS was used to identify the number of dwellings within walking distance (400m) to transit and the commercial core areas, both of which increased over the Baseline. The number and density of dwellings increased over the Baseline to an extent where district energy is possible. The federal fuel efficiency standard and energy efficiency improvements to the BC Building Code were included. Forest cover and agricultural factors were not impacted by the additional dwellings; their data were maintained at the same levels as in the Baseline. Other variables such as liquid and solid waste increased proportionately to the projected population increase. The recently initiated kitchen waste collection program is not factored into the Baseline or BAU Scenario. Accounting for all of these factors, GHG emissions in 2020 under the Business as Usual Scenario amount to 208,597 tCO2e, a 14.8% increase over 2007 levels.

Scenario 1: New Housing Densification - 33% reduction under 2007 levels by 2020

Scenario 1 was designed to test what would be required for North Cowichan to achieve the GHG reductions target adopted by the municipality in its OCP: a 33% reduction in emissions under 2007 levels. Instead of evaluating land-use plans, as was the approach for the Baseline and BAU Scenario (a forecasting approach), an emissions reduction target was set and required actions were determined to reach it (back-casting). The first step was to calculate the 33% reduction under the 2007 baseline emissions level, which yielded a target of 121,767 tCO2e. The goal seeking function in GHGProof was used to create, using best judgement, a combination of emissions reduction actions that would achieve this 33% reduction.

Actions modelled to achieve a 33% emissions reduction under the 2007 baseline by 2020 include:

- Decreasing the average car trip length by 44%;
- Increasing the dwellings within 400 metres of a commercial core area from 2,949 in the Baseline to 6,476 (220% increase);
- Increasing the dwellings within 400 metres of frequent public transit from 4,863 to 6,807 (140% increase);
- Attaching 476 dwellings to district energy systems by 2020;
- Displacing 20% of the natural gas and 50% of the heating oil consumption with renewable energy sources;
- Decreasing per capita solid waste production by 60%;
- Increasing local food production from 20% in the Baseline to 60%;
- Increasing municipal forest cover by 20%;
- Increasing the area of land farmed (sustainably) by 23%;
- Increasing the energy efficiency of new dwellings by 50% over existing building stock;
- Retrofitting 3% of the existing building stock each year, resulting in a 25% energy savings by 2020; and
- Implementing parallel fuel efficiency standards to those in the US by 2016 (federal government responsibility).

New dwelling types (i.e.: apartment, single detached home, etc.) are the same as in the BAU Scenario, but they are concentrated primarily in the James Alexander, Gibbins/Prevost, Chemainus and Crofton areas.

Scenario 2: Mixed-use Nodes - 33% reduction under 2007 levels by 2025

Scenario 2 investigates a more gentle curve initially with greater reductions over the long term, recognizing the challenge of a 33% reduction by 2020, but the potential for new transportation and land-use changes in the long-term. It should be noted that as the time period increases, so does the degree of uncertainty in these projections. Despite this uncertainty, land-use patterns tend to last between 50 and 100 years, beyond the scope of this scenario, and are thus very relevant to investigate.

This Scenario achieves an 80% emissions reduction under 2007 levels by 2050, which is in line with the provincial recommended target. This translates to a 33% reduction by 2025. In order to achieve this, total GHG emissions would need to fall to 121,835 tCO2e. This is a significant challenge, but a number of developments will make this target more viable, including:

- The projected widespread deployment of electric vehicles[104] and planned carbon neutral electricity in BC;
- The ability to concentrate development around new destinations or nodes in areas that may be currently sprawling;
- Real estate trends that are favouring urban centre development with smaller homes and much higher building density;[105] and
- Increased market penetration by renewable technologies for heating and cooling such as heat pumps[106] and photovoltaics,[107] amongst others.

The following actions could achieve a 33% reduction under 2007 levels by 2025:

- Reducing the average car trip length from 12.2 km to 8.1 km (66% of the Baseline);
- Increasing the dwellings within 400 metres of a commercial core area from 2,949 in the Baseline to 5,898 (200% increase);
- Increasing the dwellings within 400 metres of frequent public transit from 4,863 to 6,382 (131% increase);
- Restricting new dwellings to 50% detached homes, 50% apartments;
- Attaching a district energy system to a major industrial or commercial facility to also serve a residential neighbourhood;
- Decreasing per capita solid waste production by 10% and collecting the gas released from a landfill;
- Replacing 75% of the heating oil and 60% of the natural gas with renewable energy sources;
- Increasing the amount of food that is locally produced by 25% and locally consumed by 100%;
- Increasing the total forest cover by 20% (includes adopting an urban forest strategy);
- Increasing the efficiency of new dwellings by 39% over the existing building stock;
- Retrofitting 1% of the existing building stock for an 18% energy savings; and
- Implementing the same US vehicle fuel efficiency standards in 2016 and 2025 in Canada (federal government responsibility).

Each of these strategies are on trajectories that continue to have increased emissions reductions in order to achieve an 80% reduction by 2050.

104 Center for Entrepreneurship & Technology (CET) Technical Brief (2009). Electric Vehicles in the United States: A New Model with Forecasts to 2030. 2009.1.v.2.0.

105 Canadian Home Builders' Association (2011). Canadian Housing Industry - Performance and Trends.

106 Canadian GeoExchange Coalition (2010). The State of the Canadian Geothermal Heat Pump Industry 2010 - Industry Survey and Market Analysis.

107 Lawrence Berkley National Laboratory (2011). Tracking the Sun IV: An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010.

The following two graphs are a snapshot in time for GHG emissions in 2020 and 2050 for the BAU case, Scenarios 1 and Scenario 2.

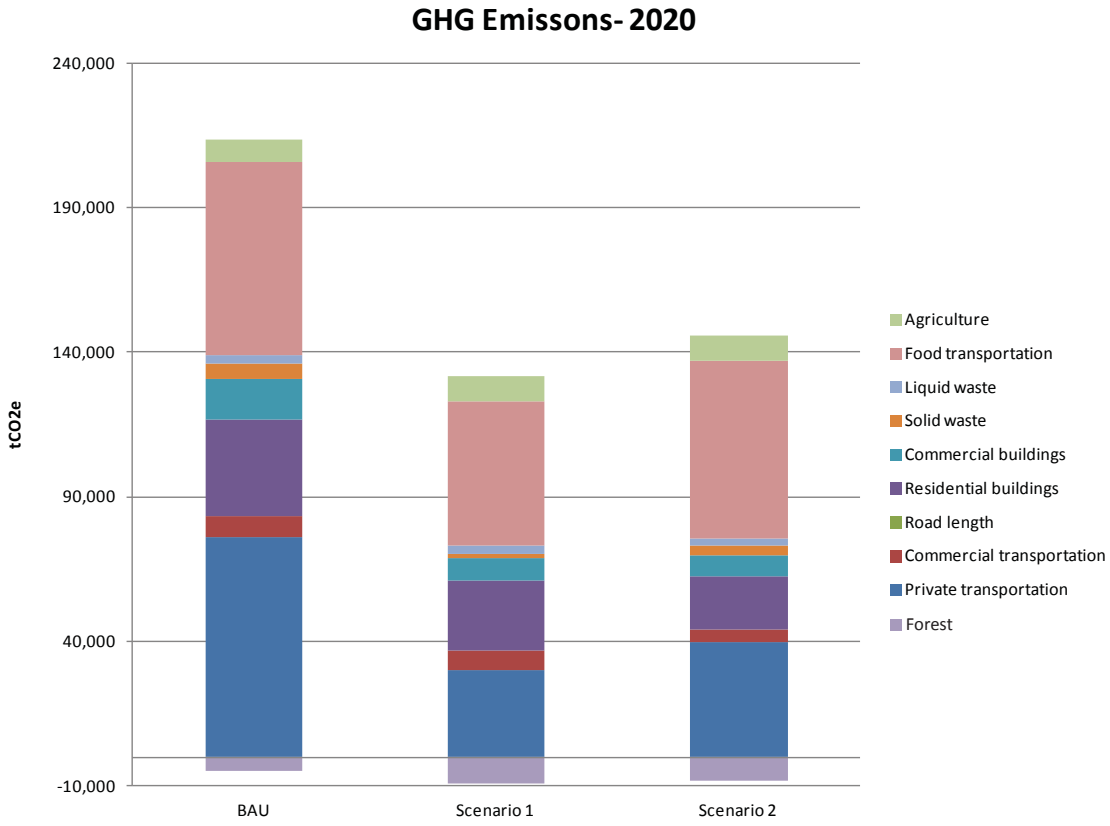
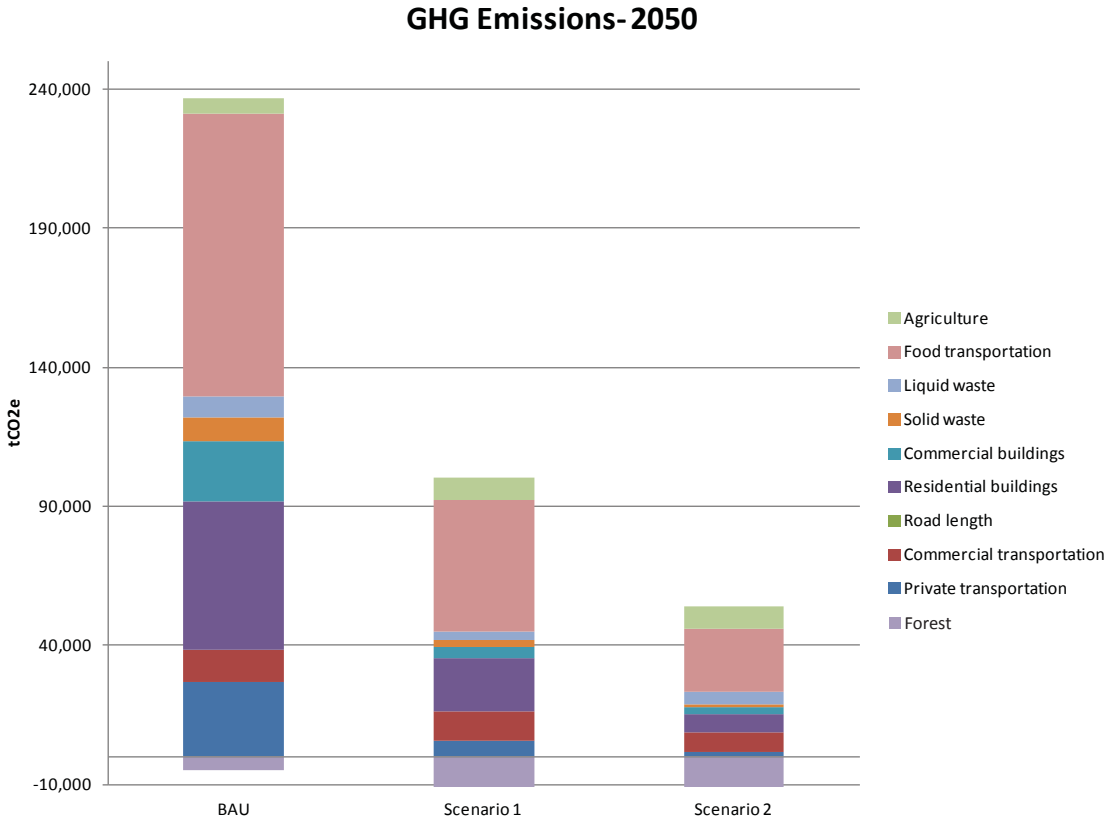


Figure 24: Emissions by source for each scenario in 2020 and 2050.



5.4 Modelling Results

Overview

Achieving significant GHG emissions reductions in North Cowichan represents a major challenge. In the absence of any new actions and within the existing planning regime, the BAU Scenario indicates GHG emissions will continue to climb to 15% over 2007 levels by 2020 and to 27% over 2007 levels by 2050. The projected population increase, with its demand for more dwellings, more vehicles and more food, counters the reductions achieved by federal and provincial policies related to fuel efficiency and low carbon fuels. The effects of these federal and provincial fuel policies is seen as a dip in the emissions graphs starting in year 2020 when they take effect. The BAU Scenario also reflects that the current size of North Cowichan's urban containment boundaries (UCBs) is too large to prevent significant increases in GHG production. Even though the vast majority of development is modelled to happen within these areas, emissions are shown to steadily increase, mostly due to the new population's increased vehicle use.

Achieving the 33% reduction under 2007 levels in Scenario 1 requires immediate and aggressive action by North Cowichan. The same actions required to achieve a 33% reduction by 2020 will only achieve a 55% reduction by 2050. Scenario 2 allows for a more gradual ramping up of effort than that required in Scenario 1. It too requires major investments in buildings, transportation, agriculture and forestry, but over a longer period.

Figures 25 and 26 illustrate the compounding impact of seeking reductions in the context of a growing population. Federal and provincial policies show a decline in per capita emissions in the BAU Scenario. A 33% reduction by 2020 in absolute terms requires a 48% reduction in per capita emissions and an 80% reduction by 2050 requires a 90% reduction in per capita emissions.

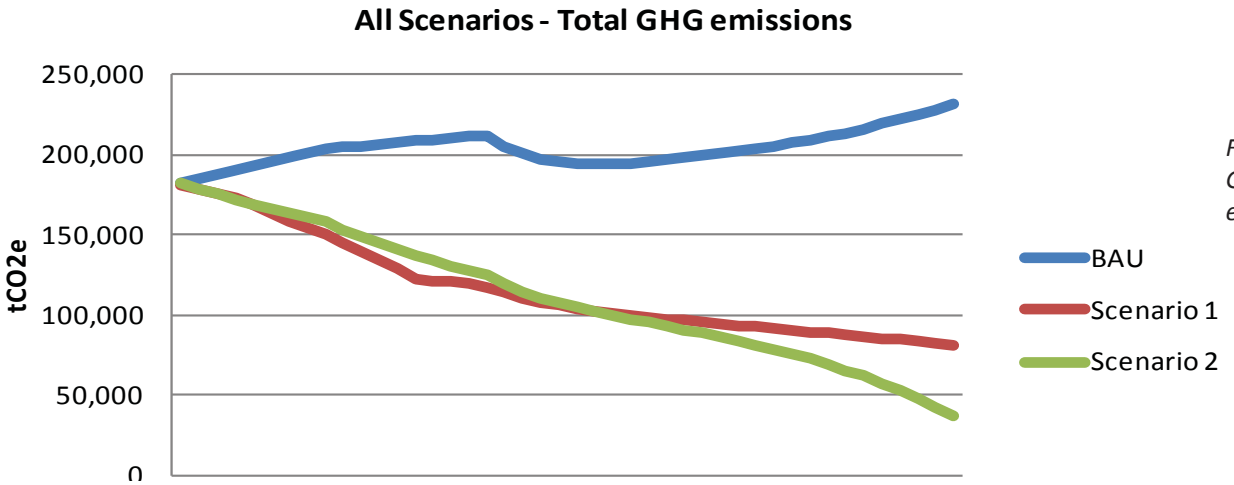


Figure 25: Total GHG emissions in each scenario.

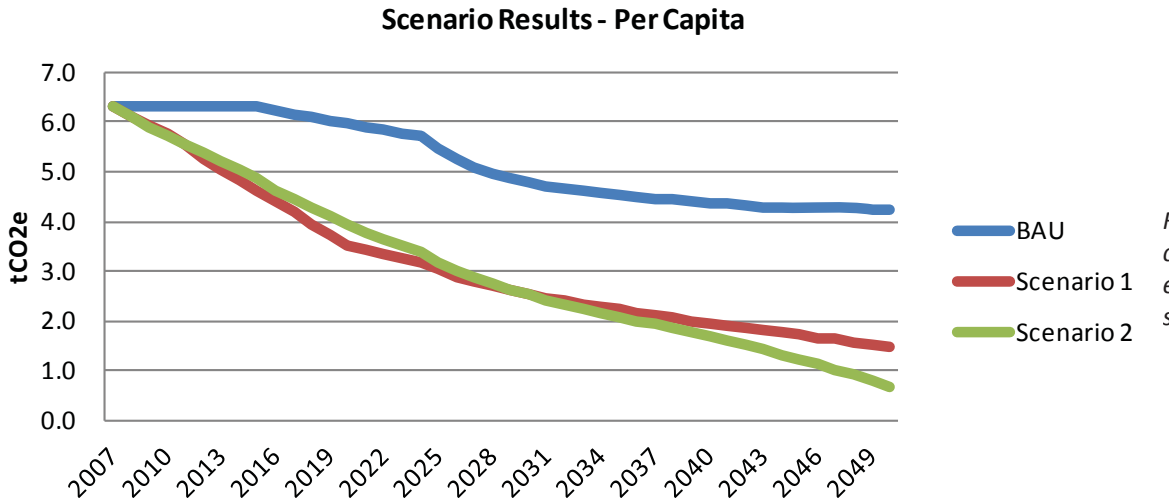


Figure 26: Per capita GHG emissions in each scenario.

Distribution of Emissions

In the BAU Scenario, emissions continue to increase in all sectors except for transportation, due to federal policies on fuel efficiency and provincial policies on low carbon fuels. Emissions produced by new homes to accommodate the projected increase in population outweigh the emissions reduced through improved energy efficiency standards in the provincial building code. Emissions from liquid and solid waste continue to increase on a per capita basis. Without additional agricultural capacity, North Cowichan imports increasing amounts of food, adding to the GHG emissions.

To achieve the reductions, emissions need to be reduced in every sphere. The target in Scenario 2 provides more scope for reductions and as a result the curve is less steep in the next fifteen years than what is required for the 2020 target in Scenario 1.

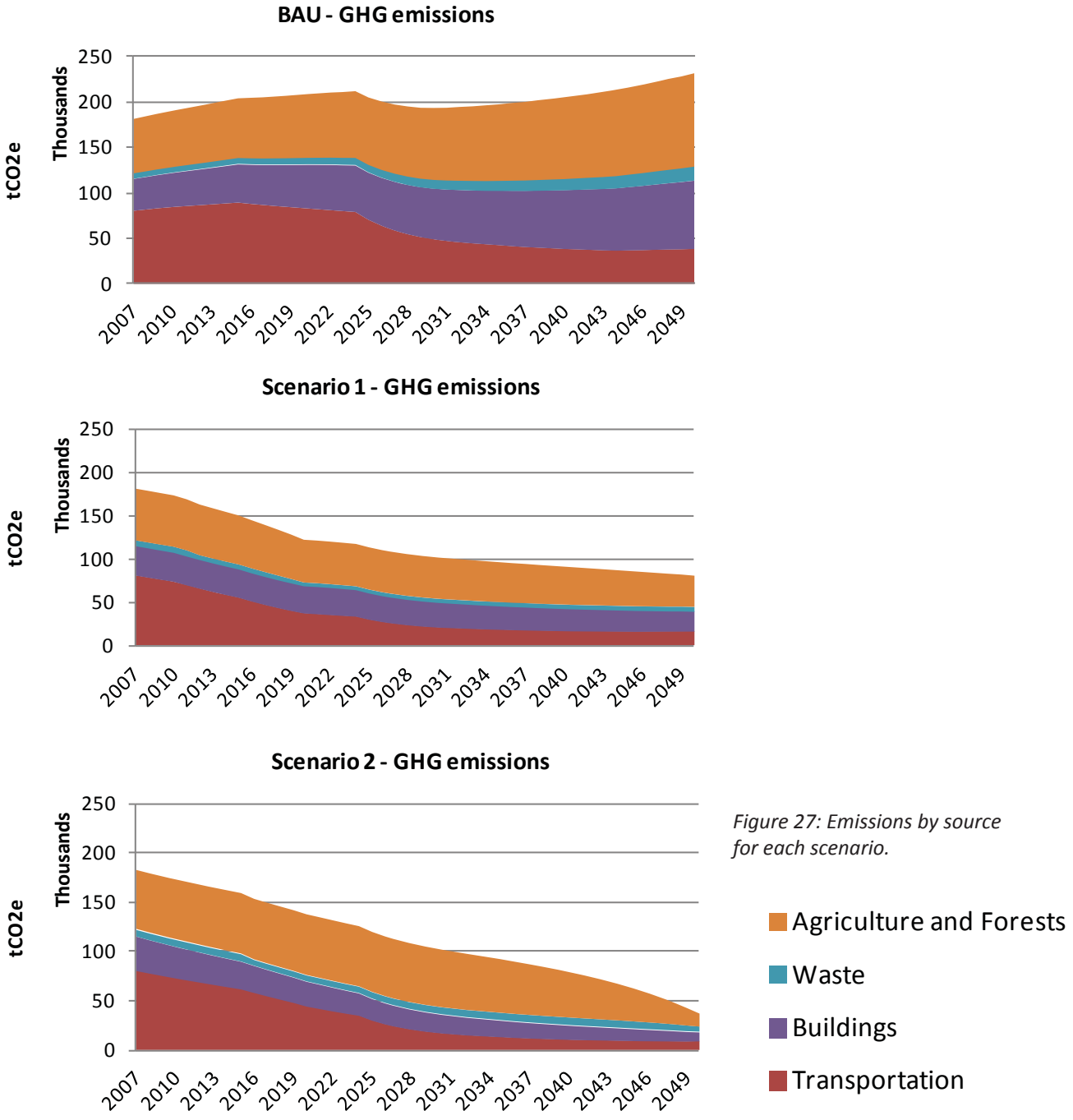


Figure 27: Emissions by source for each scenario.

Transportation

Transportation emissions are driven by three factors including the distance people drive (vehicle kilometres travelled, VKT), the carbon intensity of the fuel used and the efficiency of the vehicle.

Reducing VKT through land-use planning is the most certain way to reduce transportation emissions.[108] Our transportation modelling indicates the scope for reducing VKT through land-use is very limited in North Cowichan. For example, after concentrating all future housing developments in the south end, Chemainus and Crofton in Scenario 2, the average trip length only declined from 11.89 km to 11.67 km. This is due in part to the fact that people in new dwellings in Chemainus and Crofton will continue to travel to Duncan and Nanaimo for many services. To achieve the 33% and 80% reductions, average trip lengths in the range of 6.5 km and 5 km, respectively, are required. Providing a full suite of amenities in Chemainus and Crofton, where new housing will be concentrated, will encourage people to walk or cycle, resulting in fewer trips and shorter trips, thereby reducing the average VKT.

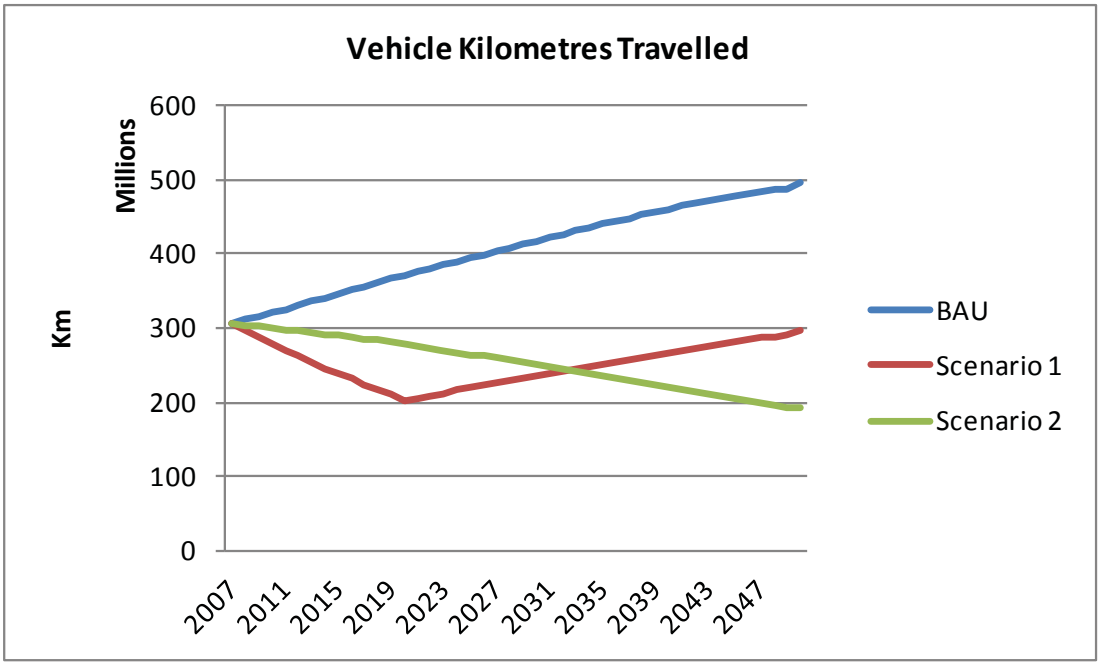


Figure 28: Vehicle kilometres traveled in each scenario.

Other efforts beyond land-use planning will also be required to reduce VKT. For example, developing incentives, policies and infrastructure for tele-working, establishing shared office spaces for individuals and small organizations (e.g.: HiVE Vancouver), encouraging live-work spaces, working with organizations to incorporate tele-working technologies, green travel plans for new development, car sharing programs, maximum parking standards, etc.

Additional emissions reductions can be achieved by supporting the uptake of electric cars and biodiesel. Public transit could play a role if the high cost of servicing the distributed population in North Cowichan is overcome through a combination of improved transit technologies and population densification. The land-use impact of clustering dwellings in Scenario 1 and 2 does result in a mode shift away from private vehicles to bicycles and walking, but the geographically distributed population limits the possible reductions.

108 Ewing, Bartholomew, Winkelman, Walters, and Chen. 2008. Growing Cooler: the Evidence on Urban Development and Climate Change. Urban Land Institute

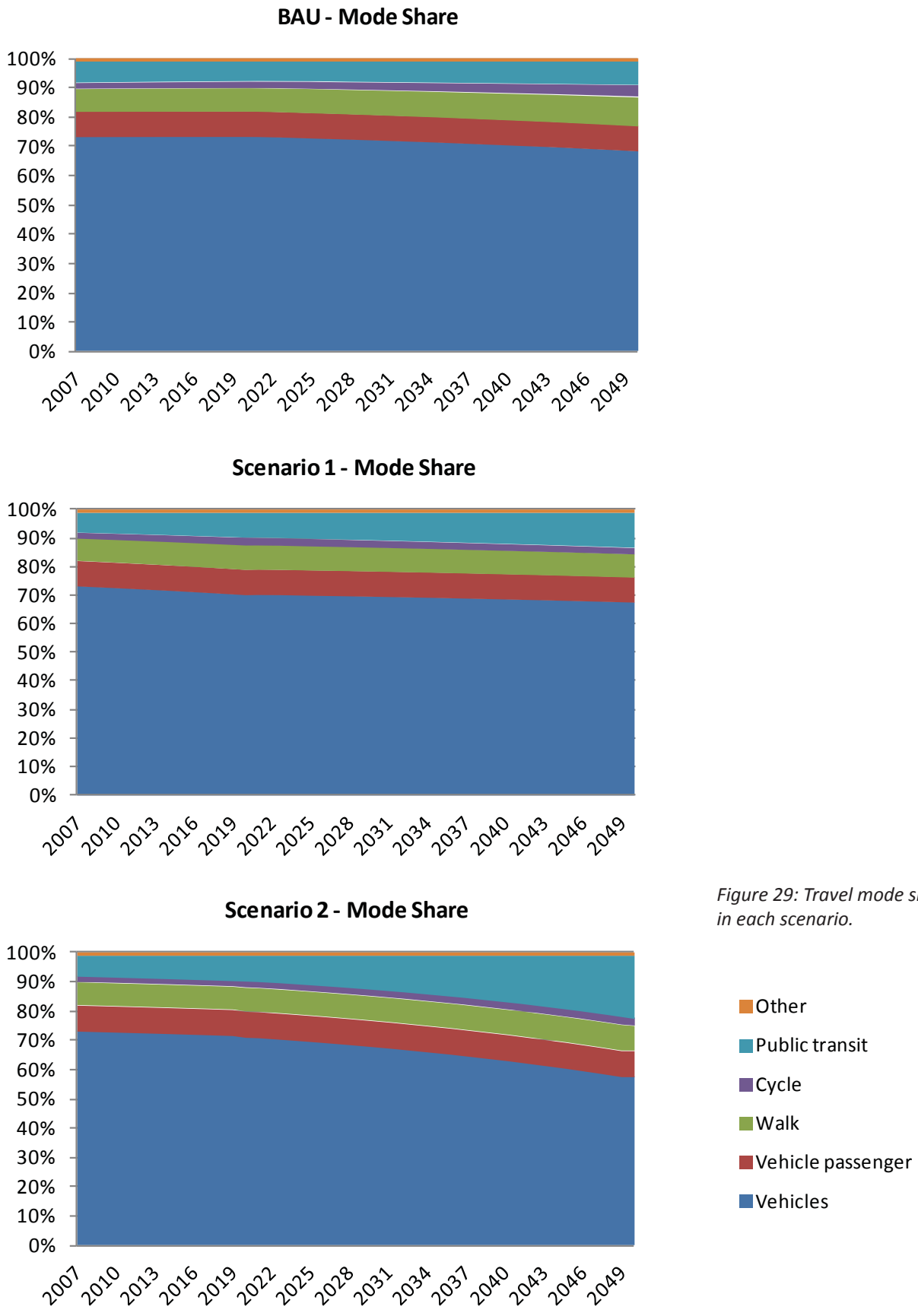


Figure 29: Travel mode share in each scenario.

Energy Consumption

The share of electricity consumption out of total energy consumption increases substantially in every scenario, due to two factors: the projected adoption of electric vehicles and energy source switching from natural gas, heating oil and propane to electricity. In Scenario 1, natural gas consumption decreases by 60% and heating oil consumption by 67% by 2020. In scenario 2 it is assumed that natural gas consumption decreases by 90% and heating oil consumption by 95% by 2050. To achieve these reductions it is assumed that BC Hydro reaches its mandate net zero emissions from new generation including a mix of localized renewable electricity generation as well as other types of renewable energy. The consumption of wood remains constant in each of the scenarios, with gains in efficiency as its use shifts from combustion in wood stoves to gasification boilers and combined heat and power.

Major gains in energy efficiency are modelled in Scenarios 1 and 2 through substantial commercial and residential energy efficiency retrofit programs. Combined with significantly increased vehicle efficiencies, these actions result in overall energy reductions in Scenarios 1 and 2, despite an increasing population.

In Scenario 2, fossil fuel use including natural gas, heating oil, gasoline and propane declines significantly, replaced by renewable energy in the form of electricity. The emissions factor of electricity also declines as BC Hydro brings more renewables on board in line with its mandate. Some of this renewable generation occurs in North Cowichan, as described in Section 4.2.

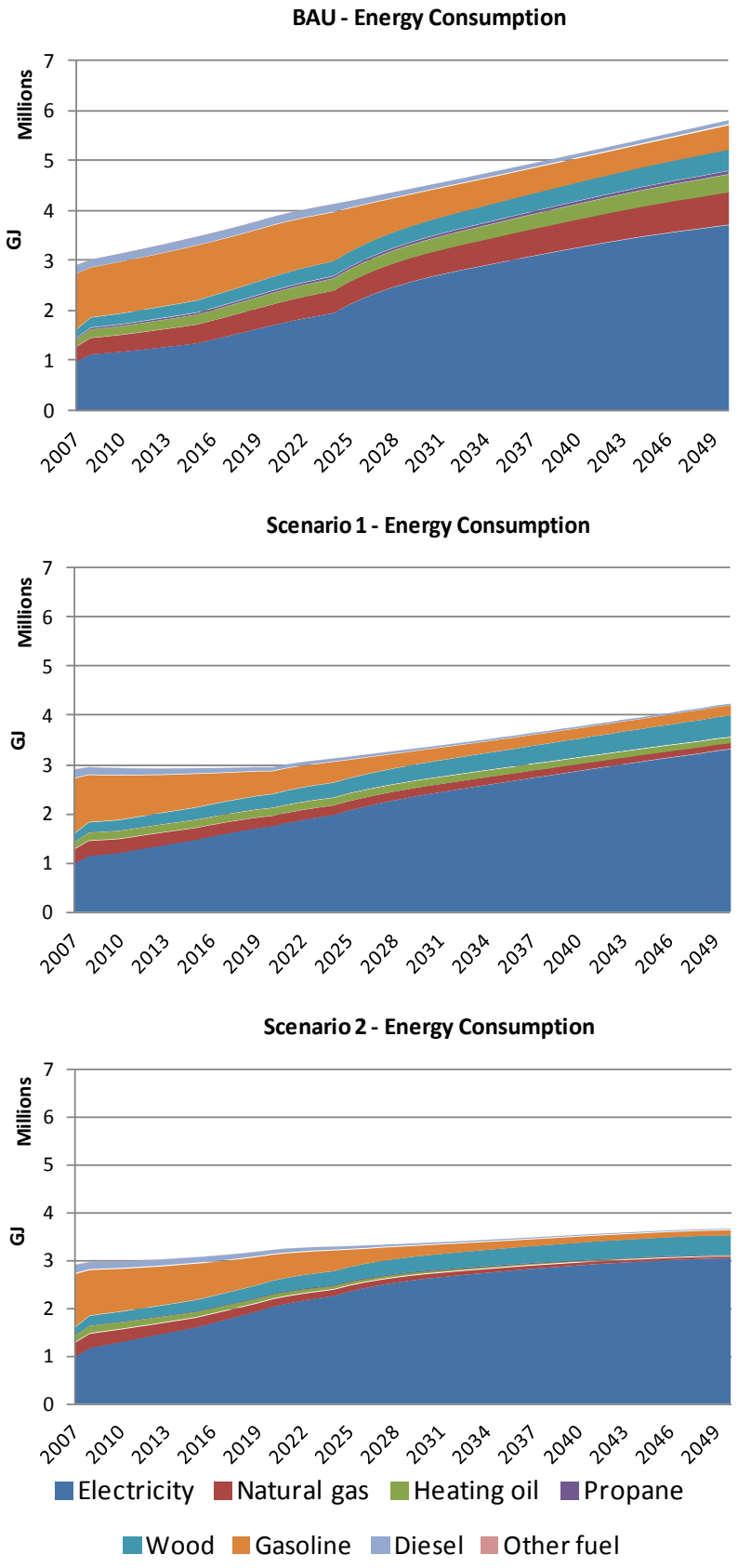


Figure 30: Energy consumption by fuel type in each scenario.

Reduction Strategies

Figures 31 and 32 illustrate the relative impacts of reduction strategies for Scenarios 1 and 2. The steeper curve in the first figure illustrates the greater effort required to achieve the 33% in the first 13 years (2007-2020). Efforts after this are more gradual in their effects. The most significant reductions result from fuel switching from gasoline to electricity (dark red), reducing driving (dark green), shifting from natural gas and heating oil to electricity (lighter green), local agricultural production and increasing tree cover within North Cowichan. Many of the strategies have comparatively little effect and are barely visible on the graph. The dip that occurs at 2020 is a result of federal and provincial fuel efficiency and low carbon content policies coming into effect.

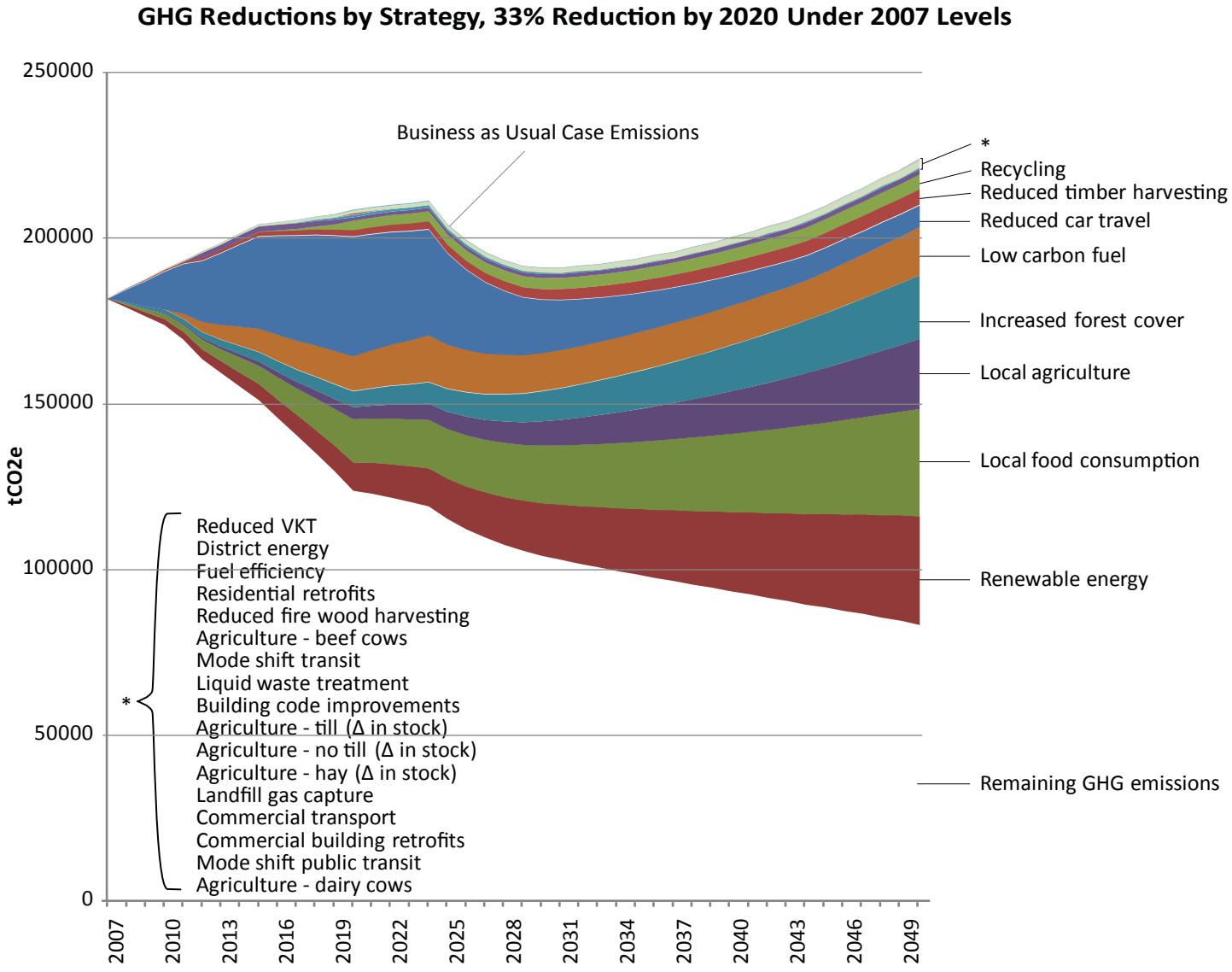
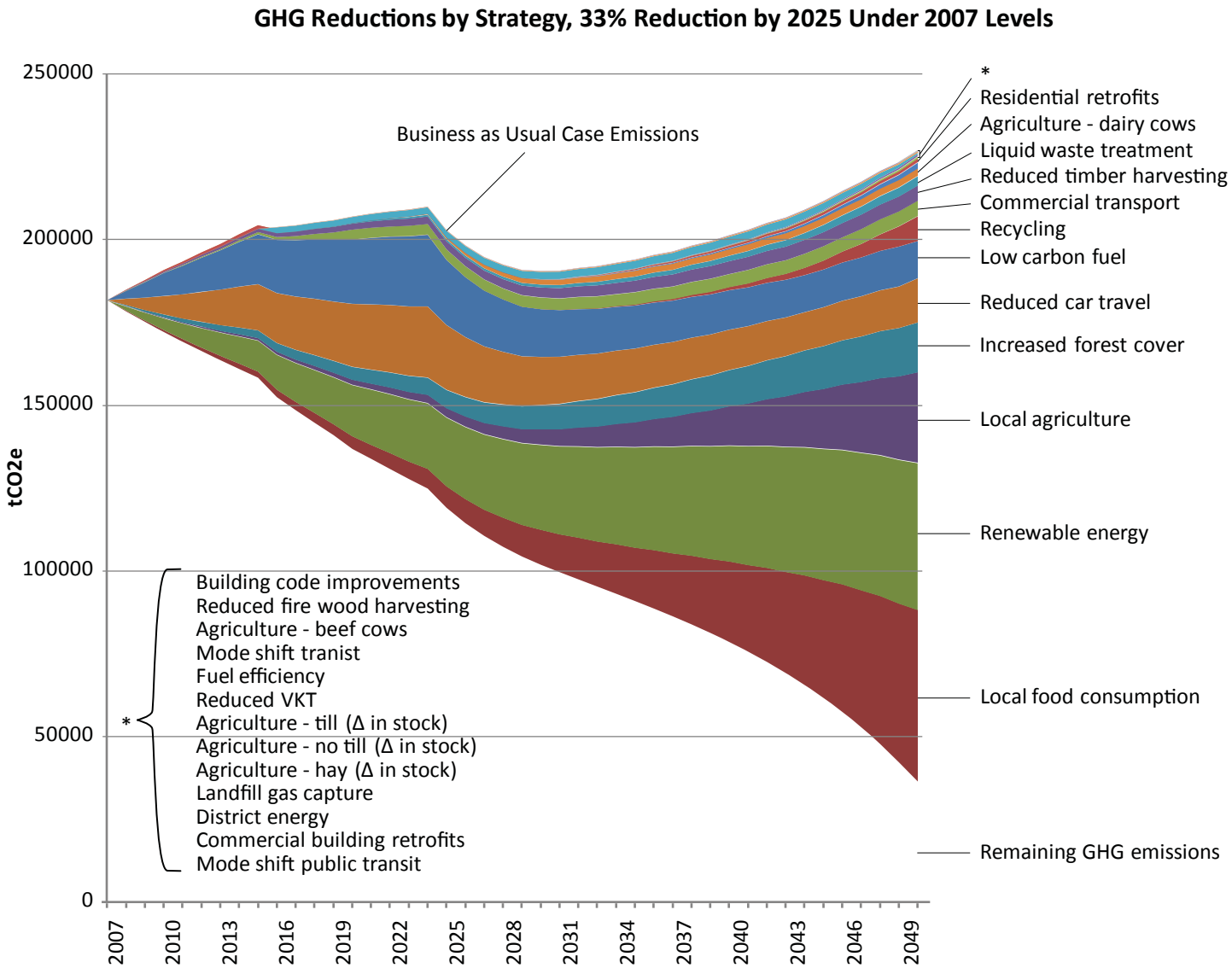


Figure 31: Emissions reductions by strategy, Scenario 1.

The reductions by strategy graph for Scenario 1 reflects the early impact of a large mode shift from driving to more sustainable forms of transportation. Later on this trend lessens in its contribution to overall emissions reductions. The four major contributing strategies of renewable energy production, local food consumption, local agriculture and increased forest cover realize their full potential in later years after a steady ramping up.

The reductions by strategy graph for Scenario 2 shows a more even distribution between major strategies. Early implementation of local agriculture and food consumption programs steadily increase their emissions reductions. Renewable energy installations and increasing forest cover also steadily increase in reductions contributions.

Figure 32: Emissions reductions by strategy, Scenario 2.



Reductions Strategies Summary

Figures 31 and 32 demonstrate the relative emissions reductions in each action area. Sustainability actions in each of the 8-10 major areas will be required to achieve emissions reductions related to those areas. The reductions depicted here are based on broad modelled actions. The CAEP recommendations in Section 6 are detailed actions to be taken within these broad areas in order to achieve the emissions reductions required.

5.5 Economic impacts

A central focus of the CAEP is to recommend strategies and actions that have holistic benefits to North Cowichan. The green economy was a focus of the project's public engagement program. This theme is continued here with a high-level analysis of energy costs, investment required (by the municipality, its partners and the community) and employment generated by the efforts required to achieve the GHG targets, as modelled in the previous section.

Energy Costs

Under the BAU Scenario energy costs in North Cowichan will total $285 million by 2050 based on conservative estimates in the escalation of the price of energy. Saving energy equals savings money, and the potential annual savings from reduced energy costs are $90 million by 2050 in Scenario 1 ($3,000 per household in 2050) or $130 million in Scenario 2, ($4,000 per household in 2050). Actions taken by the Municipality will result in energy cost savings for North Cowichan residents.

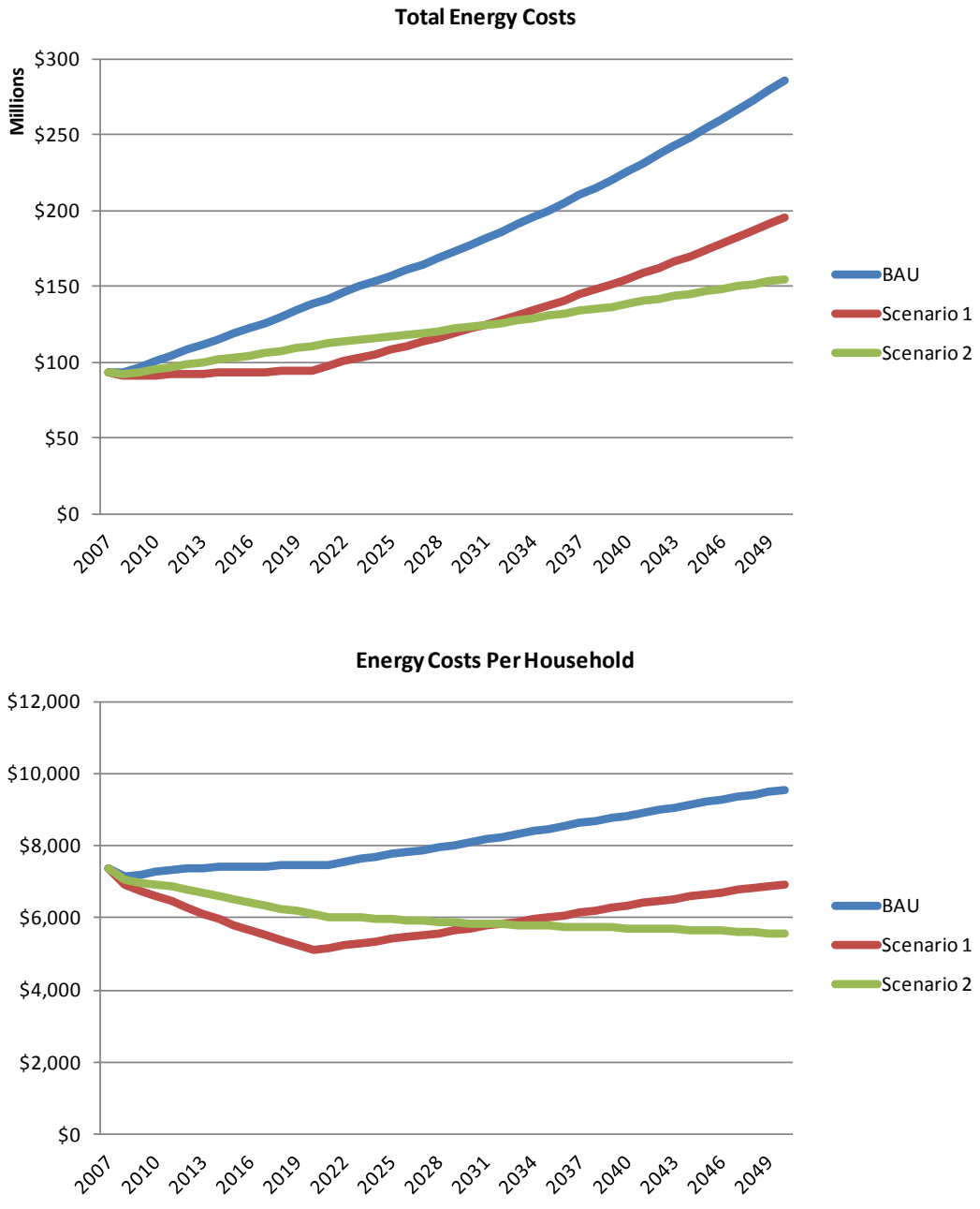


Figure 33: Costs in each scenario.

Investment

Achieving the reductions represented in Scenarios 1 and 2 will require a major investment by the community and the municipality. The potential investment required to achieve the 2020 and 2025 (2050) targets was modelled. Annual investments for Scenario 1 will reach $11 million for the year 2020 and $23 million for the year 2050 (total investment between 2007 and 2050 is $560M). Investments for Scenario 2 will reach $7 million for 2020 and $25.5 million for 2050 (total investment between 2007 and 2050 is $470M). This includes reforestation costs of $1,000/hectare, agricultural production costs of $15,000/hectare, renewable energy generation at $36/GJ, retrofit costs of $10/GJ, recycling costs of $50/tonne, and district energy costs of $7/GJ.

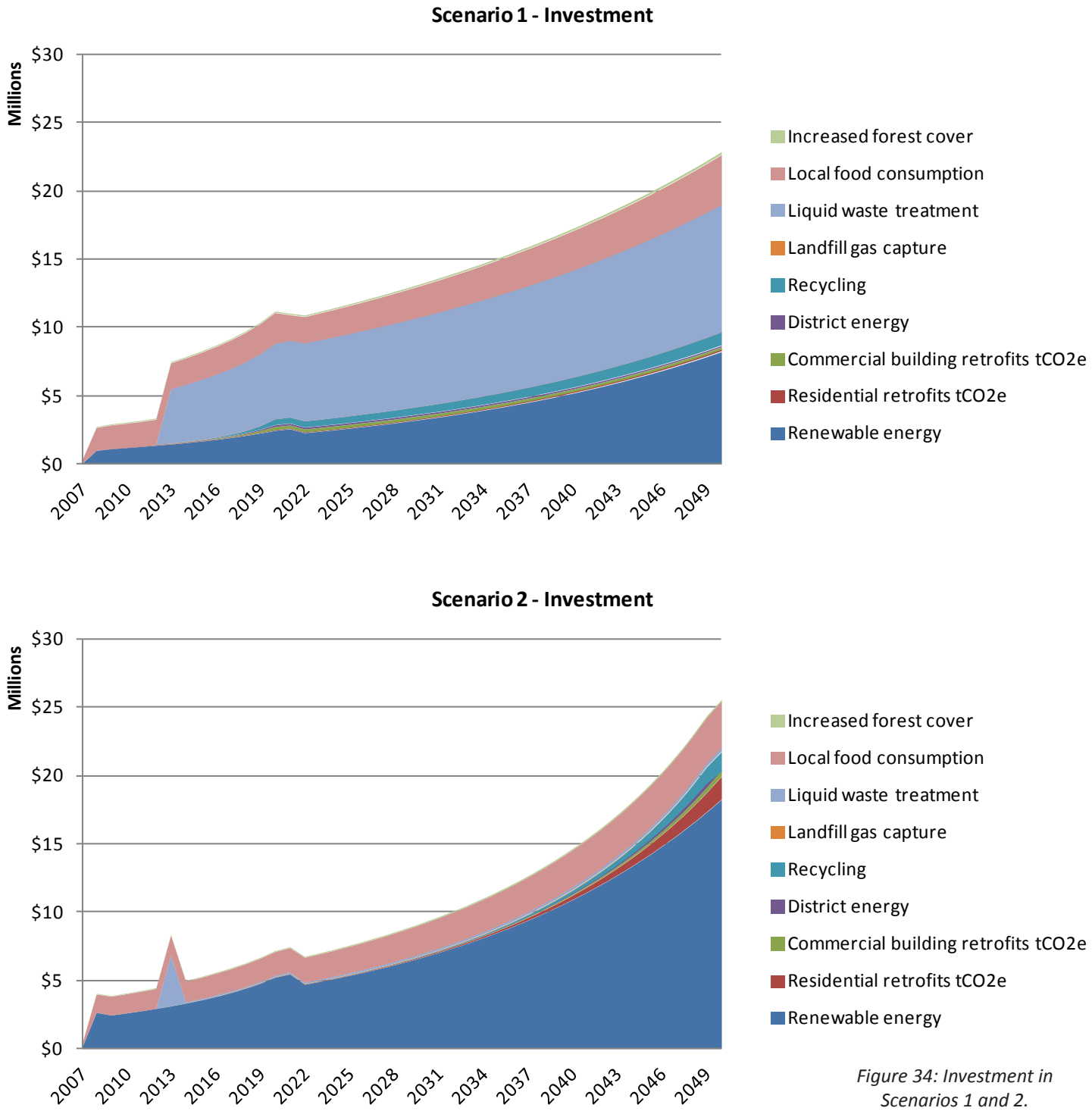


Figure 34: Investment in Scenarios 1 and 2.

Employment

In addition to investment, achieving GHG emissions reductions targets will also require the efforts of many people. The potential employment benefits associated with each scenario were estimated using employment generation numbers. It is estimated that there will be a total of approximately 595 jobs created in Scenario 1 by 2050, including 200 jobs in construction, 109 jobs in retrofits, 20 new jobs for increased building code improvements, 31 new jobs in recycling and waste management, 67 in agriculture and 11 in reforestation. In Scenario 2, there are an estimated 598 total jobs by 2050, including 200 jobs in construction, 242 in renewable energy, 48 in retrofits, 7 in district energy, 25 in recycling, 5 in waste management, 63 in agriculture and 8 in forestry.

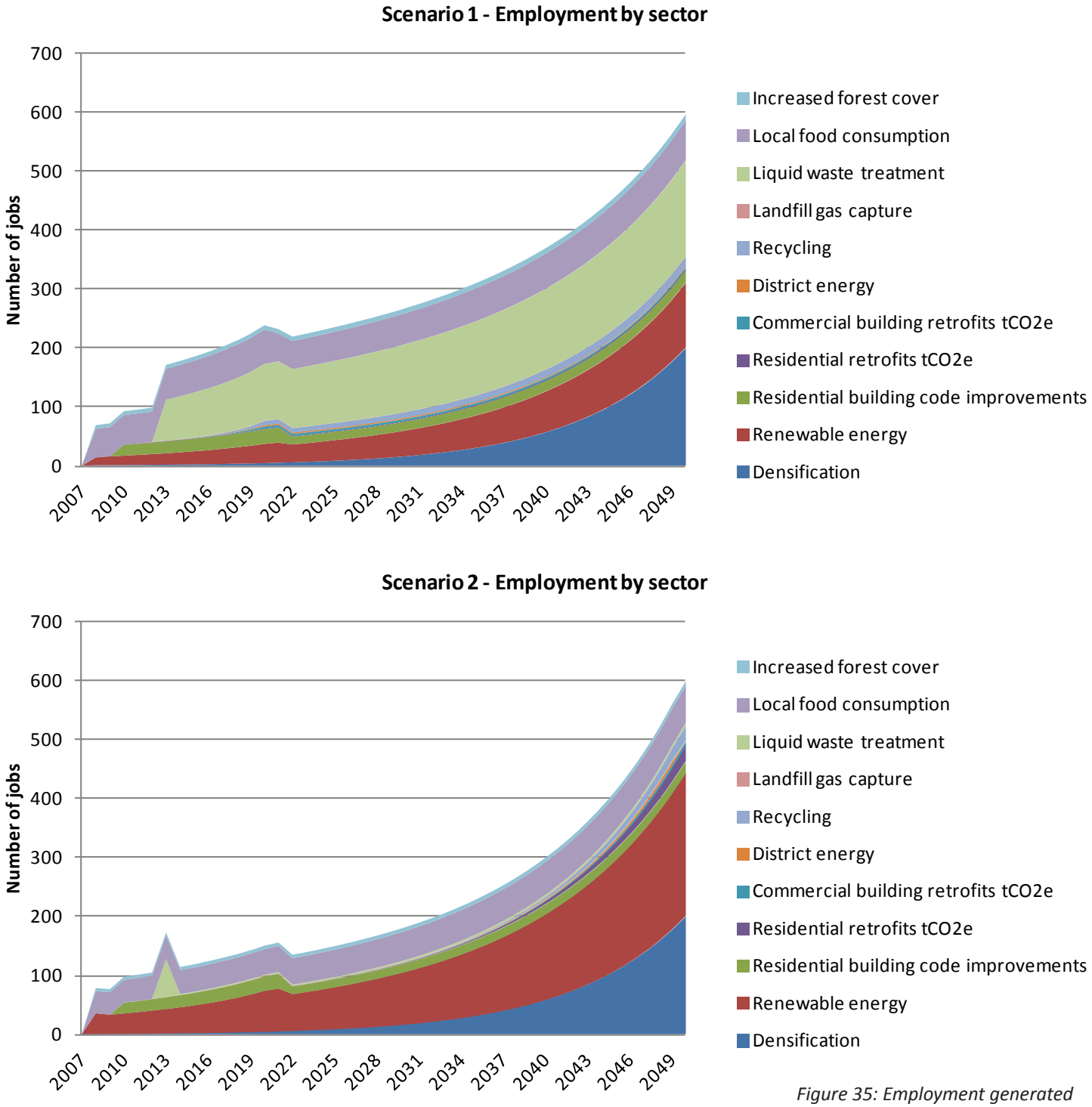


Figure 35: Employment generated in each sector for Scenario 1 and 2

Summary: Savings, Investment and Employment

In both Scenarios 1 and 2 cost savings from energy significantly exceeds the investments required. In both scenarios, there is an opportunity for job creation. A major challenge, however, is that those who incur the savings, primarily households, are not necessarily those who make the investments. This poses an economic challenge as return on investments (ROIs) aren't necessarily directly realized by investors. Funding partnerships and creative investment strategies will be required to help allay any potential lost ROIs.

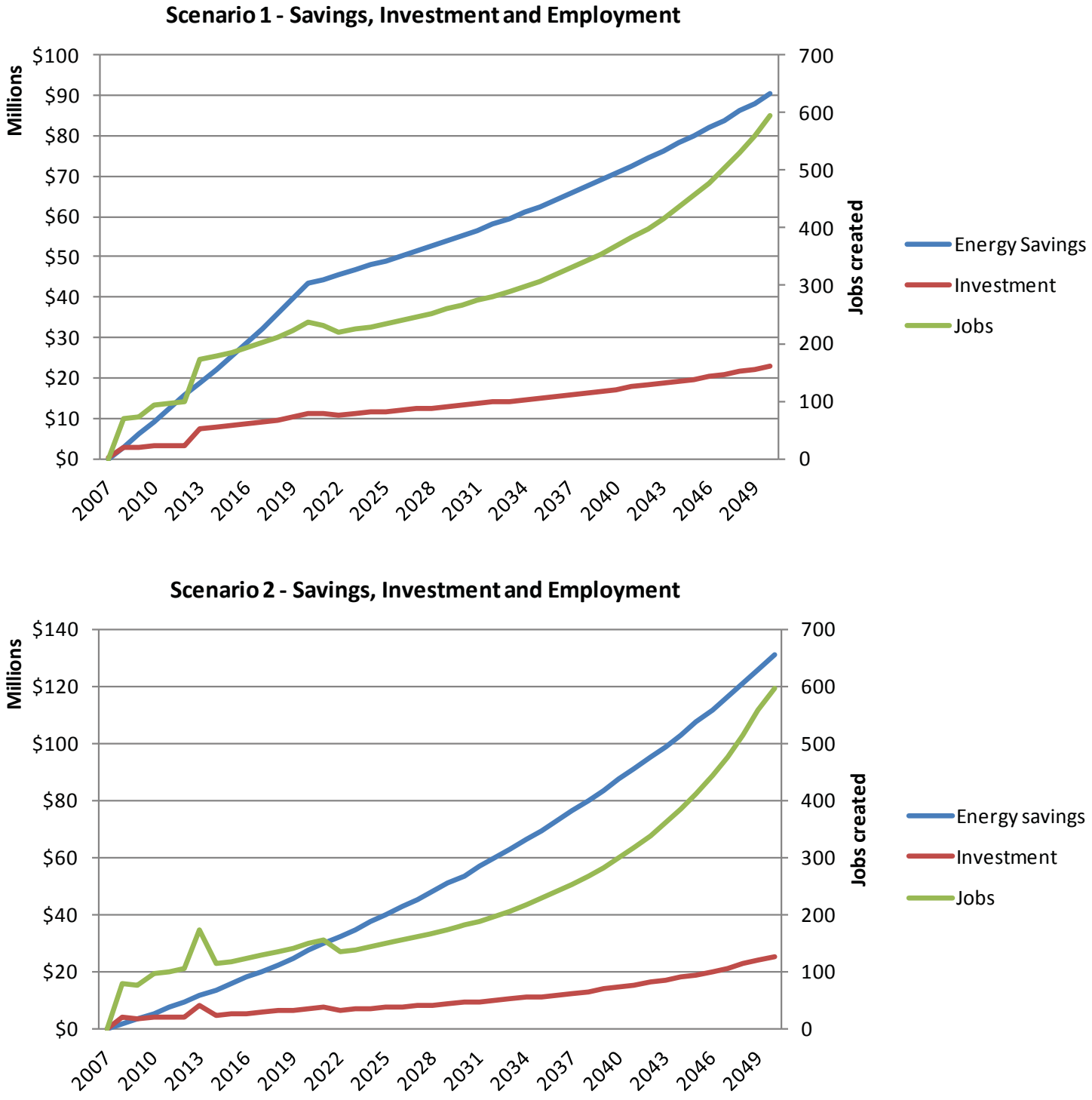


Figure 36: Summary of savings, investment and employment for Scenarios 1 and 2.

To clarify the meaning of Figure 36, here in an example depicting energy savings, investment required and jobs created for Scenario 2. Energy and investment numbers are rounded.

		Year 2020	Year 2035	Year 2050
Scenario 2	Energy savings in this year	$25M	$70M	$130M
	Investment in this year	$7M	$12M	$25.5M
	Jobs created to date	151 (+8 from 2019)	228 (+11 from 2034)	598 (+40 from 2049)

In this example, $7M, $12M and $25.5M is invested in years 2020, 2035 and 2050, respectively. This investment yields $25M, $70M and $130M in energy savings in each of those years, respectively. As mentioned above (p.74), this averages to $4000 savings per household in 2050. This investment also creates 8, 11 and 40 jobs for each of those years, and allows jobs created to date (143, 207 and 558 cumulative from previous years) to be retained.

The Cost Effectiveness of Emissions Reduction Strategies: Marginal Abatement Cost Curves

An important consideration for North Cowichan is the cost effectiveness of different strategies in reducing GHG emissions. Which strategy will cost the least or deliver the most financial savings? The marginal abatement cost (MAC) curve is an illustration of cost effectiveness. The total estimated cost of implementing a strategy for the community (not only the Municipality's capital and operating costs, but also investments by the private sector) and the total resulting estimated savings are used here to calculate the marginal abatement cost for each strategy. Marginal abatement cost is calculated by dividing the net present value (present value of an investment's future net cash flows minus initial investment) by the project life and the annual average CO2 reduction:

$$\$MA = NPV / tCO2e / years$$

For some strategies there is a net savings per tonne of carbon reduced (e.g.: densification substantially reduces the distance people drive and therefore the energy cost of transportation, without a substantial investment). In other cases there is a net cost (e.g.: renewable energy costs more to install than it generates in savings under the cost projections in the model). There may be other reasons to undertake a measure than its marginal abatement cost. For example renewable energy creates energy security, improves air quality and creates jobs, in addition to reducing GHG emissions.

The other dimension of a marginal abatement curve is the amount of GHG reductions that are possible from a particular strategy or action. There are limits to GHG reduction amounts for each strategy. For example, while district energy producing combined heat and power will produce net financial savings, the opportunities for district energy in North Cowichan are limited by land-use patterns (i.e.: the building arrangements are not dense enough). By comparison, the opportunity for GHG reductions from renewable energy is much greater as natural gas and heating oil are replaced with solar hot water or electricity.

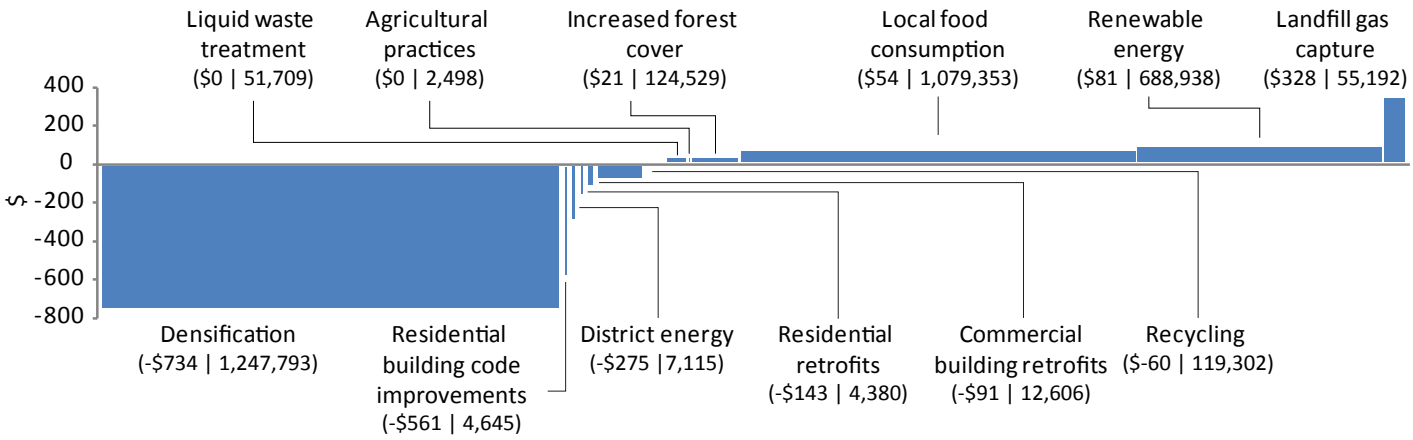
In the MACs, the height of a bar indicates the marginal abatement cost, while the width represents the amount of GHG reductions available from the strategy. The best strategies to employ from a cost perspective are those whose graphed bars are in the negative along the vertical axis; the more negative the number, the greater the payback. The best strategies to employ from an emissions reduction perspective are those whose graphed bars are wide along the horizontal axis; the wider the bar, the greater the emissions reduction. In these graphs, the width of the bars are relative to each other (i.e.: the emissions reduction effectiveness of each action is graphed relative to each other action).

The overall most effective strategies from both perspective are those that generate cost savings and have great emissions reduction impacts (i.e.: the more negative and the more wide the graphed bar, the better the strategy). Densification is the obvious strategy of choice as it saves a lot of money and substantially reduces emissions for the effort required to implement. Landfill gas capture, on the other hand costs a lot of money and does not have as significant an effect on emissions reductions. Actions like increasing forest cover and local food consumption have slight costs associated with them, but result in substantial emissions reductions.

These graphs provide a quick overview of what strategies cost as compared to their emissions reduction effectiveness and is a useful tool to quickly compare strategies. Note that the Marginal Abatement Curve analysis does not include co-benefits such as health outcomes, new jobs, improved air quality and other variables.

Scenario 1 - Marginal Abatement Curve

($/tCO2e saved | total tCO2e saved between 2007 and 2050 over BAU scenario)



Scenario 2 - Marginal Abatement Curve

($/tCO2e saved | total tCO2e saved between 2007 and 2050 over BAU scenario)

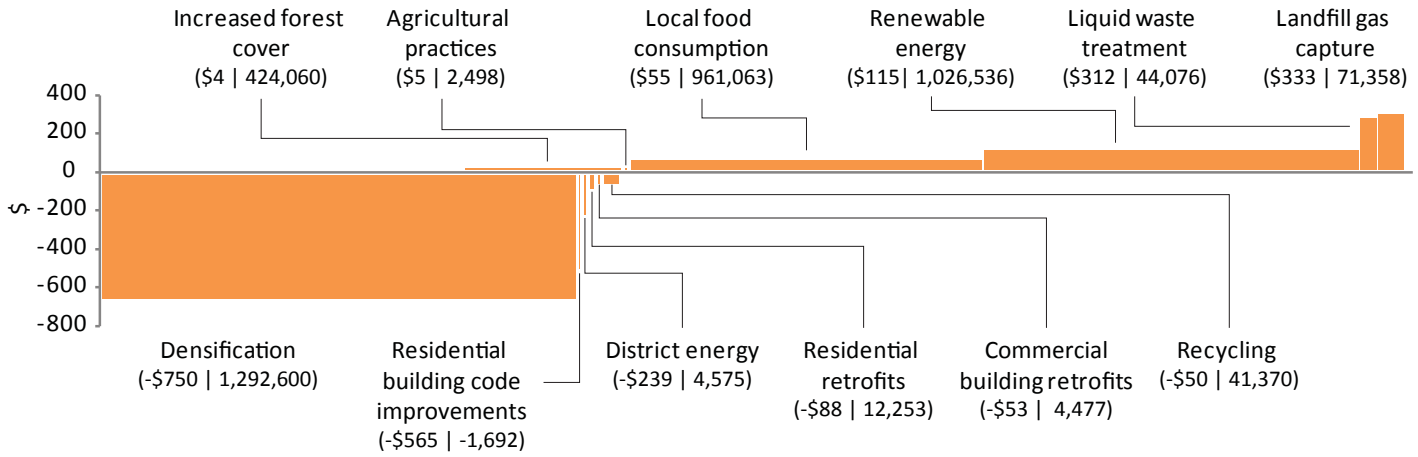


Figure 37: Marginal abatement curves for each Scenario.
(Chart interpretation is explained on page 78)

The cost or saving of preventing the emission of one tonne of GHGs varies greatly between the twelve different strategies. In Scenario 2 $750 is saved per tonne of GHG saved under land-use densification. At the other end of the scale, liquid waste treatment and landfill gas capture cost over $300 per tonne saved. This is due to the high costs of the technology retrofits that would be required to achieve GHG savings. The marginal abatement curves give guidance on where capital investments are best spent on a strictly dollar per tonne of GHG saved basis. This guidance is reflected in the choice of recommended actions presented in Section 6.

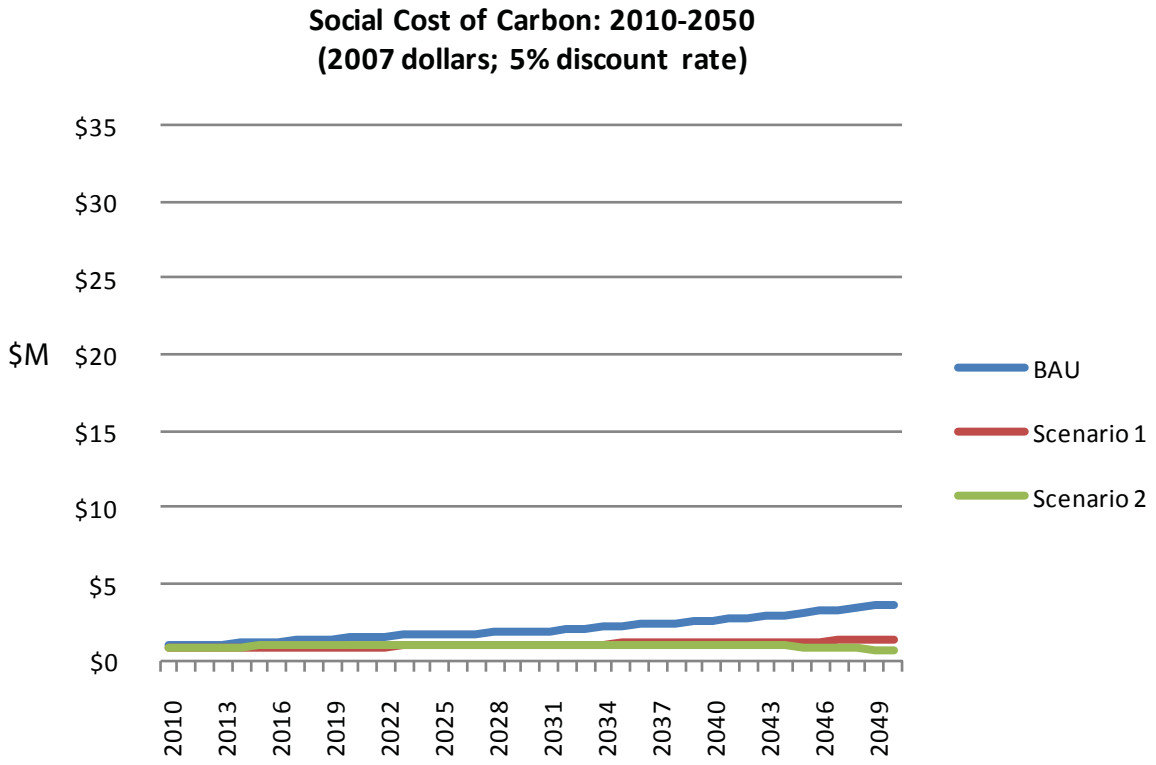
The Impact of GHG Emissions: The Social Cost of Carbon

GHG emissions contribute to climate change, which has a wide range of impacts from droughts to floods, from displacing animals from their habitat to increasing the range of diseases. The complexity of the climate system makes it difficult to attribute these impacts and value the damage. One economic strategy for expressing these damages is the Social Cost of Carbon (SCC). The SCC is an estimate of the monetized damages associated with an increase in GHG emissions each year and includes impacts on agriculture, human health, increased floods and ecosystem services. The range of SCC values used by the United States Government for cost benefit analysis are used here.[109] The US Government presents a range of numbers to capture the uncertainty of the estimate, in particular by using three different discounting rates. Discounting is used in economic analysis to recognise that people value current dollars in hand more than dollars in the future. This practice has been criticized in the context of climate change because it carries the implicit assumption that it will be easier for future generations to solve climate change with new technologies than for the current generation. For this reason, while a range of discount rates is presented (2.5%, 3% and 5%), lower discount rates are favoured as a conservative approach (i.e.: future technologies may have little success in addressing climate change issues). A more conservative estimate is included as a fourth scenario that represents a higher level of damages (95th percentile). The SCC increases over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climatic change.

The social cost of carbon graphs provide a compelling argument for North Cowichan working to reduce GHG emissions. Mitigating emissions will reduce energy costs, create new jobs, and reduce the climate change impact burden on communities around the world. The SCC assigns a value to the damages that will occur globally as a result of emissions produced in the municipality. For some communities in the present these costs can be devastating, while impacts in the future are less certain. North Cowichan can also use the SCC as a policy tool, requiring that it be calculated and incorporated into the economic decision-making for major projects. This helps to ensure that the economic analysis reflects the damage resulting from climate change and provides an economic case for selecting lower carbon options.

By 2050, in the Business as Usual case, annual damages resulting from emissions in the Municipality of North Cowichan are estimated to be between almost $4 million (5% discount rate) and $32 million (3% discount rate, 95th percentile). By contrast, Scenario 2 yields a SCC between $570,000 (5% discount rate) and $5 million (3% discount rate, 95th percentile). The graphs of the four discount rate estimates are presented in Figure 39 on the following pages.

109 Interagency Working Group on Social Cost of Carbon (2010). Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 128666. Accessed April 2012 at: http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf


Social Cost of Carbon: 2010-2050
(2007 dollars; 5% discount rate)
$35
$30
$25
$20
$15
$10
$5
$0
$M
2010
2013
2016
2019
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2025
2028
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2034
2037
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2043
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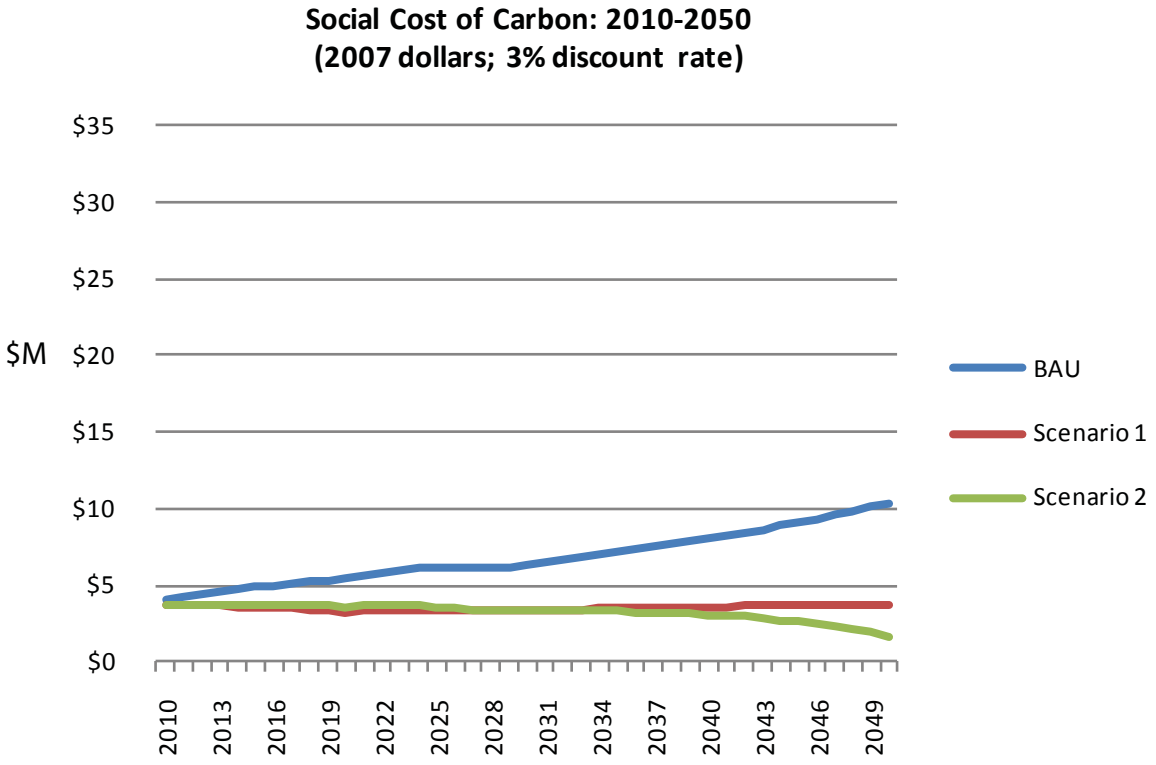
2049
BAU
Scenario 1
Scenario 2


Social Cost of Carbon: 2010-2050
(2007 dollars; 3% discount rate)
$35
$30
$25
$20
$15
$10
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$0
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2010
2013
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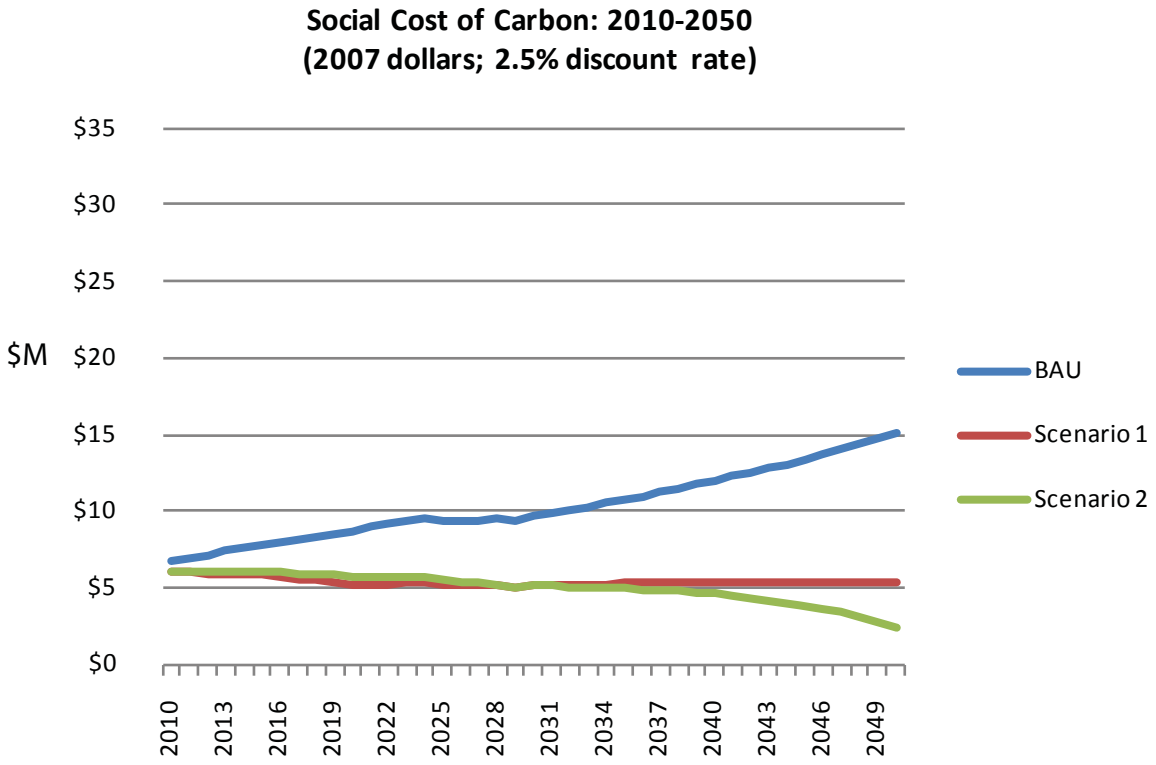
Scenario 1
Scenario 2



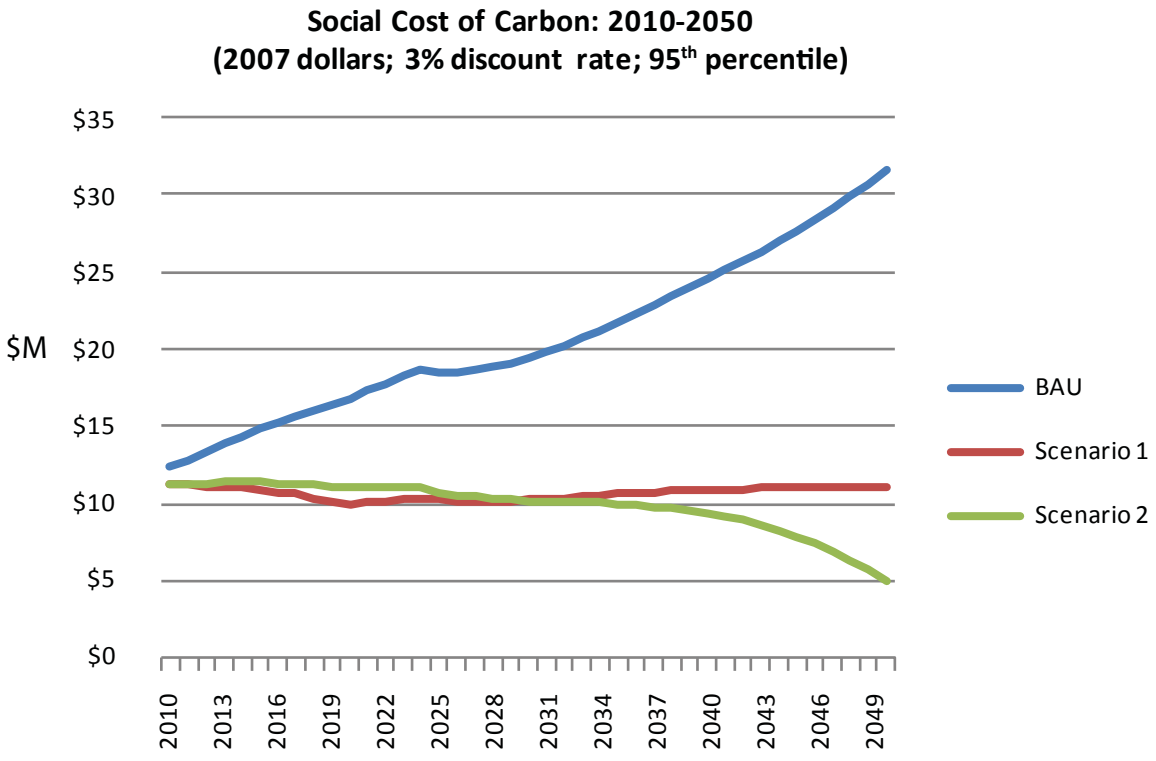


Figure 38: North Cowichan's Social Cost of Carbon estimates for different economic discount rates for each Scenario.

5.6 Scenario Analysis Summary

The geographical relationship of the three concentrations of population in Chemainus, Crofton and north Duncan results in a surprising modelling outcome: concentrating future development in these three areas stabilizes and even increases transportation from one centre to the other. Thus no tangible emissions reductions are necessarily achieved. Ensuring that each community has a full complement of amenities and that public transit is used to link each community will mitigate this consequence.

Reducing GHG emissions by 33% under 2007 levels by 2020 will be extremely difficult. We therefore recommend restating the official OCP target to a 33% reduction by 2025, providing an additional five years to achieve the target. Additional targets on the same trajectory will be a 57% reduction by 2040 and an 80% reduction by 2050. Achieving this target also requires substantial actions and monitoring progress is critical to success. Figure 39 shows the interim GHG reductions targets between 2007 and 2050.

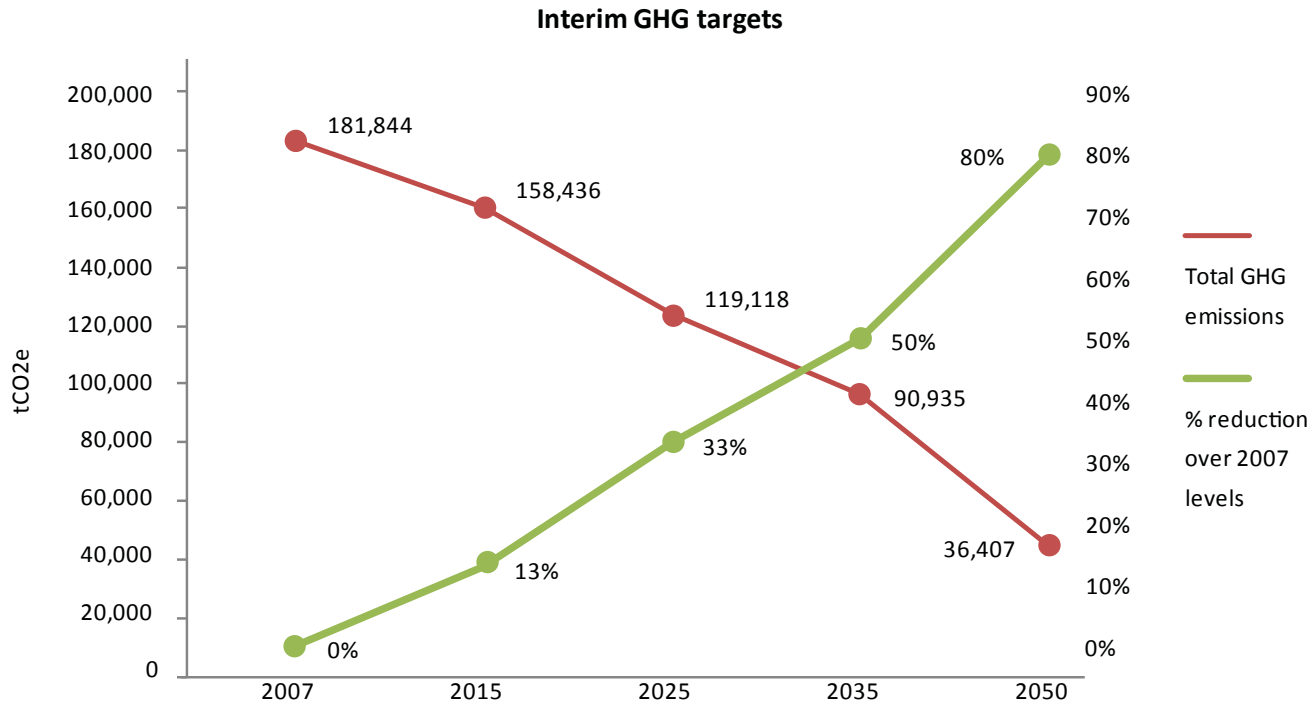


Figure 39: GHG targets for Scenario 2 between 2007 and 2050.

Achieving substantial GHG reductions will require a major effort on behalf of the municipality and the community. The effort will deliver substantial benefits including new employment, cost savings for each household, healthier lifestyles and a more resilient community. The following section presents a series of recommended actions that lay the groundwork for this course of community development.


4.40m

6 The Conservation Imperative

There are numerous strategies to achieve energy efficiencies, categorized as technological improvements or behaviour change. In addition to resulting in reduced energy consumption, they also save money. Potential efficiencies including eliminating undesired or misused services, eliminating conflicting services for the same use, eliminating parasitic loads and ensuring the most productive use of the energy.

The rebound effect

The rebound effect can reduce the benefits of energy efficiency initiatives. For example, the introduction of energy efficiency measures in the building code could result in the construction of larger homes so that the benefit of the efficiency is offset partially or fully by behaviour changes. As vehicles become more efficient in terms of their fuel consumption, there has been an increase in both driving speed and kilometres driven. This impact needs to be carefully considered in the design and implementation of energy efficiency projects.

Induced benefits of efficiency

It is important to note that a kWh of electricity saved in North Cowichan represents greater savings than one kWh in the context of an electricity system. That final kWh used for lighting, equipment, heating or cooling requires the generation of more than one kWh to account for efficiency losses in the conversion of primary energy into electricity, the distribution of the electricity from the point of conversion to the point of end-use and the efficiency with which the electricity is converted to that end-use. As a result reduction in demand of electricity in North Cowichan delivers significantly more reductions upstream- in the case of a thermal power station the ratio can be as high as ten to one, 10kW of generating capacity reduced for every 1kW of end-use demand reduced .

Community energy planning hierarchy

As introduced in Figure 19 (page 45) BC Hydro has outlined a community energy planning hierarchy that involves four steps.

- Reduce energy demand: first and foremost, identify strategies to reduce the energy consumed through conservation strategies;
- Reuse waste heat to heat buildings and hot water: identify opportunities to capture and reuse energy that is otherwise wasted;
- Develop renewable heat sources to heat buildings and hot water: identify opportunities for renewable sources of heat to supplement or replace fossil fuels; and
- Develop renewable energy sources to supply electricity needs: the final step is to identify options for generating electricity with renewable sources.

North Cowichan context

The District of North Cowichan has adopted ambitious GHG reduction targets including 33% reduction over 2007 levels by 2025 and an 80% reduction by 2050. In order to reduce demand, the first strategy is to focus on land-use, resulting in development patterns that reduce the need for driving and support walking and cycling. In the case of North Cowichan with three distributed communities (North Duncan, Crofton and Chemainus) the opportunities for land-use change are limited, placing increased pressure on fuel switching from gasoline and diesel vehicles to electric vehicles as well as concerted transportation demand management strategies to achieve transportation-related GHG emissions reductions. In the residential dwellings, the slow turnover of the building stock means that reductions from energy efficiency measures in new construction require a long period to achieve reductions and similarly the time required for retrofitting a substantial portion of the existing building stock means that this is also a longer-term source of reductions. To achieve, North Cowichan's 2025 GHG target, fuel switching is also necessary from natural gas and heating oil to electricity. This shorter term fuel switching on the residential and transportation side offsets the impact of the electricity demand reduction efforts until 2040, at which point electricity savings begin to incur from the strategies described below.

Minimizing electricity demand (or maximizing demand reduction) is critical to North Cowichan's GHG target because if BC Hydro runs out of sufficient capacity and needs to purchase additional supply from higher GHG intensity sources, the increased emissions factor for electricity has the potential to undermine or minimise the GHG benefits resulting from fuel switching in the residential and transportation sectors. Low carbon electricity is thus critical to ensuring that the District of North Cowichan can achieve its GHG emissions target.

Electricity and energy targets

The analysis completed for Scenario 2 includes a significant emphasis on demand reduction with respect to energy consumption. The targets that we have outlined for this project include the following:

Table 10: Electricity and energy targets

Energy planning hierarchy	Strategy area	Targets		
		2015	2025	2050
1. Overall electricity target		Achieve 12% electricity consumption reduction over BAU by 2050.		
2. Reduce energy demand	Land-use	Decrease detached dwellings share from 63% in 2007 to 61% in 2050.		
	Green building - residential	-33% energy savings over 2007	-39% energy savings over 2007	-60% energy savings over 2007
	Green building - commercial	-33% energy savings over 2007	-39% energy savings over 2007	-60% energy savings over 2007
	Energy efficiency retrofits - residential and commercial	0.1% of building stock	1.35% of building stock	50% of building stock
	Energy efficiency retrofits- commercial	Retrofits results in 13% energy savings over 2007	Retrofits results in 18% energy savings over 2007	Retrofits results in 40% energy savings over 2007
3. Re-use waste heat to heat buildings and hot water	Major commercial and/or industrial facilities	Capture waste heat from the arena facility for greenhouse or other uses		Explore opportunities with mill for district energy system
4. Renewable heat sources to heat buildings and hot water	District energy systems - dwellings attached	10	55	3,280
	Energy savings from district energy	33%	39%	60% (combined heat and power)
5. Renewable energy for electricity	Meet 75% of residential energy demand with local renewable energy sources (as per Ea Energy Analyses and gras (2012). Cowichan Valley Energy Mapping and Modelling: Report 4).			

7 Recommended CAEP Actions and Implementation

The previous section detailed the magnitude of the energy and emissions challenge at hand and provided the scopes of various means to achieve emissions reduction targets along with environmental, economic and social justifications for these means. This section starts with a summary table of the objectives detailed above and the general approaches to addressing these objectives. Following is a suite of recommended, detailed actions, each of which addresses one or more objectives. Taken together, the suite of actions represent a comprehensive approach for North Cowichan to achieve its energy and emissions reduction targets starting immediately.

6.1 Recommended Climate Change Mitigation Actions

Recommendations Summary

Scenario 2 details what objectives are required to achieve a 33% reduction under 2007 levels by 2025, putting North Cowichan on track to an 80% reduction by 2050 (in line with the Provincial target). Table 10 describes the results of the modelling analysis until 2050. The columns are defined as:

Objective: the objective modelled in GHGProof to achieve a certain emissions reduction target.
Description: the elements that were modelled to achieve the objective.
Responsibility: who is primarily responsible for taking action to achieve the objective.
Project GHG reductions, 2050 over BAU: the difference in the year 2050 between Scenario 2 and BAU emissions.
Average annual cost/savings: the average annual cost or savings the action incurs in order to achieve the objective (over 43 years).
Marginal abatement cost: the cost or savings per tonne of CO2e reduced in achieving an objective.
Employment created: number of direct and indirect jobs created through achieving the objective. Most, but not all, jobs are local.

Table 11: Summary of Scenario 2 Modelling Outcomes

Objective	Description	Responsibility	Projected GHG reductions, 2050 over BAU (tCO2e)	Average annual cost/ savings (2007-2050)*	Marginal abatement cost per tCO2e**	Employment created
Transportation						
Low carbon fuel	Adoption of electric vehicles increases share of electric fuel to 80% of total for transportation.	Local	11,204	-$40 million	-$750	201 jobs in construction for new homes, infrastructure.
Fuel efficiency	US fuel efficiency standards are implemented in Canada.	Federal	No reductions over BAU.			
Densification (reduced VKT)	The number of dwellings within walking and cycling distance of key destinations increases by 350%. Trip length declines as dwellings are located near destinations from 11.6 km to 4.9 km. 7,364 new dwellings have walking access to transit. Fuel emissions of transit decrease by 45% with the adoption of hybrid and electric buses and people are 45% more likely to take transit.	Local	13,372			
Commercial transportation	Adoption of proposed commercial vehicle fuel efficiency standards by US EPA and DOT.	Federal	-4,658***	N/A	N/A	N/A

Objective	Description	Responsibility	Projected GHG reductions 2050 over 2007 (tCO2e)	Average annual cost/ savings (2007-2050)*	Marginal abatement cost per tCO2e**	Employment created
Buildings						
Residential building code improvements	60% increase in efficiency of new buildings by 2050.	Provincial	No reductions over BAU	$40,000	-$565	13 jobs in design and construction related to energy efficiency.
Renewable energy	Electricity share of total energy use climbs from 61% to 83% reflecting a shift to heat pumps, geothermal and PV. Emissions factor for buildings declines by 85% with shift to wind, tidal and solar for electrical generation and solar hot water on residential scale.	Local	44,324	$5 million	$115	242 jobs in installation and design for wind, solar and tidal.
Residential retrofits	50% of dwellings upgraded by 2050 with an energy reduction per area of 40% by 2050.		1,778	-$45,000	-$88	28 new jobs in residential retrofits.
Commercial retrofits	50% of all commercial buildings retrofitted by 2050 with an energy reduction per area of 40% by 2050.		646	-$10,000	-$53	7 jobs in design and construction.
District energy	3,280 buildings connected with a 60% reduction in energy use with the introduction of combined heat and power systems by 2050.	Local	587	-$45,000	-$239	7 new jobs in design, construction and maintenance.
Waste						
Landfill gas capture	100% of waste going to a landfill with landfill gas capture.	CVRD	448	$23,000	$333	1 new jobs in landfill gas capture maintenance.
Liquid waste treatment to tertiary	100% of dwellings treated by tertiary treatment.	Provincial	2,830	$224,000	$312	20 new jobs in design, construction and maintenance.

* This is the average cost or savings to the community. The calculation includes capital costs but not returns on investment.
** Marginal abatement cost is calculated by dividing the net present value (present value of an investment's future net cash flows minus initial investment) by the project life and the annual average CO2 reduction ($MA = NPV/tCO2e/years).
*** The emissions reduction effect of the commercial vehicle fuel efficiency standard increase is outweighed by the increase in commercial transportation correlated to the increase in population

Objective	Description	Responsibility	Projected GHG reductions 2050 over 2007 (tCO2e)	Average annual cost/ savings (2007-2050)*	Marginal abatement cost per tCO2e**	Employment created***
Biomass and Agriculture						
Increase agriculture intensity	Area of farms increases from 6,120 ha to 10,331 ha. Percent of food produced locally that is consumed locally increases from 20% to 88%.	Local	79,269	$2.2 million	$55	63 new jobs in farming.
Increase in hay production	Area of land farmed for perennial crops increases from 2,254 ha to 3,458 ha.	Local	400		$5	
No-till agriculture	Area of land in no-till agriculture increases from 85 ha to 985 ha.	Local	296	$509	$5	
Methane capture from dairy cows	50% of the methane released by dairy cows is captured for energy production.	Local	2,343	Unknown	Unknown	Unknown
Increased forest cover	Area of forest increases from 5,112 ha to 7,842 including urban plantings.	Local	19,679	$80,000	$4	8 new jobs in forestry.

The combined reductions from achieving all of these objectives will result in emissions reductions of 33% under 2007 levels by 2025 and 80% reductions by 2050. These modelled objectives are what inform the recommended actions that follow in this section. The actions have not been modelled to determine their absolute emissions reduction impact (that would be a large, intricate project on its own). Rather, they are the best options to pursue now to start a path to achieving the required emissions reductions.

Recommendations Preamble

This section details recommended actions to achieve North Cowichan's three CAEP goals, as originally stated in the Official Community Plan:

1. Achieving carbon neutrality as soon as possible;
2. Achieving an 80% reduction in GHG emissions by 2050 (restated); and
3. Sequestering more carbon than produced.

The recommended actions also serve to guide North Cowichan to its BC Climate Action Charter obligations:

1. Being carbon neutral with respect to operations by 2012;
2. Measuring and reporting on community GHG emissions; and
3. Creating complete, compact, more energy efficient rural and urban communities.

The actions and implementation recommendations are a culmination of inputs from the public, the Climate Change Action Committee of Council, the Strategic Action Group (municipal staff representatives), municipal staff CAEP project managers and the consulting team, as described in Figure 2.

As already indicated, achieving North Cowichan's original goal of a 33% emissions reduction below 2007 levels by 2020 will be too onerous. A more reasonable goal is a 33% reduction by 2025 (i.e.: an 80% reduction by 2050). North Cowichan's OCP allows for adjusting its initial target of 33% by 2020; we recommend it be changed to 33% below 2007 levels by 2025.

The following recommended actions reflect the magnitude of achieving the Scenario 2 goal. Nearly all of the actions are long term projects that can begin immediately and will increase in effectiveness over time. They were selected using three criteria:

- Relevance to North Cowichan in terms of the geography and culture of the community;
- Proven ability to deliver significant GHG emission reductions using a systematic approach; and
- Proven ability to deliver co-benefits including employment, health benefits or ecological benefits.

Each action has nine elements:

1. Relevance: how the action reflects North Cowichan's circumstances;
2. Innovation: how the action is progressive and effective in North Cowichan, Canada or globally;
3. Background: the justification for the action;
4. Key Considerations: particular challenges or advantageous elements to implementation;
5. Timeline: the start of the action, milestones, and completion or check in;
6. Budget: the estimated cost of implementing the action (borne by the Municipality, partners or both);
7. Staffing: the estimated staff time required to implement the action (provided by the Municipality, partners or both);
8. Potential Partnerships: community, not-for-profit, private sector or government organizations to help lead or support; and
9. Potential Funding Sources: identified sources that may be amenable to funding the action implementation and sustainment.

Some of the background, justification and input supporting the recommendations can be found in the Appendices. "Year 1" in the Timeline element refers to the year in which plan implementation begins, which is assumed here to be 2013. The estimated budgets, staffing ('FTE' is Full Time Equivalent staff) and timeline for each recommendation are based on experience from best practices; however, it is anticipated that these estimates will evolve during implementation and with additional planning.

The consulting team **strongly recommends** pursuing the entire recommendations package. This concerted effort is the only path to achieving the emissions reduction target. The CAEP is necessarily ambitious and requires dedicated resources, both in terms of budget allocation and staff time. The recommended actions do not necessarily mean increased regulation, rather they encourage better use of existing municipal powers. The CAEP outcomes will be successful and inspiring but only with dedication to implementation. With proper funding leveraging and community partnerships North Cowichan can share costs and program responsibility with the added benefit of community empowerment.

1. Create a Transportation Planning Program with Dedicated Staff

The vast majority of North Cowichan's GHG emissions are attributable to vehicle travel. Decreasing vehicle travel in this rural area will be a significant challenge, but a crucial endeavour. A Transportation Planning Program is required to oversee four key activities:

1. Implementing a Smarter Travel Choices Program;
2. Establishing a taxi-bus rural public transit system;
3. Encouraging bio-diesel purchases; and
4. Joining Project Get Ready.

A dedicated 'Director of Transportation Planning' staff member would work under the Director of Planning and Development to coordinate these activities. Their responsibilities would include:

- Establishing the new transportation programs;
- Coordinating a trip diaries survey (potentially with BC Transit as lead or support) every 5 years, starting in Year 2;
- Liaising with community groups and businesses in a lead or support role on the programs;
- Liaising with higher level government, neighbouring jurisdictions, funding organizations and transportation organizations;
- Coordinating with other North Cowichan departments on related work (e.g.: new developments, densification, infrastructure improvements, updating CEEI data and GHGProof, etc.);
- Overseeing transportation marketing and promotion programs; and
- Monitoring transportation program effectiveness.

The estimated cost to the Municipality of hiring a new staff member is $80,000 per year.
The estimated cost of a trip diary is $100,000.
The estimated cost of updating CEEI data and GHGProof is $10,000 every two years.

The four Transportation Planning Program elements are described in more detail below.

1a. Implement a Smarter Travel Choices Program

Relevance

North Cowichan's dispersed population means that investments in improved public transit and its related infrastructure are prohibitively expensive. A focus on changing the culture around transportation can achieve significant results at a low cost.

Innovation

A comprehensive approach to transportation behaviour change has not yet been implemented anywhere in Canada.

Background

Achieving GHG reductions through behaviour change is notoriously difficult. One particularly successful example in the UK is the Sustainable Travel Towns project which achieved carbon savings between 13% and 20% per capita (see Appendix 5). The project provided three communities with ~$20 million dollars (~$22 per person) over five years to implement a comprehensive suite of transportation behaviour change initiatives. This achieved a 10% reduction in trips and a 5-7% reduction in trip length. The cost per car kilometre reduced was approximately $0.08. This represents exceptional value, a Benefit Cost Ratio of 4.5 for congestion only which would likely be doubled if health, consumer benefits and environmental benefits were also taken into account. The project was analysed extensively and provides many insights into how North Cowichan could design a similar program.

Smarter Travel Choices (STC) is a term used for 'soft' measures used to reduce car use without building 'hard' new transportation infrastructure. These measures largely involve education and promotion of existing alternatives to the car, however, targeted complementary infrastructure (like bicycle lanes) can enhance and help 'lock in' the benefits. Smarter Travel Choices measures may include:

- Delivering school and workplace travel plans that encourage 'greener' transportation like public transit, walking, cycling and buses;
- Making personalized travel planning resources available to improve awareness of travel options through tailored advice, information and incentives;
- Improving active transportation infrastructure and promoting its use;
- Promoting a safe routes to school program for walking and biking;
- Ensuring public and business amenities include active transportation infrastructure (e.g.: bike racks);
- Offering bicycle training programs for riders of all ages;
- Promotion and education programs;
- Ensuring intermodal accessibility (e.g.: transit buses can carry bicycles, bike routes and trails intersect with transit terminuses);
- Establishing automobile use resources such as car clubs, peer-to-peer car sharing services, co-op car sharing services, and carpooling coordination services; and
- Engaging employers to offer active transportation, public transit, carpooling, and tele-working incentives for employees.

The UK program showed that in order to be successful this type of program requires a comprehensive and well-staffed approach that targets 50-100% of the population with personal travel advice, advertising, media campaigns and loyalty programs. A sustained program is also necessary as the effects of these programs are more easily realized over the medium to long term (i.e.: more than two years).

Key Considerations

- Effective marketing must use communication strategies that set out not only to 'sell' sustainable travel options, but to make them a part of the local identity.
- Sustainable travel loyalty schemes in which residents receive special offers, discounts and personal travel information can successfully encourage residents to identify with and partake in the project. Social media can be effective in delivery of incentives and tracking their uptake.
- A monitoring process is essential to evaluate the ongoing progress of the project. This requires commissioning a community travel baseline, and administering interim and post-intervention household travel surveys.

Timeline

Year 1: Program design and planning
Year 2-7: Implementation
Year 8: Evaluation

Potential Partnerships

- Other local governments and CVRD
- School district and large employers
- BC Transit
- Vancouver Island Health Authority
- Vancouver Island University (monitoring and evaluation)
- Provincial and Federal transportation initiatives
- Private developers

Staffing - Municipal

Part of Director of Transportation Planning's scope.

Potential Funding Sources

- FCM's Green Municipal Fund
- Gas Tax
- BC Ministry of Transportation and Transport Canada
- Private developers

Total Program Budget (including municipal and other costs)

Year 1: $40,000 (0.5 FTE Municipal staff)
Years 2-7: Municipal and not-for-profit staff and incentive delivery costs = ~$700,000/year
Assuming: - 0.5 FTE staff/year ($40,000/year)
- ~$20 per person per year for an estimated population of 30,987 for 2013 (program start year) plus an estimated 431 additional new residents per year
Year 8: ~$700,000 for staff and incentive delivery costs + $30,000 for plan evaluation and update

This is a comprehensive program requiring multiple partners to support and lead its various elements. Many of the elements can be implemented regionally with partners such as the CVRD and the school board. Additional study will be required for some elements; the estimated time required for study of any one element is only a few months and much of it could easily be completed by a dedicated staff member. Some study details will be established in conversation with the partners, once the capacity of the partners to champion or support the action is identified. The implementation of each element can be phased in so that the efforts are iterative and complementary. An example of a phased approach is depicted in Figure 40. In most cases, primary responsibility of a program element can be transferred to another organization once sufficiently established. Partners may still need financial support from the Municipality, but costs can be financed in part by program beneficiaries (e.g.: large employers, School District). One arrangement could be for each partner (e.g.: North Cowichan, large employer, not-for-profit) to pay one-third of the program element cost.

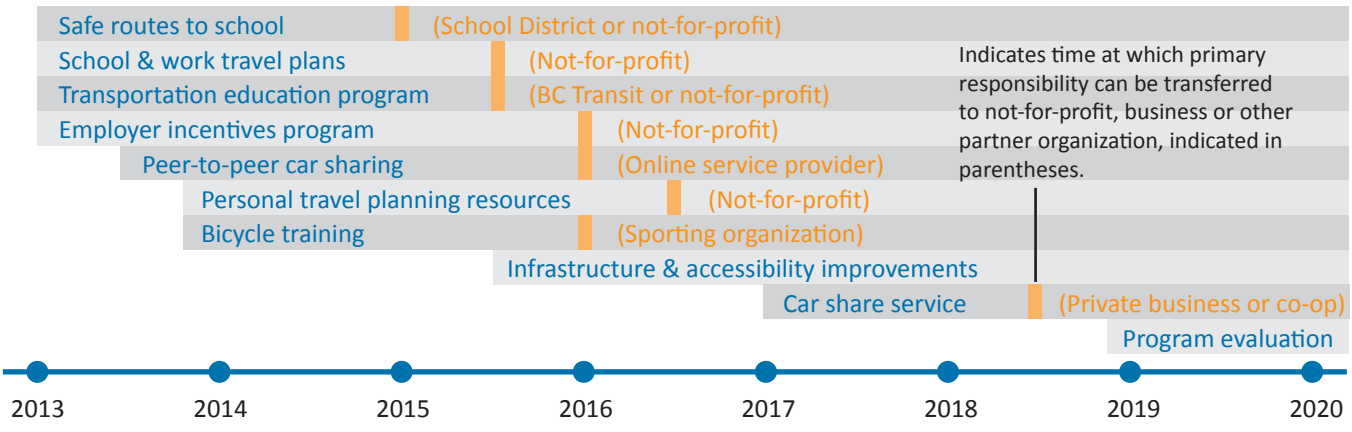


Figure 40: Example of a phased approach to Smarter Travel Choices elements.

1b. Establish a Taxi-bus Rural Public Transit System

Relevance

Taxi-based transit can be effective public transportation for low density areas.

Innovation

Taxi-bus enables people to travel without set schedules or routes. It does not require any additional infrastructure or fleet.

Background

The Taxi-bus model has been developed and implemented in Rimouski, Quebec. Rimouski is a 530 square kilometre town of 47,000 people - over 2.5 times larger in area than North Cowichan with only a little over 1.5 times the population. Taxi-bus is a demand-responsive service. Passengers can travel between any two designated stopping points, sharing taxis that are dispatched in a manner to maximize occupancy. All trips are made without transfers and leave within 15 minutes of the scheduled time. A non-profit corporation created by the city administers the service and performs registration, reservation and financial functions. Local taxi drivers formed a cooperative to dispatch and drive the taxis.

North Cowichan could create a similar organization in collaboration with BC Transit and local private transportation providers. Using information already gathered by these partners, stopping points and routes could be determined. Specific services could be developed for work commuters, shoppers and students.

Key Considerations

- The CVRD has recently endorsed BC Transit's regional transit plan. Systems to supplement this plan should be coordinated with BC Transit and CVRD.
- There are many co-benefits associated with this program, including ensuring access for two population segments that can be isolated in rural areas: the elderly and the young. It also creates an opportunity for people in rural areas to live without a car, whether because they don't have the financial means, are unable to drive or are reducing their environmental impact.

Timeline

Year 2: Investigation of partnerships and organization requirements
Year 3: Establishment of an organization
Year 4: Implementation

Potential Partnerships

- CVRD
- BC Transit
- Local taxi organizations

Staffing

Part of Director of Transportation Planning's scope.

Potential Funding Sources

- FCM's Green Municipal Fund
- Gas Tax
- BC Ministry of Transportation
- Transport Canada

Budget

Year 2: $30,000 to research and set up the program (0.5FTE or contract)
A subsidy in the range of $150,000 to $200,000 will be required for the setup of the organizing body.
There are no running estimated capital costs required for this service, as the private sector will provide the service once established.

1c. Increase Community Biodiesel Purchases and Require Municipal Fleet Biodiesel Use

Relevance

Vehicles using biodiesel can go beyond the BC Government's low carbon fuel requirements for vehicles.

Innovation

This measure supports GHG reductions and possibly the local biodiesel co-operative.

Background

Biodiesel is produced from carbon neutral feedstocks, such as straight vegetable oil and canola oil. One local supplier, the Cowichan Bio-Diesel Co-operative (CBDC), collects waste vegetable oil from Vancouver Island and the Lower Mainland to process it into biofuel. Restaurants usually have to pay a waste removal service to properly dispose of waste cooking oil. The CBDC opened in 2005 and currently has 170 members. The co-op is volunteer-based and members can purchase biodiesel at the cardlock pump at Bings Creek Solid Waste Management Complex or order it online. The price per litre has a slight premium as compared to regular diesel. Business and residential programs are in place to collect waste cooking oil. The facility currently produces 150,000 L/year of 100% biodiesel (B100) for operation in buses, trucks and industrial equipment. The CBDC is also planning to deliver biodiesel blends to the CVRD. Burning bio-diesel can produce 70% less CO2e emissions than burning traditional fossil fuels. The CBDC's B100 has operated without problems to -10°C.

The co-op could expanded its operations to serve more members. This would require collecting more waste cooking oil from restaurants throughout the Cowichan Valley Regional District and beyond. The bio-diesel refinement and dispensing facilities could be expanded on the Bings Creek Solid Waste Management Complex site and to other sites. The Municipality could require contractors and municipal equipment to use biodiesel or a biodiesel/regular diesel blend from this facility. This would support the local economy and build community capacity to generate energy. Community GHG reductions could be up to 5% of the 499 tCO2e generated from the combustion of diesel each year.

Corporate Action

North Cowichan consumed approximately 160,000 L diesel (petroleum diesel and biodiesel) for its corporate operations, not including contractors, in 2011. Of this, around 6400 L comes from biodiesel in blends, as current regulations require at least 4% of diesel fuel to be biodiesel. Shifting to a 20% biodiesel blend (B20) would reduce petroleum diesel consumption by over 25,000 L, resulting in almost 65 t CO_2e in emissions reduction, avoiding over $1600 in offsets. The Municipality should immediately require its diesel-using fleet and equipment to exclusively use biodiesel mixtures - the highest biodiesel content advisable. This requirement should be extended to all contractors' fleets and equipment.

Key Considerations

- Cowichan Biodiesel's production is limited based on sourcing waste vegetable oil.
- Cowichan Biodiesel has only one fuelling station at which to procure the biodiesel.
- The co-op currently relies on volunteers. A service expansion may require hiring staff.
- Marketing may be required to encourage local consumer uptake of biodiesel purchases.

Timeline

Year 1: Investigate purchasing biodiesel for North Cowichan's needs including cost, reliability and mix.
Year 2: Decide whether or not to purchase Cowichan biodiesel

Potential Partnerships

- Cowichan Biodiesel Co-op
- Other biodiesel producers
- Local businesses, the school board, other government operations and contractors with fleets and diesel equipment

Staffing

Part of Director of Transportation Planning's scope.

Potential Funding Sources

- FCM's Green Municipal Fund
- Gas Tax
- BC Ministry of Transportation and Transport Canada

Budget

Year 2 onwards: Up to $50,000 in premium fuel costs depending on the cost of diesel.

1d. Join Project Get Ready and Transition the Municipal Fleet to Electric Vehicles

Relevance

Reducing personal vehicle use is *the* major challenge to reducing North Cowichan's GHG emissions. Recognising the difficulty in reducing the number of vehicle trips, a shift from combustion engine vehicles to electric vehicles is critical.

Innovation

Only two municipalities in Canada currently participate in Project Get Ready: Vancouver and Toronto. Some BC municipalities are piloting the use of electric vehicles in corporate fleets and installing electric charging stations. North Cowichan would be the first community of its type to implement the program in Canada.

Background

The Rocky Mountain Institute has been working with cities across North America on Project Get Ready (2012), an initiative by cities to lead the transition to electric vehicles. Two key barriers to the shift to electric vehicles are the expense of current battery technology (resulting in high initial costs of electric vehicle purchase) and the lack of commitment to the shift in many well-established sectors (including consumers, utilities and auto-makers). Project Get Ready recommends:

- Committing municipal fleet to electric vehicles use;
- Convening a dedicated group of people or organizations interested in purchasing electric vehicles to drive the process;
- Dedicating resources to develop a project steering committee, including municipal planning and engineering staff, interested community groups, energy utilities and other organizations to guide community-wide efforts to support the uptake of electric vehicles;
- Identifying opportunities for financing (e.g.: a revolving loan fund);
- Assigning a staff champion to guide these efforts (e.g.: 10 hours per week);
- Fast-tracking permitting for new charging stations;
- Establishing an incentive program for home electric vehicle charging station retrofits;
- Ensuring new construction requires the installation of plug-in charging stations;
- Installing public charging stations; and
- Working with manufacturers and dealers to create social marketing and incentive campaigns.

Corporate Action: The Municipality should transition its fleet to electric vehicles. Electric vehicles cost ~$20,000 more than a comparable internal combustion engine vehicle but will generate fuel savings of ~$13,000 over their lifetime, as well as saving $780 in carbon offsets. If all internal combustion engines are phased out, 19 tCO2e per year will be eliminated.

Key Considerations

- Electric vehicle uptake has been slower than anticipated to date. This is attributed to their cost, lack of consumer return on investment considerations, lack of understanding by dealers, lack of charging stations, consumer perceptions of electric vehicle shortcomings, and poor marketing.
- Charging times can be an issue. Long waits at 'refueling' stations for adequate charge is undesirable to drivers. Quick charge stations and battery swap stations should be considered.
- Existing land-use patterns mean that electric vehicles are a central factor in efforts to reduce GHG emissions in North Cowichan.

Timeline

Year 1: Install electric charging stations; establish a committee ; purchase electric vehicles; join Project Get Ready.

Year 2: Review options for supporting EVs through permits and regulations

Year 3: Investigate additional financing packages to support the purchase of EVs

Year 4: Purchase electric maintenance equipment

Potential Partnerships

- BC Hydro
- Duncan
- CVRD
- Local electric vehicle and electric vehicle charging station companies
- Local electricians
- Local car dealerships
- Local auto mechanics
- Fraser Basin Council
- Vancouver Island University

Staffing

Part of Director of Transportation Planning's scope.

Potential Funding Sources

- BC Hydro
- Ministry of Energy and Mines
- Ministry of Transportation
- Ministry of Environment
- Gas Tax
- Fraser Basin Council (Green Fleets BC)
- Plug In BC

Budget

Year 1: $20,000 for 2 charging stations at $10,000 each

Year 2 and year 3: 1 municipal electric vehicle at $20,000/year

Year 2+: ~$30,000/year for home charging stations retrofit and new construction incentive program costs

Year 3+: Annual cost of transitioning remaining municipal fleet (dependent on capital budget availability)

2. Ensure Strict Implementation of OCP Development Guidelines

Relevance

North Cowichan's population is increasing at a slow and consistent rate. Housing and amenity demand can be largely met through the development of compact communities. There are numerous policies in the OCP that can significantly reduce greenhouse gas emissions once implemented.

Innovation

Despite the guidance of their OCP commitments, few municipalities in BC have succeeded at redirecting growth towards commercial core areas. Long-term commitment is critical to realize the success of this collection of policies.

Background

Since 2002 the municipality has designated three growth centre nodes and established urban containment boundaries with the goal to encourage mixed use, higher density and pedestrian friendly communities, which in turn create opportunities for active transportation and alternative energy use. These actions also foster a healthier community by providing a variety of lifestyle, housing, economic and cultural opportunities.

North Cowichan's OCP was updated in 2011. The five principles of the plan are: sustainability, economic opportunity, smart growth, healthy and safe community, and community engagement. These principles reflect the collective values of residents and will guide the development of policies, programs and actions resulting from the OCP. The policy areas that have a direct relationship to climate change and reducing our GHG emissions are:

- Protecting the agriculture and forestry land base by discouraging rural sprawl;
- Supporting mixed-use developments;
- Establishing urban containment boundaries (UCBs) around growth centres;
- Directing growth to the commercial core areas in the Municipality;
- Supporting appropriate infill development;
- Directing development to areas with existing amenities and transit services (areas of highest density and commercial cores);
- Establishing future density expectations for less dense subdivision developments;
- Restricting development on unserviced lands to comprehensive development plan reviews;
- Placing equal importance on movement by foot, bicycle, public transit and automobile; and
- Including Land Use and Development Application Objectives to guide appropriate development.

Strictly implementing OCP development guidelines and ensuring that all development occurs in Chemainus, Crofton, Quamichan Lake and the area north of Duncan will increase opportunities for GHG reduction strategies. These compact communities will support active transportation (e.g.: walking, cycling), short vehicle trips, public transit, energy savings and healthier residents.

Implicit in the OCP are the development powers granted by Bill 27 (Green Communities). These powers include:

- The option to waive development cost charges (DCCs). This can be used to encourage desirable developments, such as those with sustainability requirements, affordable housing or small lot subdivisions. Under North Cowichan's OCP, DCCs and building permit fees are waived for non-market and special needs housing. Policies and bylaws could be updated to include the option to waive DCCs for developments that meet sustainability criteria.
- The power to designate Development Permit Areas (DPAs). North Cowichan's OCP includes 5 DPAs: General, Marine Waterfront, Natural Environment, Hazard Lands, and Farm Land Protection. Parts of these DPAs encourage energy and water conservation in developments and encourage awareness of GHG emissions resultant from neighbourhood layouts. These mentions are non-prescriptive; a prescriptive approach could further benefit the efficiency and quality of sustainable developments. Examples of items that could be included in a prescriptive approach include: building solar orientation, pervious surfaces, reducing the development's GHG reductions under that of a typical similar development, green roofs, local materials, proximity to transit, adhering to a green building standard, etc.

- The power to vary or exempt off-street parking requirements based on activities or circumstances related to the transportation needs associated with the land or building. North Cowichan's OCP allows for reduced parking requirements for affordable housing but does not have provisions for varying or exempting off-street parking allowances. Parking allowance practices could be modified to include maximum parking allotments for developments (typically, minimum allotments are required) while including provisions for covered and/or secure bicycle parking spot minimums.
- The power to accept cash in-lieu of off-street parking for deposit in a cash in-lieu reserve fund. This fund can now be used to provide alternative transportation infrastructure. The fund could be invested in public transit infrastructure, electric vehicle charging stations, car sharing service development, etc. A cash-in-lieu bylaw currently applies to Chemainus. Coordination with Duncan would be required for a similar bylaw in the south end.

Implementing the OCP policies

The OCP is over one year old and the municipality is beginning to identify and undertake initiatives to implement its policies. The following are various initiatives that should be given the highest priority for implementation in order to achieve the 33% by 2025 reduction target. Some initiatives coordinate with other recommendations and are mentioned here to specifically highlight their relevance to OCP implementation.

Develop a comprehensive strategy to facilitate increased density in the Urban Containment Boundaries

- Establish density targets for the commercial core areas and neighbourhood centres;
- Undertake a feasibility study to establish a density bonusing program;
- Establish a community amenity contribution policy and procedures;
- Ensure UCB are not increased (as they are already large); and
- Review DCC charges to encourage smaller housing units and zero emission developments.

Establish a Transportation Demand Management Strategy (Coordination with Recommendation 1)

Such a strategy contains a broad range of policies, programs and services designed to reduce the demand for vehicle use by influencing individual travel behaviour and providing expanded options. It seeks to enhance options such as transit, walking, cycling, carpooling and telecommuting. A TDM strategy can avoid future road congestion, save money on road construction, increase social well-being and reduce GHG emissions. Establishing a TDM strategy requires a bylaws and standards review to encourage alternatives to the automobile (e.g.: establish bicycle parking (short and long term) standards and create a public parking management policy including maximum parking standards).

Develop a food security strategy (Coordinate with Recommendation 7)

Create more opportunities to allow community members to grow and sell food on small rural lots as well as in the UCBs. Such initiatives would include horticulture in urban neighbourhoods, establishing community garden guidelines, and requiring multi-family developments to provide community garden space.

Update regulatory bylaws and standards to be better aligned with the OCP goals and policies that have the effect of reducing GHG emissions

- Develop and implement low impact subdivision and development standards that recognize, preserve, and protect special places, landmarks (both natural and human made), natural systems, natural grades, indigenous vegetation, hazard areas and ecological systems, including red and blue listed species and ecosystems;
- Establish Shoreline Planning areas and related risk designations for marine foreshore lands;
- Develop an urban forest strategy to increase opportunities for carbon sequestration and to reduce energy use;
- Create incentives and requirements for 'green design' and zero carbon emission for new developments;
- Review municipal fees and charges to address any disincentives to new development and redevelopment in growth centres;
- Establish a permissive tax exemption program for low or no emission developments; and
- Develop and implement a sustainability checklist by which applications can be evaluated.

Key Considerations

- The aging population is creating a demand for more dwellings within walking distance of key destinations.
- Residents of Chemainus and Crofton drive to Duncan for many services. Increasing the population of these communities will increase the feasibility of additional services in those areas and reduce the need for additional trips to Duncan or Nanaimo.
- It is possible that people moving to North Cowichan do so to enjoy its rural character and may not be interested in more dense residential developments.

5. The GHGProof model can be re-calibrated every two years with the release of new CEEI data. It can be used to track and modify CAEP actions and the effects of OCP implementation.

Timeline

Year 1: Review extent of development outside of UCBs. Review effectiveness of existing Bill 27 powers practice and explore increased application of these powers. Update standards and bylaws.

Year 2: Develop TDM and food security strategies.

Potential Partnerships

- Neighbouring municipalities and CVRD
- Local developers
- Not-for-profits
- Residential associations

Staffing

No additional staff requirements.

Potential Funding Sources

None needed

Budget

No additional budget required if capacity exists internally.

3. Employ Municipal Energy Policy Mechanisms

Relevance

Bill 27 gives municipal governments the power to employ existing tools to ensure future development supports GHG reduction goals.

Innovation

The approach of requiring renewable energy on new buildings or in new developments has been widely discussed in BC, but municipalities have yet to apply it.

Background

Municipalities have a number of policy tools at hand that can be used to decrease energy consumption. Three of the most effective instruments are density bonusing, development permit areas (DPAs) and the building code.

1. **Density bonusing:** The Local Government Act section 904 enables local governments to give development applicants permission to build increased density developments in exchange for providing amenities. There is already a precedent amongst BC municipalities for classifying improved building energy performance as an amenity.
2. **DPAs:** North Cowichan can create DPAs, or modify existing DPAs, that contain a performance-based guideline of producing 10% of new energy requirements from renewable sources on site. This approach has been widely adopted by UK municipalities and is known as the Merton rule, but has not yet been applied in Canada.
3. **Building Code:** Bill 10, the Housing Statutes Amendment Act, enables local governments to enforce the new Part 10 requirements of the Provincial Building Code. Municipal councils were previously limited to enforcing building standards in relation to "health, safety or protection of persons or property". Councils now have additional authority in relation to the conservation of energy or water, or the reduction of greenhouse gas emissions. This includes the ability to set energy efficiency targets for new buildings. The building code could incorporate something like the Merton rule, mentioned above.

The OCP already has an increased development density focus. Encouraging developers to take advantage of density bonusing policies will create more energy efficient developments. Requiring 10% of a building's energy to be produced on site is in line with North Cowichan's adoption of the BC Solar Hot Water Ready program, under which new buildings are required to provide space for mounting solar hot water panels and the fit up for the basic associated plumping. Under the building code powers, Council can set energy efficiency targets for new buildings and renovations. Pursuing this suite of options will achieve significant building-related energy efficiencies and emissions reductions.

Key Considerations

- A renewable energy DPA would impose additional costs on new construction.
- A renewable energy DPA would establish a precedent for municipalities in BC.
- The implementation of a renewable energy DPA would require careful forethought.
- Density bonuses can be applied on a case-by-case basis.
- Reviews are required to ensure that new homes are meeting the Solar Hot Water Ready program requirements.

Timeline

Year 1: Review Solar Hot Water Ready program uptake. Review OCP and bylaws for density bonusing application opportunities.

Year 3: Identify a potential area for a renewable energy DPA; include community engagement. Establish viability of adpating building code to include energy provision requirements and guidelines. If viable, implement.

Year 4: Contract the development of a renewable energy DPA.

Potential Partnerships

- BC Hydro
- Ministry of Energy and Mines (Office of Housing and Construction Standards)
- Canadian Mortgage and Housing Corporation
- Local renewable energy retailers
- Local renewable energy not-for-profit organizations
- Local building associations

Staffing

Year 1: 0.05 FTE
Year 3: 0.2 FTE
Year 3: 0.2 FTE

Potential Funding Sources

- BC Hydro
- Fortis BC
- Development fees
- Credit union low interest loans and grants

Budget

Year 1: $4,000 (0.05 FTE)
Year 3: $16,000 (0.2 FTE)
Year 4: $56,000 (0.2 FTE and $40,000 consultant contract for renewable energy DPA)

4. Implement a Home Energy Program

Relevance

Buildings use the most energy and produce the most emissions in North Cowichan, after transportation. Energy efficiency programs and energy system retrofit and replacement programs will help residents and businesses transition to alternative energy systems and more efficient energy sources.

Innovation

Approaches to home energy programs often focus on one element: boiler replacement, solar hot water installation, energy audits, etc. A program offering education, audits and energy efficiency upgrades would provide a comprehensive and effective approach with meaningful outcomes.

Background

Best Practices

The Solar Colwood Project and Halifax Regional Municipality's (HRM) Solar City Project are pioneering programs that support the deployment of solar hot water systems. Solar Colwood is in the implementation phase, whereas the Solar City Project is still working through financing arrangements.

The HRM Solar City project was designed to address three issues: complexity of technology options, complexity of financing and the fragmented solar industry. HRM would act as a financial administrator and contracting agent to install an initial 1,000 to 1,500 panels on 500 to 700 homes within one year. The project would be financed through a low-interest loan through the FCM Green Municipal Fund and residents would be able to repay the cost at a schedule that would match the energy savings on their tax bills

Solar Colwood has four components: renewable energy home retrofits, municipal building solar installations, a new development clean energy demonstration project (district energy), and electric vehicle charging infrastructure. The program has a dedicated program manager, aims to increase economic development and provide jobs, offers a contractor training program, and includes a communications and outreach element. The program includes plans to establish a municipal energy utility to continue the work. Over one sixth of the program budget, $2.3M, will go towards home owners and businesses as cash incentives.

Energy Systems

Unfortunately, the current payback on these systems is very long. If conventional fuel prices increase or subsidy programs are available, solar hot water will become a viable option. Similarly, as indicated in Section 4.4, many other available renewable energy options are not viable in North Cowichan, due to either lack of natural resources (e.g.: wind) or reasonable pay back period. Alternatively, energy efficiency measures and technologies can be employed and programs like those offered by HRM and Solar Colwood can be used as examples of renewable energy program structure best practices that can be applied to other types of energy programs as well.

If subsidies materialize and/or convention fuel prices increase significantly, renewable energy systems will become viable and their installation should become a priority. Two key barriers to the installation of renewable energy systems are up-front cost and finding qualified contractors. To address these, North Cowichan can work with local banks and credits unions to develop financing packages that match cost savings from energy with the capital cost of energy systems. North Cowichan can create a list of qualified suppliers and installers to facilitate bulk purchasing of energy systems. Cowichan Energy Alternatives has already looked into this approach and would make an excellent partner in this endeavour.

Energy Demand and Efficiency Measures

Since renewable energy systems are not currently viable, energy demand and efficiency is the next place to focus. There are two main components to this approach: education and incentives. There are various energy demand mitigation education programs to draw upon that have shown some success (e.g.: David Suzuki Foundation, Pembina Institute, BC Hydro offerings), and any of these could be endorsed and taken up by North Cowichan for promotion.

For energy efficiency measures, North Cowichan can develop and offer services similar to those of the City of Vancouver's Home Energy Loan Program (HELP). Upgrades covered under the Home Energy Loan Program were selected based on research showing the potential for the greatest cost savings on BC Hydro and Fortis BC energy bills for the 'average' Vancouver single family home or duplex. Energy efficiency upgrades that qualify for Home Energy Loan Program financing include any of the following:

- ENERGY STAR natural gas furnace and boilers*
- Air source heat pump*
- Hot water heater
- Increased attic, exterior wall or basement/crawlspace insulation*
- Weatherization **

*Must meet LiveSmart BC standards. Note that ideally non-fossil fuel heating sources are preferred. Natural gas is cleaner burning than other fossil fuels, but it has significant associated extraction emissions.
**Weatherization: Must be completed to satisfaction of energy auditor, demonstrating reduction in equivalent leakage area (ELA).

Air source heat pumps are very efficient and are worthy of incentive program investigation. Under the Solar Colwood program, heat pumps are incentivized. The cost of a ductless system depends on the size of space to be heated, but a simple system (single head) will cost between $4,000 and $6,000 (before incentives). The system should pay for itself in about 7 to 10 years. Systems eligible for Solar Colwood product discounts and other government incentives can result in up to 52% systems cost savings, reducing payback to between 3.5-5 years.

Key Considerations

- North Cowichan can act as the coordinating organization (as is the case of Halifax Regional Municipality), or a facilitator (as is the case of Colwood) for the home energy program. We recommend the latter approach, partnering with Cowichan Energy Alternatives as the organizing body.
- The scope of the project can focus on energy efficient technologies and education.
- If renewable energy systems become viable, North Cowichan will need to manage potential liability risk for incorrect installs or malfunctioning equipment.

Timeline

Year 1: Review home energy programs in other jurisdictions and establish a framework for a local program.
Year 2: Organize, launch and market the home energy education program and first incentive program.
Year 3+: Add elements to the incentive program and monitor technologies and ROIs for renewable energy systems.

Potential Partnerships

- Cowichan Energy Alternatives
- Cowichan Green
- Local building contractor associations
- Local developers
- First Nations

Staffing

Year 4: 1 FTE
Years 5-8: 1 FTE

Potential Funding Sources

- FCM's Green Municipal Fund
- BC Hydro
- Local banks and credit unions
- Natural Resources Canada

Budget

Year 1: $40,000 (program development)
Year 2+: dependant on level of incentives

5. Establish a Community Energy Organization

Relevance

North Cowichan could benefit from an organization that can implement energy retrofits of residential and commercial buildings, produce renewable energy, development district energy projects and lead municipal efforts to reduce building-related energy use. The organization's mandate would be threefold: to reduce energy consumption, reuse waste energy and produce renewable energy in North Cowichan. It would be responsible for renewable and retrofit aspects of North Cowichan's community GHG target.

Innovation

Few municipal or community energy organizations exist in Canada. Best practices can be drawn from the Revelstoke Energy Corporation, Vancouver's Southeast False Creek Neighbourhood Utility and North Vancouver's Lonsdale Energy corporation, each of which provide district energy and other services.

Background

Energy is a critical element of the community GHG target but it is beyond the capacity of the Municipality to take on. A potential solution is to create a separate organization using one of a number of possible structures including a community owned co-operative, a municipally-owned non-profit corporation, a community contribution company, or corporation.

The mandate of the organization would be to work with the Municipality and other local partners in North Cowichan to:
1. Reduce energy consumption;
2. Reuse waste energy; and
3. Produce renewable energy.

One option is to run the organization as a unit of the municipality, parallel in structure and function to the operations of the community forest. The organization could be established in collaboration with BC Hydro, Cowichan Tribes and Duncan. Specific projects could rely on a mix of grants, investments by financial institutions and investments by citizens, if an appropriate legal mechanism is created. The organization would gain locally-specific knowledge of energy reductions and generation opportunities in North Cowichan and implement viable projects with a longer term horizon than conventional private sector investments. The municipality would provide financial support as well as creating enabling policies and regulations. Examples include implementing a Merton rule requiring solar hot water on new construction, or a district energy bylaw requiring dwellings in a certain area to connect to a district energy system, or providing financing for household renewable energy attached to municipal taxes if and when provincial legislation allows.

If the option of a municipal subsidiary is ruled out, It may be that Cowichan Energy Alternatives can fulfill this mandate, however it would need a closer relationship with the municipality and infusion of resources.

Key Considerations

- Providing renewable energy may implicate utilities regulation under the Utilities Commission Act from the perspectives of both energy production and land use regulation of energy installations. Two important exceptions are local governments providing energy services within their own boundaries and a landowner servicing only itself or its employees or tenants (an owner-operated building) as long as the service is not used by or resold to others.
- An alternative approach is to create a community energy co-operative. Examples in Canada include the Toronto Renewable Energy Co-operative, Peace Energy Co-operative and Vancouver Renewable Energy Co-operative.
- BC Hydro has a potentially similar mandate in terms of energy conservation. The mandate of this organization should be to reduce GHG emissions in North Cowichan.
- The organization could also partner with private business to provide energy services. For example, Peace Energy Co-operative partnered with private finance for a major wind farm while Lonsdale Energy Corporation has contracted Corix Energy to run its district energy system.

Timeline

Year 1: Establish terms of reference for a non-profit organization and establish the scope of work and service offering of the organization.
Year 2: Organization is established and a business plan is created.
Year 3: First project begins.

Potential Partnerships

- BC Hydro
- Fortis BC
- Cowichan Energy Alternatives
- Independent power producers
- First Nations

Staffing

Year 1+: 0.1 FTE

Potential Funding Sources

- FCM's Green Municipal Fund
- BC Hydro
- Local credit union and bank investors
- Community bonds

Budget

Year 1: $8,000 (0.1 FTE)
Year 2: $100,000 of start-up cost
Years 3+: unknown

6. Reduce Municipal Building Energy Use

Relevance

North Cowichan can cut energy costs, emissions and lead by example in addressing municipal building energy use.

Innovation

Energy audits, energy use tracking and fuel switching represent a comprehensive approach to building energy use reduction.

Background

GHG emissions and energy management generally follows a five step process:

1. Measure;
2. Identify reduction opportunities;
3. Implement;
4. Purchase offsets; and
5. Evaluate, and then begin again.

Reducing energy consumption is prioritized as this strategy both reduces operating costs and GHG emissions, whereas offsetting has a cost that may not benefit the community, if the offset project is not locally based.

Corporate Action: Perform Energy Audits on North Cowichan's 12 Major Facilities

The cost of an energy audit ranges from $5,000 -$20,000 and will identify on average the potential for 20% energy savings. As energy, mechanical and insulation technologies develop, regular energy audits will find increasing energy efficiencies. It is estimated that up to 20% energy savings could be achieved through audits, as well as improved air quality in the buildings. The estimated cost for the audits is $240,000 over four years.

Corporate Action: Track GHG Emissions of Municipal Buildings Using EPA's Energy Portfolio Manager

Natural Resources Canada (NRCan) has partnered with Environmental Protection Agency (EPA) to create a Canadian version of the Energy Portfolio Manager, available in spring, 2013. The Manager enables North Cowichan to track the GHG emissions of all its buildings and benchmark performance year over year while normalizing for weather and use changes. Benchmarking facilitates tracking energy retrofit performance and identifies problems or abnormal usage. Energy Portfolio Manager is available at no cost and free webinars are provided for training purposes.

Corporate Action: Phase out Natural Gas Use in Municipal Buildings, Starting with Fuller Arena

Phasing out the arena's natural gas use will have significant GHG and cost savings. The local building density is not such that geothermal energy is viable. There is an opportunity to capture waste heat generated by the arena for internal reuse for a variety of purposes. It is estimated that a feasibility study for energy use at the arena would cost $20,000. District or geothermal energy may be viable at the Cowichan Aquatic Centre and should be explored further. Heat pumps are also a viable energy system retrofit for the aquatic centre.

Key Considerations

- The sooner the building audits and energy transitions can occur, the sooner North Cowichan will reap energy savings benefits and progress towards its carbon neutral goal.
- There are different energy audit approaches with differing levels of thoroughness. Depending on the complexity of a building's energy systems, municipal staff can choose whether a base assessment is sufficient, or something more detailed (e.g.: ASHRAE level 1, 2 or 3) is required.

Timeline

Year 1: Perform building energy audits and Fuller Arena assessment; tweak energy systems according to outcomes.
Year 2: Begin using Energy Portfolio Manager; begin Fuller Arena energy transition.
Every 3-5 years: perform building energy audits.

Potential Partnerships

- BC Hydro
- Fortis BC
- local geoexchange energy equipment/service provider
- local energy auditors
- Ministry of Environment

Staffing

Variable, depending on in-house capacity for energy audits and energy use tracking.

Potential Funding Sources

- BC Hydro
- Fortis BC

Budget

$240,000 over four years for energy audits.
Costs associated with energy improvements as determined by energy audits.
$20,000 for an energy feasibility study for Fuller Arena, plus energy improvement and fuel switching costs.

All costs are expected to pay back in a reasonable time (i.e.: fewer than 20 years).

7. Create an Agricultural Development Centre

Relevance

Imported food transportation is a major source of GHG emissions in North Cowichan.[104] Local food and agriculture are key community priorities.

Innovation

While many municipalities are developing agricultural strategies or food security plans, the actual development of programs related to food security is a new area for municipalities in Canada

Background

With a moderate climate and long growing season by Canadian standards, the opportunity for local production and consumption of food in North Cowichan is significant, and builds on a strong agricultural history. Producing and consuming local organic foods is one of the top community priorities, as illustrated by the Cowichan Food Security Plan (2010), the Cowichan Food Charter signed by the Municipality of North Cowichan (2009) and the strong commitment within the OCP to protecting and enhancing agriculture in North Cowichan. Cowichan Green Community produces a "Buy Local Buy Fresh" map of local farms, a farm to school project and an urban farm project. The Cowichan Co-operative Creamery, set up in 1895, was the first dairy co-op in BC and was a major hub of the community until 1988. By the late nineteenth century farmers were producing a wide variety of crops on numerous small farms that were consumed locally and exported to other communities. North Cowichan has 6,119 hectares of Agricultural Land Reserve. All land in the ALR is considered good farming soil.

The concept for an Agricultural Development Centre is based on the structure and success of the Intervale Centre in Burlington, Vermont, a tried and tested model for significantly increasing the agricultural capacity of a region with a twenty year track record. Intervale Centre owns or manages 350 acres of farmland 1.5 km from the centre of Burlington. Its goals are to:

- Enhance the viability of farming;
- Promote the sustainable use and stewardship of lands; and
- Ensure community engagement in the food system.

An Agricultural Development Centre in North Cowichan can deliver similar programs to those of the Intervale Centre. A farms program can be established on municipally-owned agricultural land that removes start-up barriers to farming by providing access to training, land, capital and markets, knowledge of equipment operation and maintenance and reducing isolation. A local, permanent farmers market could be established and promotion could encourage purchase of locally sourced food. It could also provide support for urban garden and agriculture programs on private and public lands, thus helping to achieve some objectives stated in the OCP around developing community garden standards/guidelines and permitting horticulture in residential neighbourhoods. The centre could also help address the issue of farm succession planning, helping to pass family farm operations to the next generation of young farmers. The Centre would play a central role in increasing production of local food and making more local food available to consumers, resulting in decreased food-related GHG emissions.

An innovative funding mechanism could be created in which funds from development rights (density bonuses) are allocated to the Agricultural Development Centre.

110 It is estimated that food transportation accounts for 1.3 tCO2e per household. Weber, C., & Matthews, H. (2008). Food-miles and the relative climate impacts of food choices in the United States. Environ. Sci. Technol.

Key Considerations

- North Cowichan has a vibrant local food community. With support from the municipality, key barriers can be overcome and local farming can provide an increasing share of the local food requirements, as demonstrated by the Intervale Centre's experience.
- Partnering with existing local organizations will be key to ensuring the success of this initiative. The municipality has a key role to play in providing land and core funding, similar to the approach by the City of Burlington in founding the Intervale Centre.
- It is possible an organization exists that could champion and be responsible for this effort. The Agricultural Land Commission Act mandates the Agricultural Land Commission (ALC) to "work with local governments to accommodate, support and encourage farming on ALR lands." It is possible that the ALC could take primary responsibility of this project. If not, a new entity could be created by the Municipality or as a community group to take on the role.
- An asset to this process would be a survey of North Cowichan's ALR land to determine what areas are being farmed and what areas are available for increased farming activity. The ALC may be able to help in this endeavour.
- It is possible that existing farming practices could increase their farming intensity to grow more food on existing farmland. Crop biodiversity and permaculture approaches should be explored to achieve high output local crops.
- An agricultural development centre advances North Cowichan's mandate to reduce transportation-related GHG emissions, while supporting food security, an emerging, but as yet un-legislated mandate for local governments.
- Metro Vancouver has completed a business plan for a Farm Incubator program which can help inform North Cowichan's efforts.
- Creating a centre of this nature is a major endeavour but in addition to environmental benefits, it will yield economic and employment benefits, particularly for young people.

Timeline

Year 1: Build partnerships, identify land use and available land, draw from best practices, create a business plan.
Year 2: Establish a lead organization (create a new entity, if necessary). Perform an agricultural land survey.
Year 3: Issue a lease on municipal land to the organization.
Year 4: Agricultural Development Centre launches.

Potential Partnerships

- CVRD, City of Duncan
- Cowichan Green Community
- Cowichan Agricultural Society
- Ministry of Agriculture and Lands
- Agricultural Land Commission - Island Panel
- Vancouver Island university
- BC Association of Farmers Markets
- BC Young Farmers Association
- Certified Organic Associations of BC
- BC Agriculture Council
- Farm Management Canada
- First Nations

Staffing

Year 1: 0.5 FTE
Year 2: 0.5 FTE
Year 3: 0.5 FTE
Year 4: 0.5 FTE

Potential Funding Sources

- Gas Tax
- CVRD
- Ministry of Agriculture and Lands
- Portion of farmers market sales
- Farm Management Canada (scholarships)
- Federal government agriculture grants

Budget

Year 1: $100,000 (0.5 FTE, contract for a business plan)
Year 2: $40,000 (0.5 FTE)
Year 3: $60,000 (0.5 FTE plus legal costs)
Year 4: $200,000 (0.5 FTE plus start-up funds)
Year 5: $50,000/year ongoing costs

8. Increase North Cowichan's Forest Area

Relevance

North Cowichan has an abundance of municipally-owned forest. Increasing the volume of forest will add to the region's ability to act as a carbon sink and may attract carbon offset investment.

Innovation

No municipalities have implemented this type of project to date. The Capital Regional District is exploring the use of carbon offsets in order to purchase new lands for parks. Metro Vancouver has planted trees in regional parks as part of a carbon offset program.

Background

The District of North Cowichan's municipally-owned community forest is an unusual asset and provides a range of benefits including revenue, employment, recreation and potentially carbon offsets. There are four strategies that form a comprehensive increased forest area strategy for North Cowichan.

Rural afforestation: North Cowichan can work with land-owners to incentivize increasing forest cover. Such a program could involve a partnership with an external third party, such as ERA Ecosystem Restoration Associates, that would be able to sell offsets from the project, or simply provide free trees to targeted property owners. Co-benefits would include improved capacity for natural stormwater management, improved air quality, fruit harvesting (depending on tree varieties) and habitat creation.

Urban forestry strategy: An urban forestry strategy and tree bylaw can protect existing trees and forested areas in urban areas while encouraging new planting. The Municipality, citizens and not-for-profit groups (e.g.: Scouts Canada) can all contribute to new tree planting along roads, sidewalks, and certain properties. In addition to being a carbon sink, increased urban tree cover adds benefits including reduced air pollution, reduced heat island effect, natural stormwater management, fruit harvesting (depending on tree varieties), and aesthetic. Trees can be provided for free to residents for planting.

Increase the area of the municipal forest: There are limited options available for increasing the municipal forest area. Purchasing land from private owners or forestry companies is unlikely in the near term given the lack of opportunity and the current market price of land. This option should be considered in the future in case circumstances change.

Investigate forest carbon offset programs: The Nature Conservancy of Canada (NCC) led an innovative project to develop a forest management methodology for quantifying the amount of carbon stored in temperate and boreal forests with timber harvesting. The methodology was validated by the Verified Carbon Standard. NCC purchased Darkwoods forest in 2008 from Pluto Darkwoods Forestry Corporation in the Kootenays - an area of 136,000 acres. This eliminated the possibility of mass-logging the area, thus making the land a perpetual carbon sink. A small-scale harvest operation still continues on the land. The forest was used for the sale of carbon offset credits to Pacific Carbon Trust. The first sale of Darkwoods carbon credits was completed in May 2011, raising in excess of $4 million for conservation. This initial transaction involved the sale of 700,000 tonnes of carbon offsets. A similar strategy and methodology could be investigated for North Cowichan's municipal forests.

Key Considerations

- The sale of carbon offsets resulting from improved forest management projects have attracted some controversy, relating to the nature of offsets and whether forests actually represent a long-term GHG reduction. However, given the rigour of the approach developed by the Nature Conservancy of Canada, we recommend investigating this avenue.
- North Cowichan's forest has historically generated revenues for the municipality. If the rate of cut were reduced under an EBM harvesting regime, revenues would be reduced. Carbon offset revenues are unlikely to fully offset reduced harvesting revenues, but can provide an additional source of revenue and support forest restoration efforts.
- North Cowichan's community forest provides a range of ecosystem services that are increasingly valued in economic terms. These include clean water, removing air pollution, providing recreation areas, etc. (see the World Bank's WAVES partnership, 2012). Valuing these benefits can clearly demonstrate the case for continuing to manage and enhance the community forest.
- Forest fires are a risk identified in the climate change adaptation research and the interface between forests and existing and potential development needs to be carefully considered.
- There may be opportunities to expand North Cowichan's forestry activities. A larger community forest can create opportunities to provide biomass for a future district energy system.
- Additional forest land purchase would increase the volume of forest for this endeavour. If found to be economically viable, North Cowichan could purchase forest land within its boundaries or in other parts of the CVRD.

Timeline

Year 1: Establish partners in all programs. Begin GIS mapping of standing timber.
Year 2: Carbon offset feasibility and initiate new tree planting.
Year 3: Increase partners and double number of new trees planted; Implement new tree health monitoring program.
Develop an urban forestry strategy with the help of a consultant.
Year 4 onwards: Look for forest land purchase opportunities.

Potential Partnerships

- CVRD
- Cowichan Green Community
- Cowichan Agricultural Society
- City of Duncan
- Ministry of Agriculture and Lands
- Vancouver Island university
- Nature Conservancy of Canada
- Private land owners
- Forestry companies

Staffing

No change.

Potential Funding Sources

- Gas Tax
- Ministry of Agriculture and Lands
- Pacific Carbon Trust
- Carbon offset purchases

Budget

Year 1: No additional budget required.
Year 2: $25,000 (consultant to explore the option of carbon offsets); money required to purchase new plantings.
Year 3: Money required to purchase new plantings, implement a tree health monitoring program, and develop an urban forestry strategy (~$50,000).
Year 4 onwards: Dependent on land purchase options.

9. Establish a Green Revolving Loan Fund

Relevance

In order to achieve the GHG targets, a wide range of community and municipal sustainability projects will be required, and they will need start-up and support financing. A green revolving loan fund is a mechanism to facilitate the development of innovative sustainability projects.

Innovation

GRLFs are a financing structure that is not prone to annual budgetary battles that often mean investments in sustainability projects with long returns on investment are neglected.

Background

Green revolving loan funds (GRLFs) are an important municipal lever for the implementation of sustainability plans. They provide a locked-in mechanism for continuing finance for sustainability project implementation. Once established, these funds should have a life beyond political and staff turnover. Additionally, the funds remain on the municipal books as an asset, generating returns in terms of energy cost savings as well as GHG reductions. It is suggested that a 1% tax revenue allocation (i.e.: ~$12 per household) is used to build up the fund (~$225,000/year for 4 years) and that these dollars are used to leverage other sources such as FCM's Green Municipal Fund.

The GRLF will have two criteria:

1. The fund must finance measures to reduce resource use (e.g.: energy, water, materials) or to mitigate carbon emissions (e.g. renewable energy developments); and
2. The fund must revolve. Savings generated by reducing operating costs are tracked and used to repay the fund (thus providing capital for future projects).

The GRLF will address the following barriers:

- Inability to secure necessary capital through typical city operating and capital budgeting process, even when there is a business case for a project.
- Perceived technology risk. Many resource efficiency technologies are new, or may be perceived as new by city staff , Council or others, and therefore benefits are discounted.
- Risk aversion in capital investments. This reflects a justifiable and appropriate caution with public funds.
- Hidden costs and 'hassle' costs. A lack of familiarity among city staff with resource efficiency opportunities and technologies can create hidden costs in training, research and staff time, effectively increasing the costs of projects and creating a need for shorter paybacks.

The GRLF can be used to finance energy retrofits of North Cowichan buildings or buildings in the community, to purchase electric vehicles or to establish renewable energy projects, etc. The savings or revenue generated by these projects flows back into the fund so that it can continue to finance projects.

Key Considerations

- There are two key aspects to a revolving loan fund: finding the seed capital and ensuring that there is sufficient expertise to manage it.
- Revolving loan funds have proven very effective at reducing energy costs and GHG emissions while unlocking investment potential.

Timeline - RGLF

Year 1: Terms of reference for a fund, design of fund by a consultant.
Year 2: Establishment of the fund through seed funding.
Year 3: Fund begins operations, funding first projects.

Potential Partnerships

- CVRD
- Other local governments
- Community Futures
- PICS

Staffing

Year 1: No additional staff
Year 2: 0.5 FTE
Year 3: 1 FTE

Potential Funding Sources

- BC Ministry of Energy
- BC Hydro
- Fortis BC
- FCM Green Municipal Fund
- Local credit unions and banks
- Family foundations
- Western Development Canada

Budget

Year 2: $40,000 (0.5 FTE)
Year 3-6: $80,000 (1 FTE), ~$225,000 (1% of tax revenues) to a fund
Year 7-8: $80,000/year (1 FTE)

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6.2 Recommended Climate Change Adaptation Actions

North Cowichan's work on climate change impacts and adaptation begins from a strong position. There is a well-developed foundation for adaptation and implementation in the region, where forward thinking is evident in the approach taken to various plans and measures. Key strengths include:

- Experience in collaborative planning and action on flood and water management planning, emergency management and other issues in common with the CVRD and other partners;
- Previous planning that has taken an integrated and whole system approach;
- Recently completed plans reflect best practices to address key risks expected to increase under climate change scenarios, including flood, water and wildfire management;
- Experience implementing integrated stormwater management measures, with a supportive regional learning network;
- Existing mapping of numerous hazards and vulnerabilities;
- Existing policies and provisions that apply to adaptation issues; and
- Increasing integration across departments within North Cowichan, enabling more responsive, proactive and integrated planning and management.

The climate change adaptation analysis in this document provides a starting point for integrating a more robust approach to adapting to climate change into everyday business for North Cowichan. This means applying a climate change adaptation lens to standard practices and processes, and exploring the details of embedding these directions into policy, regulations and operations.

The following seven action and monitoring strategies are concrete steps that the DNC can take to enhance the adaptive capacity and resilience of its operations, and the community as a whole, to a changing climate.[111] It is expected that these activities can be completed by existing municipal staff at no extra cost. A complete list of climate change adaptation actions can be found in Appendix 5. Additional ideas and inspiration for some of these actions can be found in the Best Practices document prepared for this project in Appendix 6.

111 An international review of climate change adaptation planning (Kazmierczak and Carter 2010) identifies various factors to successful implementation, including:

- Collaboration with external stakeholders
- Strong leadership or championship
- Access to funding
- Awareness levels within the organization
- Outsourcing research and other actions
- Human resources and skills
- Public awareness and engagement
- Quality and availability of information and data
- Position of adaptation on the list of priorities
- Development of local regulations and policies

1. Create a Working Group to Carry Forward Adaptation Planning and Implementation

The Working Group would focus specifically on climate change risks and strategies for adaptation. The working group would be internal with representation from relevant departments, including finance. Its focus would be on educating staff about climate change risks and how they are relevant for municipal operations and on prioritizing municipal actions and ensuring that all infrastructure and development projects address climate risk. The Working Group can prioritize the climate change adaptation actions compiled in Appendix 5.

2. Mainstream Adaptation into Existing Planning, Operations and Decision-Making Processes

The municipality can take a number of steps to ensure that the organization is responding to climate risk in a systematic manner:

- Involving staff in identifying opportunities for integrating a climate change lens into routine decisions and operations;
- Including a line item for climate change adaptation considerations in all major staff reports to Council;
- Identify climate change risk and adaptation in the job description of staff members;
- Assigning a lead to priority actions;
- Including adaptation in the next OCP review;
- Reviewing and updating DPA guidelines;
- Integrating climate change adaptation into financial, infrastructure and capital planning; and
- Advancing measures that:
  - Are no-regrets measures (of value even in absence of climate change);
  - Are measures with multiple benefits; and
  - Address issues that are already of concern and will be heightened by climate change.

3. Identify High Priority Risks and Opportunities Requiring Additional Research and Analysis to Define and Prioritize Actions

Five areas were identified as priorities for further study in our discussions around climate change adaptation. These areas could be completed as one study are as stand alone efforts and this analysis will help inform action planning:

- Biodiversity and ecosystem restoration;
- Aquifer vulnerability;
- Updating hazard maps;
- Coastal and intertidal zones; and
- Detailed infrastructure assessment.

4. Engage Stakeholders and Citizens

Climate change adaptation is a new challenge facing communities and municipal governments. Engaging the community will help broaden the understanding of this challenge and build local capacity to respond. An extensive engagement is not recommended in the short term, but the development of a component of the municipal website on the issue and the preparation of a backgrounder following the completion of further study as initial steps. Next steps include:

- Involving a range of stakeholders and citizens in conducting a vulnerability assessment and developing adaptation options.
- Maintaining ongoing reporting and outreach with the community.

5. Establish and Maintain Partnerships and Networks

North Cowichan can request that CVRD and CRD work together to create a regional roundtable on climate change adaptation. Such an effort will serve to transfer knowledge and approaches between municipalities and create the opportunity for coordinated actions. Other partners include Vancouver Island University for research, Vancouver Island Health Authority and emergency management teams.

6. Identify Funding Opportunities and Strategies

A key focus is incorporating climate change adaptation measures into existing projects without increasing the financial burden on the municipality. In order to support analysis and prioritization of strategies and the implementation of stand-alone projects, North Cowichan can pursue pilot funding which is available from Natural Resources Canada as well as partnering with Vancouver Island University.

7. Commit To Monitoring, Reporting and Revision of Climate Change Adaptation Strategies

As climate risk and adaptation is a new field , ongoing learning and evaluation is critical. The municipality can prepare an annual report that documents what has been undertaken and lessons learned in the process. This process will be invaluable as climate impacts become more severe.

Recommended Climate Change Actions Summary

These actions are bold moves for North Cowcichan. Each require significant resources and all are critical to achieve a target of 25% below 2007 levels by 2025 (80% emissions reductions below 2007 levels by 2050). The most aggressive and comprehensive actions focus on the transportation sector as this is the source of the majority of North Cowichan's emissions. Additional ideas and inspiration for some of these actions can be found in the Best Practices document prepared for this project in Appendix 5.

In addition to working toward its energy and emissions targets, implementing these actions would make North Cowichan a world leader in small to medium-sized town climate change action. We recommend joining the carbon*n*® Cities Climate Registry (cCCR). The cCCR supports the global credibility of local climate action by ensuring comparability, transparency and accountability. Local Governments involved in the process will have continuous support in capacity and knowledge development through the services of the Bonn Center for Local Climate Action and Reporting – carbonn®. Joining this initiative will also encourage North Cowichan to do its very best in climate change planning, along with hundreds of other cities around the world.

8 In Closing

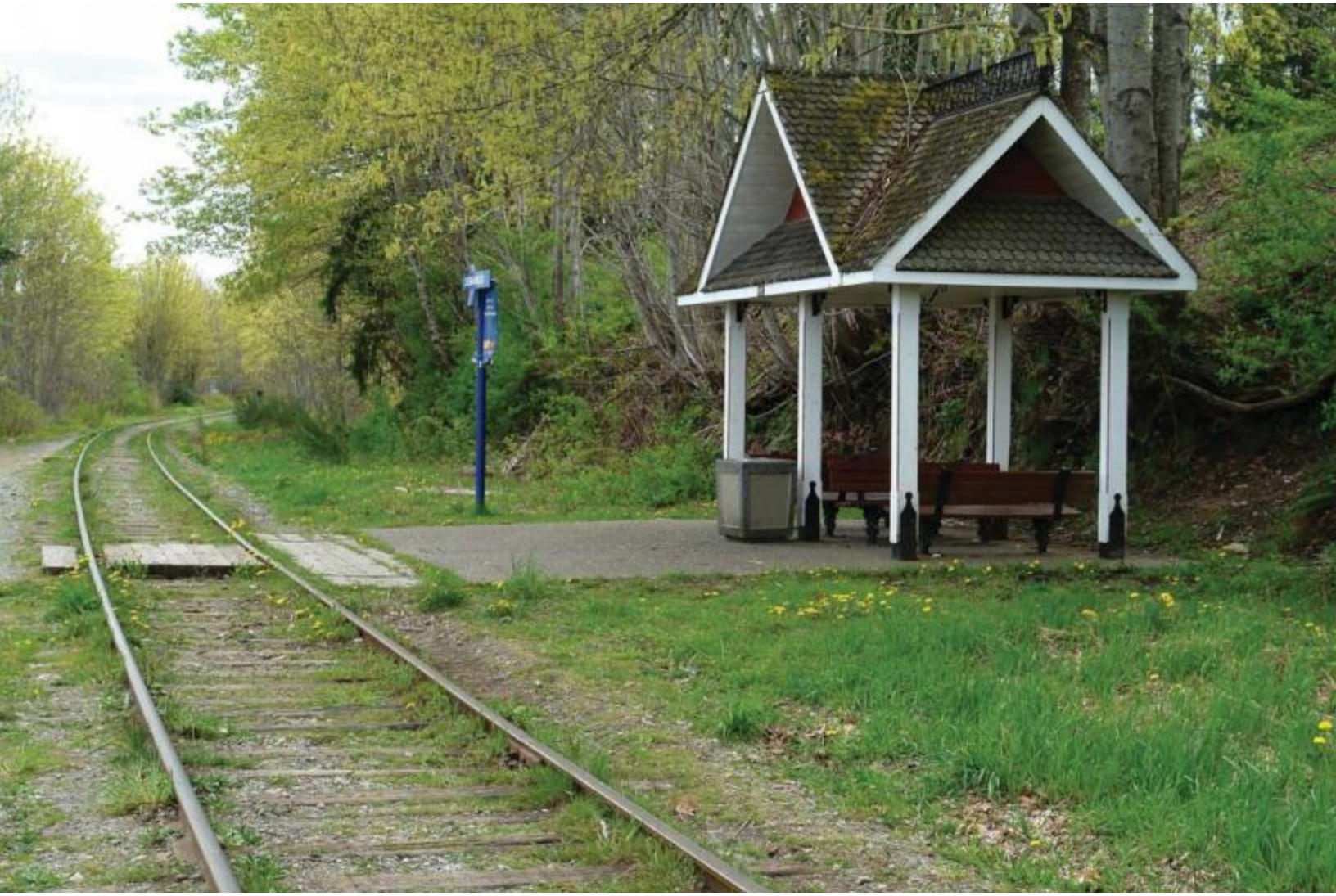

Howe Sound Queen

North Cowichan has a number of remarkable assets including a mild climate, a municipally-owned forest in the coastal-douglas fir zone, and a highly engaged community that has already laid the foundation for a green economy in North Cowichan. The Climate Action and Energy Plan builds on and broadens previous planning efforts and identifies additional community assets in the context of reducing GHG emissions by 33% under 2007 levels by 2025 (80% under 2007 levels by 2050).

In developing the Climate Action and Energy Plan, the consulting team was able to meet many community members. Conversations with them were thoughtful and insightful, focussed on addressing the challenges - and opportunities - presented by climate change. It is clear that North Cowichan has a rich resource in its active and informed citizenry.

Achieving substantial GHG reductions in North Cowichan will be a major challenge, probably the most significant effort undertaken by the municipality to date. Implementing the CAEP recommendations will take the municipality into new realms: providing renewable energy sources, supporting energy retrofits, transitioning to electric vehicles, shifting behaviour change related to transportation, and so forth. Monitoring and evaluating the program will enable the Municipality to build on its experience and increase the effectiveness of its projects. The most important aspect of the effort will be building partnerships with not-for-profit organisations, businesses, Vancouver Island University, Cowichan Tribes and others.

North Cowichan is not alone in this journey and there is much to be gained by cooperating with neighbouring municipalities and even distant ones. The Copenhagen City Climate Catalogue lists GHG targets for 2,903 communities globally and many have as ambitious or even more ambitious targets than North Cowichan, including Toronto (80% by 2050), Aarhous, Denmark (Carbon neutral by 2030), Achim, Germany (50% by 2030), and Aspen, Colorado (80% by 2050). All of these municipalities will be able to exchange advice and support with North Cowichan in its endeavour to mitigate its greenhouse gas emissions, adapt to climate change effects, bolster an emerging green economy and create a high quality of life for its citizens.



Appendix 1:
Green Economy Mapping Exercise Elements

This content follows from Section 3.6 and includes the detailed outcomes of the green economy mapping exercise conducted at the first public event. Participants identified elements of North Cowichan's green economy elements on maps, as indicated in the following tables. The numbers in brackets indicated how many elements were identified in that category.

Clean Transportation

Participants identified 29 clean transportation map elements.

Clean Transportation Elements			
Automobile Related (8)	**Bicycle Related (9)**	**Trails (12)**	**Other (1)**
• Carpool parking lots • Co-op gas station • Cowichan Biodiesel Co-op • Park and ride lots	• Bicycle sales and repair • Cowichan Recyclists • Cowichan Green Community	• Trans Canada Trail • Rail Corridor • Park trails • Dike trail & Seawalk	• Rail corridor infrastructure

Sustainable Land-use

Participants identified 73 sustainable land-use elements.

Sustainable Land-use Elements			
Farmers Markets (9)	**Farms (49)**	**Forests (8)**	**Gardens (10)**
• Vegetable markets • Meat markets • Community farm store	• Organic farms • Produce farms • Meat and/or dairy farms • Vineyards & wineries	• Gerry oak preserve • Echo Heights forest • Municipal forest reserve • Somenos wildlife area	• School gardens • Community gardens

Green Building

Participants identified 12 green building elements.

Green Building Elements		
Alternative Construction (2)	**Certified Green Buildings (4)**	**Green Renovation (6)**
• Modular homes • Cob home	• Leadership in Energy and Environmental Design (LEED) • Built Green	• Green renovated homes

Green Investment

Six green investment elements were identified.

Green Investment Elements	
Banking (5)	**Investing (1)**
• Credit unions	• Valley Investment Group

Renewable Energy Sites

Participants identified 25 renewable energy sites.

Renewable Energy Elements			
Biofuel (5)	**Geo-exchange Energy (6)**	**Solar (13)**	**Wind (3)**
• Cowichan Energy Alternatives • Sewage lagoons • Catalyst paper mill • Farm biogas digester • Biodiesel co-op	• VIU system • Home systems • Farm systems	• Home systems • School systems • Farm systems	• Home systems

Green Services

Participants identified 38 green economy services.

Green Services Elements
Miscellaneous (38)
• Second hand item retailers • Not for profit societies • Green product manufacturers and retailers • Forestry, ocean and habitat service organizations • Renewable resource industries • Renewable energy service providers • Organic food providers • Outdoor activity providers • Waste management services • Repair services

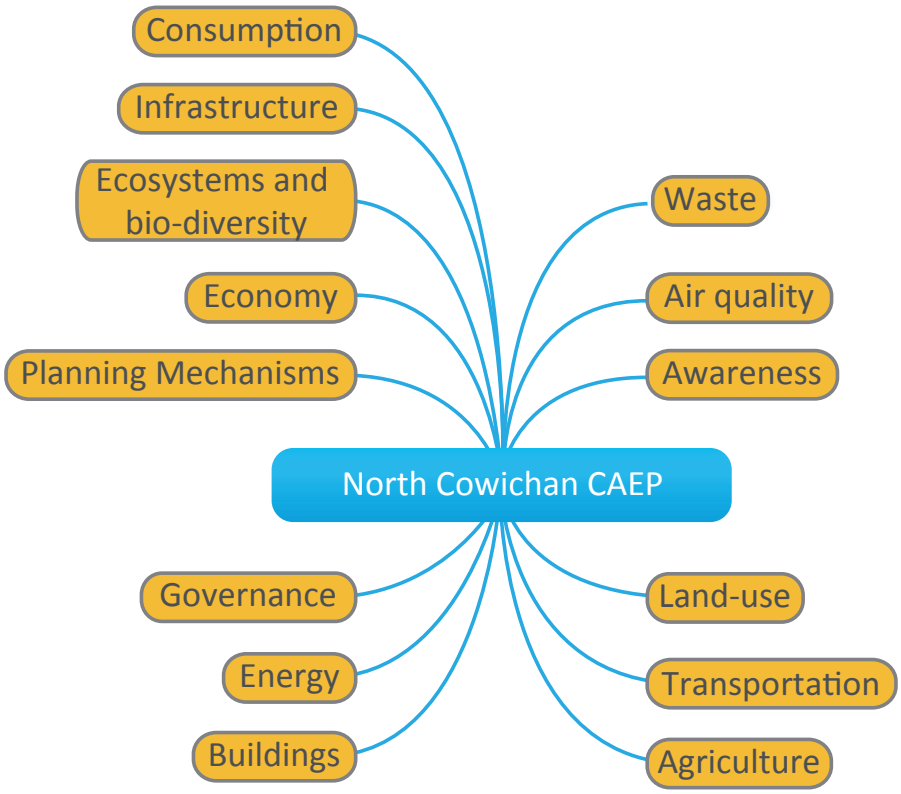
Waste Management

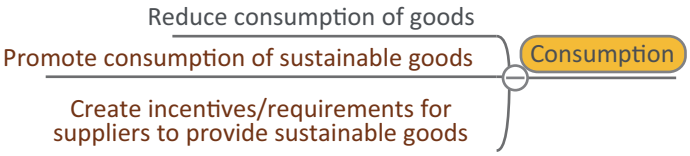
Participants identified 18 waste management elements.

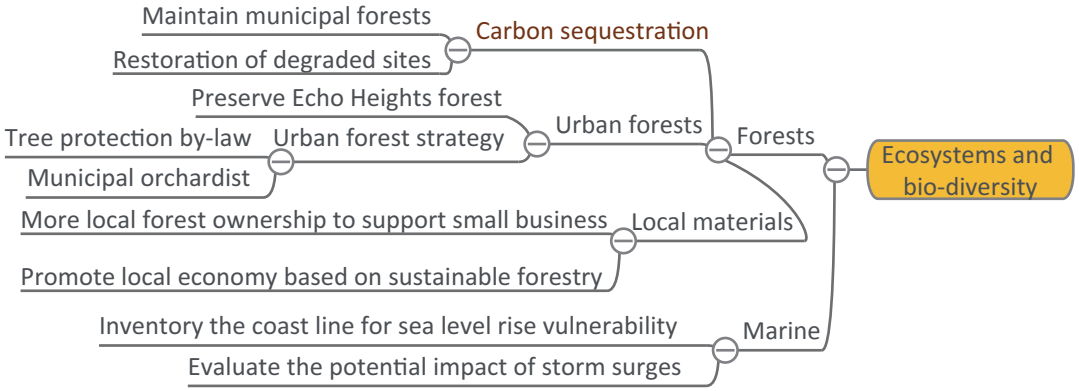
Waste Management Elements
Miscellaneous (18)
• Recycling services • Solid waste management • Water treatment • Composting facilities • Bottle return facilities

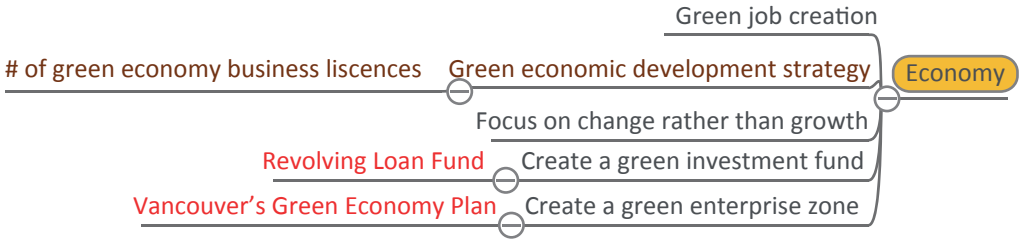
Appendix 2: Sustainability Ideas Mind Map

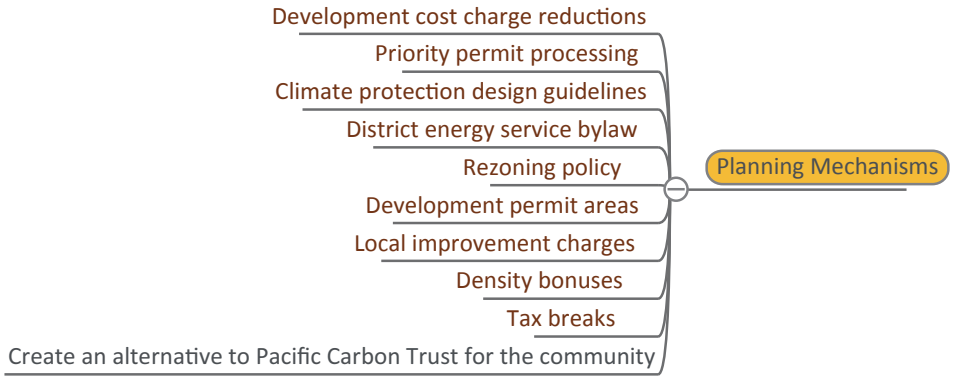
This content follows from Section 4.2. The following mind maps were used to organize the sustainability action ideas collected from public event participants, IdeaScale participants, municipal staff and the consulting team. In the expanded mind maps, black text indicates an idea from a North Cowichan resident, brown indicates an idea from the consulting team, and red text indicates a known application of the idea in another jurisdiction, from which we can draw inspiration and implementation details.

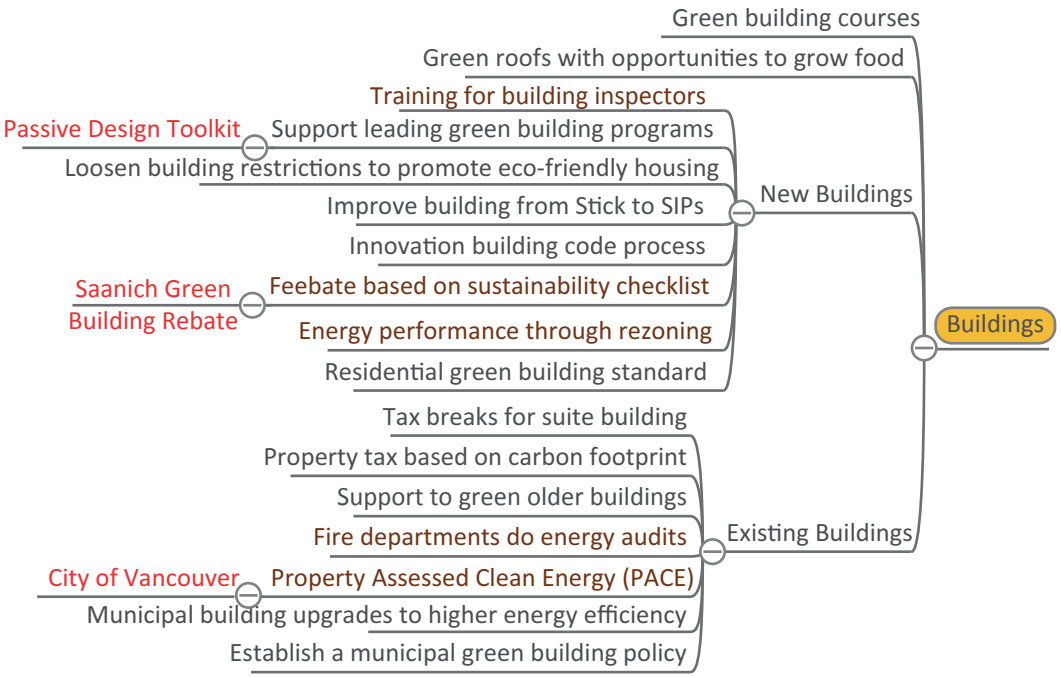


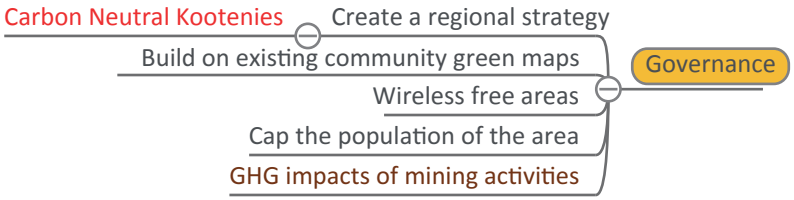

Reduce consumption of goods
Promote consumption of sustainable goods
Create incentives/requirements for suppliers to provide sustainable goods
Consumption

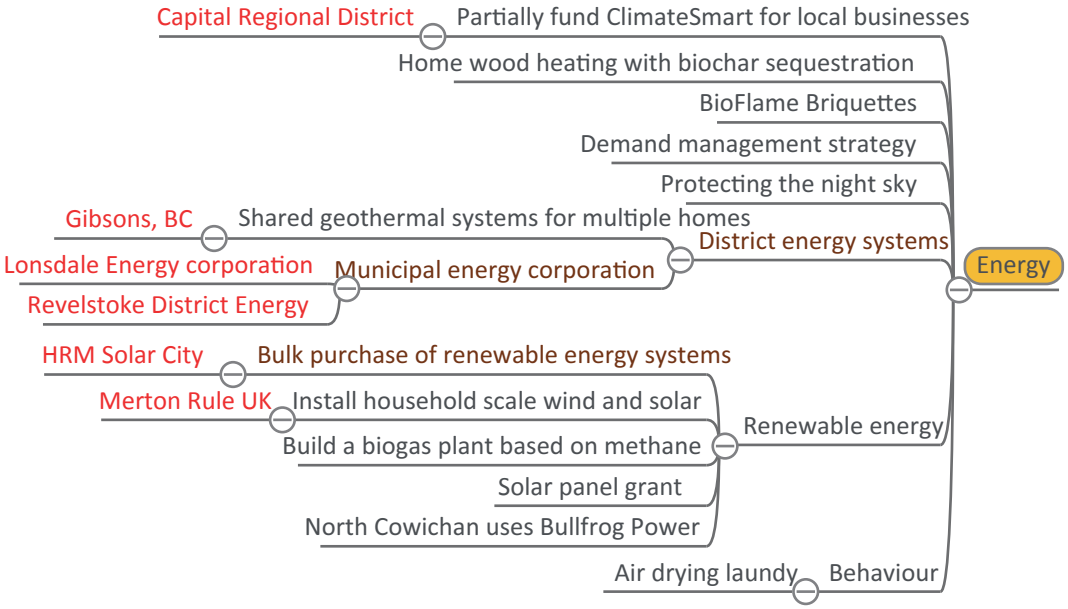

Maintain municipal forests
Restoration of degraded sites
Carbon sequestration
Preserve Echo Heights forest
Tree protection by-law
Urban forest strategy
Municipal orchardist
Urban forests
Forests
Ecosystems and bio-diversity
More local forest ownership to support small business
Local materials
Promote local economy based on sustainable forestry
Inventory the coast line for sea level rise vulnerability
Evaluate the potential impact of storm surges
Marine

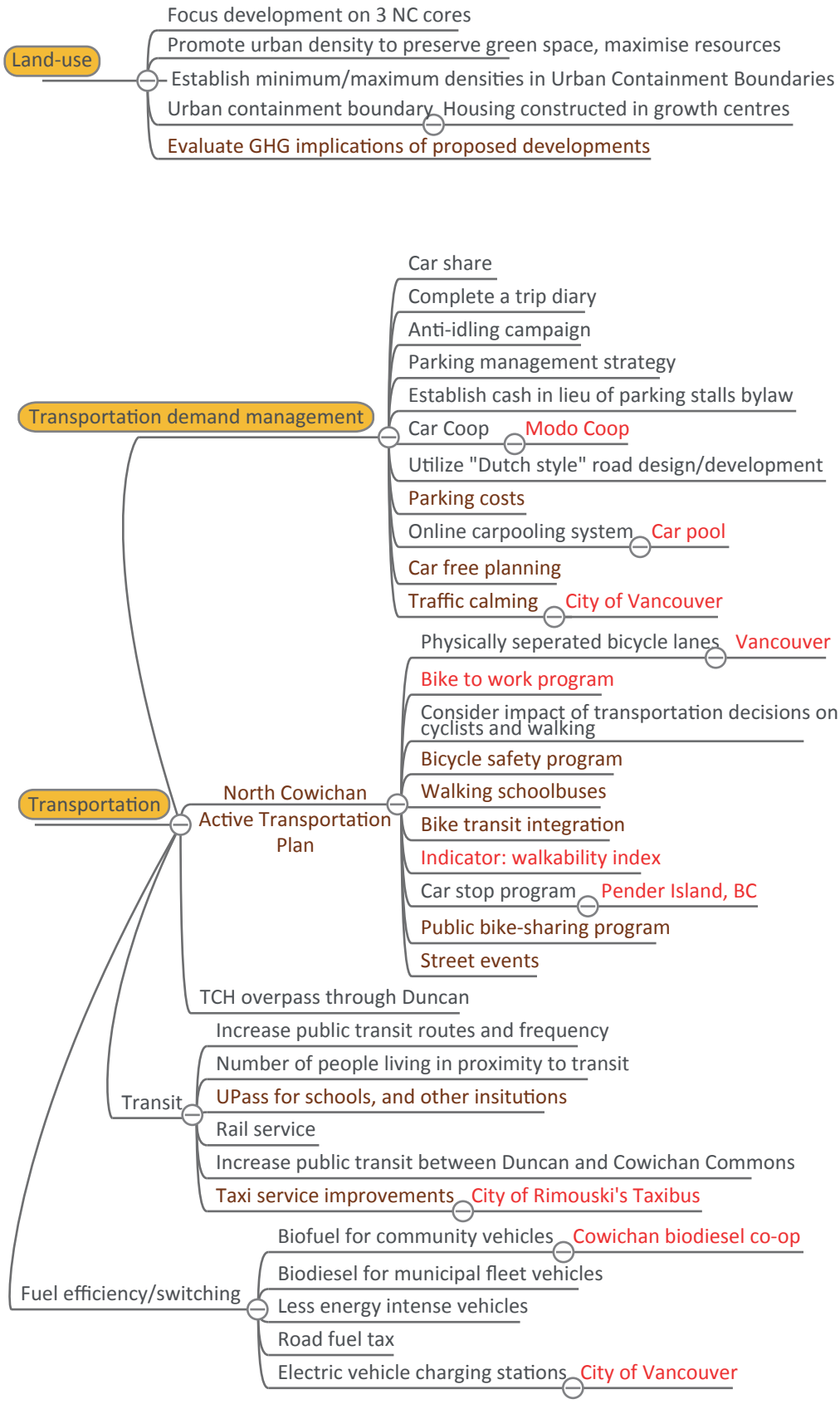

Green job creation
# of green economy business liscences
Green economic development strategy
Economy
Focus on change rather than growth
Revolving Loan Fund
Create a green investment fund
Vancouver's Green Economy Plan
Create a green enterprise zone

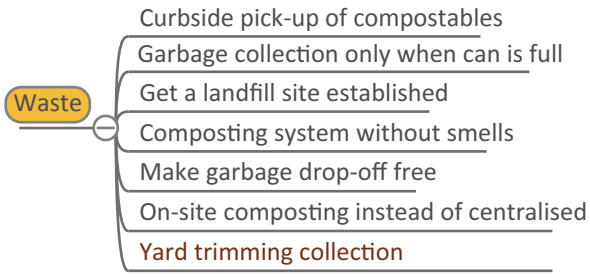

Development cost charge reductions
Priority permit processing
Climate protection design guidelines
District energy service bylaw
Rezoning policy
Development permit areas
Local improvement charges
Density bonuses
Tax breaks
Create an alternative to Pacific Carbon Trust for the community
Planning Mechanisms


Green building courses
Green roofs with opportunities to grow food
Training for building inspectors
Passive Design Toolkit
Support leading green building programs
Loosen building restrictions to promote eco-friendly housing
New Buildings
Improve building from Stick to SIPs
Innovation building code process
Saanich Green Building Rebate
Feebate based on sustainability checklist
Energy performance through rezoning
Residential green building standard
Buildings
Tax breaks for suite building
Property tax based on carbon footprint
Support to green older buildings
Fire departments do energy audits
Existing Buildings
City of Vancouver
Property Assessed Clean Energy (PACE)
Municipal building upgrades to higher energy efficiency
Establish a municipal green building policy

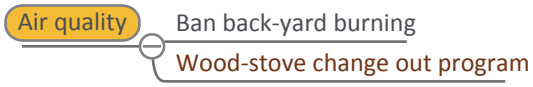

Carbon Neutral Kootenies
Create a regional strategy
Build on existing community green maps
Governance
Wireless free areas
Cap the population of the area
GHG impacts of mining activities

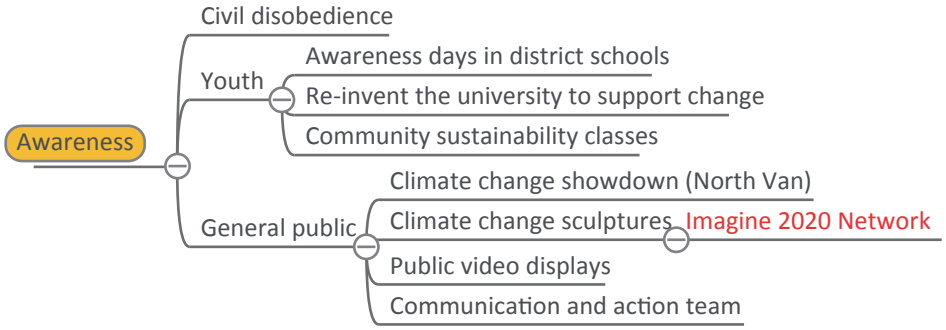

Capital Regional District
Partially fund ClimateSmart for local businesses
Home wood heating with biochar sequestration
BioFlame Briquettes
Demand management strategy
Protecting the night sky
Gibsons, BC
Shared geothermal systems for multiple homes
District energy systems
Energy
Lonsdale Energy corporation
Municipal energy corporation
Revelstoke District Energy
HRM Solar City
Bulk purchase of renewable energy systems
Merton Rule UK
Install household scale wind and solar
Renewable energy
Build a biogas plant based on methane
Solar panel grant
North Cowichan uses Bullfrog Power
Air drying laundy
Behaviour


Land-use
Focus development on 3 NC cores
Promote urban density to preserve green space, maximise resources
Establish minimum/maximum densities in Urban Containment Boundaries
Urban containment boundary
Housing constructed in growth centres
Evaluate GHG implications of proposed developments
Transportation
Transportation demand management
Car share
Complete a trip diary
Anti-idling campaign
Parking management strategy
Establish cash in lieu of parking stalls bylaw
Car Coop
Modo Coop
Utilize "Dutch style" road design/development
Parking costs
Online carpooling system
Car pool
Car free planning
Traffic calming
City of Vancouver
North Cowichan Active Transportation Plan
Physically seperated bicycle lanes
Vancouver
Bike to work program
Consider impact of transportation decisions on cyclists and walking
Bicycle safety program
Walking schoolbuses
Bike transit integration
Indicator: walkability index
Car stop program
Pender Island, BC
Public bike-sharing program
Street events
TCH overpass through Duncan
Transit
Increase public transit routes and frequency
Number of people living in proximity to transit
UPass for schools, and other insitutions
Rail service
Increase public transit between Duncan and Cowichan Commons
Taxi service improvements
City of Rimouski's Taxibus
Fuel efficiency/switching
Biofuel for community vehicles
Cowichan biodiesel co-op
Biodiesel for municipal fleet vehicles
Less energy intense vehicles
Road fuel tax
Electric vehicle charging stations
City of Vancouver


Waste
Curbside pick-up of compostables
Garbage collection only when can is full
Get a landfill site established
Composting system without smells
Make garbage drop-off free
On-site composting instead of centralised
Yard trimming collection


Agriculture
Land protection
Add to the ALR
More community gardens
Education
Grow more food
More local organic food
% of food locally consumed
Local Food Action Plan, Niagra Region
Farm skills and nature awareness education
Vancouver School Board
Agricultural centre
Intervale Center, Vermont
Infrastructure
Permanent Farmers Market facility
Halifax Seaport Farmers Market
Livestock and small animals auction
Municipal reserve fund for agriculture
Encourage agro-forestry on municipal land


Air quality
Ban back-yard burning
Wood-stove change out program


Awareness
Civil disobedience
Youth
Awareness days in district schools
Re-invent the university to support change
Community sustainability classes
General public
Climate change showdown (North Van)
Climate change sculptures
Imagine 2020 Network
Public video displays
Communication and action team

Appendix 3: GHGProof Assumptions

All assumptions are available in the open source GHGProof model. Wherever possible SSG has used assumptions based on local studies, analysis or research. All other assumptions are derived from the relevant academic literature. For more information on these assumptions, see the GHGProof literature review in the GHGProof section of SSG's website.[112]

Investment assumptions

When costs are modelled in GHGProof, we refer to the total community investment costs. These costs are not necessarily borne by the municipality.

Investment cost	$	Units	Source
Renewable energy	36	$/GJ	EA Energy Analytics, 2012 (i)
Residential retrofit	10	$/GJ	(Cohen et al, 1991, with allowance for an escalation in costs)
Commercial retrofit	50	$/GJ	Mix of lighting and HVAC retrofit costs (See Prism, 2010)
District energy	7	$/GJ	EA Energy Analytics, 2012 (ii)
Recycling	50	$/tonne	BC Ministry of Environment, 2012
Landfill gas	10	$/tCO2e	Golder Associates, 2008
Liquid waste upgrade	400	$/household	Strategic Alternatives, 2006
Local food consumption	15,000	$/ha	Based on costs of a start-up market garden
Agricultural practices change	6	$/ha	There will be some costs to switching to conservation tillage but many studies indicate that there will be savings (Statistics Canada, 2005).
Reforestation	1,000	$/ha	Natural Resources Canada, 2010

Employment assumptions

Strategy	Employment			Units	Source
	Direct	Indirect	Induced		
Densification	22	-	-	Jobs/hectare	Howland, 2007
Residential retrofit costs	4.6	4.9	3.8	Jobs/$million	CCPA, 2010
Commercial retrofit costs	7.0	4.9	4.8	Jobs/$million	CCPA, 2010
Renewable energy	4.6	4.9	3.8	Jobs/$million	CCPA, 2010
Recycling-investment	6.73	3.51	3.22	Jobs/$million	CCPA, 2010
Landfill gas	6.73	3.51	3.22	Jobs/$million	CCPA, 2010
Liquid waste upgrade	6.73	3.51	3.22	Jobs/$million	CCPA, 2010
Local food consumption	0.5	-	-	Jobs/hectare	Local expertise
Reforestation	0.1	-	-	Jobs/hectare	Local expertise

112 http://www.sustainabilitysolutions.ca/resources/GHGproof/reports

References

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Natural Resources Canada (2010). The economics of salvage harvesting and reforestation in British Columbia's mountain pine beetle-affected forests. Retrieved from: http://publications.gc.ca/collections/collection_2011/rncan-nrcan/Fo143-2-425-eng.pdf. [We used a value at the low end of total reforestation costs].

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Appendix 4: Suggested Guidelines for Coastlines in DPA-4

Sea level rise (SLR) and other climate change impacts will affect risks to properties along the coastline. Land development activities must be carried out in consideration of the following:

- Proposed developments include consideration of climate change impacts (sea level rise, storm surge, wave effects) in definition of the flood construction level for a particular site. This should be done in accordance with the guidelines provided in the BC Ministry of Environment's "Guidelines for Management of Coastal Flood Hazard Land Use," [113] and include documentation of:
    - Estimated location of the Natural Boundary ("Flood Construction Reference Plane" (FCRP[114])) in 2100, with consideration of sea level rise and wave effects for given shoreline type
    - Flood Construction Level (FCRP + 0.6m freeboard)
    - Setback line (the greater of 15m from the FCRP, or the FCL contour elevation; greater setbacks required for coastal bluff areas)
- Proposed developments must register a covenant on title of new buildings or properties to require buildings and land uses to adapt to future SLR and FCL requirements.
- Where a coastline setback renders a property totally undevelopable, the setback may be reduced provided that:
    - the development is to be located only where there is no risk to life;
    - a geotechnical report from a professional engineer certifies that the land may be used safely for the intended use and provides measures to safeguard buildings from flood or erosion damage;
    - environmental factors such as building siting, placement of fill, soil disturbance, shoreline restoration measures have been considered; and
    - a Save Harmless Covenant is registered in favour of the Municipality.
- Redevelopment in areas below the adjusted 2100 levels must register a Save Harmless Covenant in favour of the Municipality
- Shoreline stabilization should be limited to that necessary a) to prevent damage to existing structures or established uses on adjacent upland; or b) to prevent damage to a proposed public land use.
    - Where possible, stabilization measures should be designed to improve ecological shoreline functioning. Shoreline modifications should incorporate all feasible measures to protect ecological shoreline functions and ecosystem-wide processes.
    - New upland structures or additions should be located and designed to avoid the need for shoreline stabilization.
- Consider use of building materials, siting, building orientation and other measures to reduce potential damage to the property due to extreme weather
- Proposed strategies and measures for adapting to projected climate change impacts
- New shoreline developments are encouraged to meet requirements for climate change adaptation as described in the "Greenshores Coastal Development Rating System"[115]

113 Ausenco Sandwell . 2011. Guidelines for Management of Coastal Flood Hazard Land Use. BC Ministry of Environment, Victoria, BC. 45pp.

114 As defined in Ausenco Sandwell 2011: Flood Construction Reference Plane (FCRP) = Designated Flood Level (DFL) + Estimated Wave Effect Designated Flood Level (DFL) = Future SLR Allowance + Maximum High Tide (HHWLT) + Total Storm Surge during Designated Storm

115 Greenshores. 2010. Coastal Development Rating System: Version 1.0. A project of the Stewardship Centre of British Columbia. 80pp. Retrieved from: http://www.greenshores.ca/index.asp?sid=5&id=7&type=single

Appendix 5:
Suggested Climate Change Adaptation Actions

The climate change adaptation recommendations in Section 6 are important, high level approaches. The possible discrete climate change adaptation action recommendations that fall within these broad recommendations are many. Discussions with department staff in North Cowichan will determine the priority of these actions.

The recommendations here are organized into the same nine themes as in Section 3.4's discussion. Within each theme area, the recommendations are further organized into four categories:

Build Knowledge and Awareness of Risks and Vulnerabilities
Studies, information gathering needed before deciding on policies or actions to be taken.

Integrate and Enhance
Suggestions for policy, programs.

Apply
Relating to implementation / enforcement of existing or proposed policies and programs.

Iterate
Monitoring and revision of policies, strategies, programs as information is developed in the future.

1. Land Use and Built Form

Build Knowledge and Awareness

- Review wildfire hazard mapping designations to integrate climate change projections.
- Conduct risk and vulnerability assessment of coastlines for long range planning and infrastructure design and maintenance.

Integrate and Enhance

- Invest in training, enforcement and monitoring of wildfire interface risk management measures.
- Develop a "sustainability checklist" to guide development applications that also includes climate change mitigation and adaptation priorities.
- Consider provision of public amenities during the development application review process, which contribute to climate change adaptation priorities of the DNC (e.g.: temporary floodwater storage, rainwater storage, street trees).
- Adopt Coastline DPA Guidelines (to be added to DPA-4), based on guidelines outlined in Appendix 4 (Coastlines).
- Designate SLR Planning Areas in the OCP (to be updated in subsequent reviews) based on climate change impacts including sea level rise, erosion/accretion and storm surge to guide new and existing shoreline development, as outlined in the BC Ministry of Environment's "Guidelines for Management of Coastal Flood Hazard Land Use."[116]
- Consider application of avoid, protect, accommodate, and retreat strategies within the SLR Planning Areas.

Apply

- Evaluate options outlined in the IFM study, to determine a proactive, phased approach to managing the changes in flood risk over time.
- Develop objectives and actions for implementing the chosen approaches to SLR Planning Areas.
- Promote use of the "Greenshores Coastal Development Rating System,"[117] in the development application process.

116 Ausenco Sandwell . 2011. Guidelines for Management of Coastal Flood Hazard Land Use. BC Ministry of Environment, Victoria, BC. 45pp.

117 Retrieved from Green Shores: http://www.greenshores.ca/index.asp?sid=5&id=7&type=single

Iterate

- Conduct periodic reviews to ensure that planning portions of flood management are applied (e.g.: preventing new development in floodplain, concentrating new development in non-hazardous areas).
- Review, monitor and update floodplain maps, flood management policies and standards relative to information on flood risk change over time, and incorporating future projections.
- Continue to monitor changes in peak flows to determine if/when to invest in raising the dikes. An additional 0.4m beyond the freeboard was recommended in the IFM study, to account for climate change effects over the next century.

2. Parks, Ecosystems, Biodiversity

Build Knowledge and Awareness

- In coordination with the CVRD, conduct a climate change vulnerability assessment for ecosystems and species in the region that includes marine and intertidal ecosystems. Include baseline mapping and indicators to monitor change over time, and integrate this into the CVRD's State of the Environment report and mapping of ecologically sensitive areas in the OCP.

Integrate and Enhance

- Promote use of the "Greenshores Coastal Development Rating System" and/or guidelines developed according to this type of framework, in the development application process. In particular, encourage developments to fulfill Credit 5 "Rehabilitation of Coastal Habitats" and Credit 6 "Rehabilitation of Coastal Sediment Processes."
- Work with the CVRD, private forest companies, and provincial government to enhance pest, weed and disease monitoring and response systems, with consideration of future risks due to climate change.
- Add "may be used for climate change adaptation purposes" to the set of priorities for parkland acquisition in the OCP (e.g.: as
- water storage and infiltration, water source protection, migration of species habitat as climate suitability changes, etc).
- Revise the "Park and Open Space Strategy" to incorporate climate change impacts and adaptation strategies.
- Continue to incorporate climate change impacts into water and flood management plans and measures.
- Incorporate climate change impacts analysis into design, construction and maintenance of trails and parks.

Apply

- Continue to support and protect ecological functioning in the DNC's operations and through the development process, by enhancing the understanding and integration of climate change impacts.
- Continue and expand the DNC's work to increase ecological area connectivity in support of the ecological adaptation process
- Develop guidelines and strategies for planning, design, construction and maintenance of shoreline trails and maintaining public access to the waterfront, in light of future climate change predictions.

Iterate

- Establish and maintain a monitoring program to track changes in ecosystems, habitat and species, integrating this feedback into the Parks & Open Space Strategy, the OCP, and DPA guidelines at regular intervals.

3. Forests

Build Knowledge and Awareness

- Review tourism and economic development plans for climate change impact opportunities and risks on forest ecosystems.
- In the short term, review the function and management of the Municipal Forest Reserve to identify climate change adaptation responses. Consider the implications of climate change impacts to the forests and forest ecosystem, as well as the potential role of forested lands in managing climate change impacts more broadly (e.g.: water source protection, water infiltration and storage, wildfire risk, etc).

Integrate and Enhance

- Incorporate climate change projection information into design and maintenance of infrastructure supporting forestry.
- In OCP section 2.1.2.4, add "climate change projections and impacts" to the list of considerations for periodic review of the role, function and management of the Municipal Forest Reserve.

Apply

- Work with the CVRD, private forest companies, and provincial government to enhance pest, weed and disease monitoring and response systems, with consideration of future risks due to climate change.

Iterate

- Review fire hazard maps as new information becomes available about climate change projections and impacts.

4. Transportation and Energy Infrastructure

Build Knowledge and Awareness

- Conduct a climate change risk & vulnerability assessment of transportation and harbour infrastructure that falls under DNC's area of responsibility.

Integrate and Enhance

- Where possible, include features to offset other climate change impacts in the design and construction of transportation infrastructure (e.g.: green stormwater infrastructure, permeable materials, landscaping, street trees for cooling).
- Consider climate change impacts (more intense rainfall events, erosion, wind, etc) in design, construction and maintenance of active transportation infrastructure.
- Include trees and other vegetation in planning for active transportation routes, for cooling and shelter from intense rain events.

Apply

- Based on a risk & vulnerability assessment, identify specific actions needed to adapt the approach, design and maintenance of transportation infrastructure to climate change.
- Investigate and pursue viable options for alternative energy production locally.

5. Water Resource Management and Infrastructure

Build Knowledge and Awareness

- Conduct a risk & vulnerability assessment of water supply, stormwater and wastewater systems (including septic), with a timeframe of 2050-2100.
- Produce educational materials for the public and developers, to showcase green infrastructure options employed in municipal operations and developments in North Cowichan and elsewhere.
- Update the aquifer vulnerability study to include climate change impacts on groundwater, as a basis for developing adaptation strategies for groundwater management.

Integrate and Enhance

- Based on a risk & vulnerability assessment, identify specific actions needed to adapt the approach, design and maintenance of systems to climate change
- Develop a comprehensive green infrastructure strategy, incorporating future climate change impacts and taking into consideration the best combination of new and existing infrastructure, site-specific requirements, and public space assets. Work with the CVRD and partner local governments to integrate this with the CBWMP.
- Examples of green infrastructure features that could be considered for North Cowichan:
  - green roofs
  - open storm water channels leading into ponds
  - sustainable drainage infrastructure
  - ecological wastewater treatment ponds
  - green stormwater infrastructure
  - xeriscaping and rain gardens
  - reduction of total impermeable area
  - planting of drought-tolerant varieties
  - planting of species appropriate to local soils and adaptable to future climate
- Develop strategies for anticipating, preventing, and responding to water shortages and drought through demand-side management.
- Consider opportunities for developing surface water storage during the wetter winter and spring months, for use at low times later in the year.

Apply

- Support ongoing implementation of the CBWMP, with increasing integration of evolving climate and hydrological conditions and future projections
- Continue to promote use of green infrastructure and technologies in new and re-developments.
- Continue to promote water conservation measures and practices to reduce stormwater runoff.

6. Agriculture and Food Security

Build Knowledge and Awareness

- In cooperation with the agriculture sector, investigate key impacts for agriculture, such as drainage and water supply/ storage infrastructure, to identify actions the DNC can take to improve conditions agricultural conditions.

Integrate and Enhance

- Include climate change impacts and adaptation options in the Agricultural Area Plan. Engage agricultural producers to determine priority needs and engage the public to understand and support local agriculture.
- Work with the CVRD to incorporate learning from the Regional District's current pilot project ("Regional Agriculture Adaptation Strategies") into DNC policies to support agriculture sector climate change adaptation.

Apply

- Increase support to, and integration with, agricultural producers and organizations to ensure viability of agriculture into the future.

7. Economic Development

Integrate and Enhance

- Incorporate climate change adaptation measures, programs, policies into financial planning of the DNC (see implementation section for more details), both annual and longer-term capital planning. Consider establishing an Extreme Weather Reserve Fund (e.g.: City of Toronto).
- Take climate change impacts (sea level rise, storm events, erosion) into account in maintenance and upgrades to harbour infrastructure.

Apply

- Promote development of a local green economy, including the establishment of businesses with local supply chains and markets and contributors to local energy production.

8. Health

Integrate and Enhance

- Develop an urban forestry strategy that integrates climate change adaptation considerations, as outlined in the BC report: "Urban Forests: A Climate Adaptation Guide." [118]
- Review DPA guidelines for solar exposure vs shading, with consideration of climate projections for warming average and low temperatures.
- In cooperation with the CVRD, develop mitigation and response plans and capacity for extreme heat, water shortages and water supply quality events.
- In cooperation with the CVRD, develop mitigation and response plans for vector-borne disease risks.

Apply

- Invest in growth of urban forests for shade, shelter, cooling and air quality benefits. Include street trees in development plans and road and active transportation plans.
- Include climate change risk modules in ongoing public education on emergency management led by the CVRD.

9. Emergency Management

Build Knowledge and Awareness

- In cooperation with the CVRD and partner local governments, maintain public education and capacity-building programs to enhance awareness, preparedness and response by the community.

Apply

- Provide training for staff to support emergency response and integrate hazard mitigation into planning, design and implementation.
- In cooperation with CVRD and partner local governments, ensure adequate budget and other resource sharing arrangements to accommodate increasing frequency of emergency response.

118 Cullington & Gye (2010) "Urban Forests: A Climate Adaptation Guide"

Appendix 6:
CAEP Monitoring and Evaluation

Monitoring and evaluation of the CAEP is critical to its success. This appendix provides an initial overview of the types of monitoring and reporting requirements that could be implemented to ensure that the CAEP is progressing towards North Cowichan's energy and emissions goals. The municipality already reports regularly on Climate Action Revenue Incentive Programs (CARIP) to the Province. CAEP reporting can build on this existing structure.

Table 1: Summary of evaluation and reporting activities

	Annual	Bi-annual	Five years
Evaluation	1. Participant survey	3. Staff survey	
Reporting	2. Staff CAEP report to council	4. GHGProof update 5. Review of CEEI	6. Trip diary 7. Plan review

Evaluation

1. Participant survey
A survey is sent to all participants in CAEP-related activities each year. The survey is designed to solicit feedback on the effectiveness of the activities, identify challenges or weakness and capture new ideas.

2. Staff survey
Every second year a survey is sent to North Cowichan staff to solicit their feedback on the plan and identify new ideas.

Reporting

3. Staff, Climate Change Action Committee (CCAC) and Strategic Action Group (SAG) report to council
An annual staff report to council will describe progress on the CAEP, lessons learned and activities going forward.

- Description of initiatives: A summary of the activities undertaken by the municipality and with partners.
- Indicators table (See Table 2): Indicators that demonstrate progress in each of the areas of the plan.
- Weather events tracking table (See Table 3). A summary of experienced weather events and the implications for the community.
- Lessons learned: Reflections on lessons learned from the process so far, recognising that it is an evolving strategy as technology changes and the municipality gains experience.
- Opportunities: Summary of funding and partnership opportunities.
- Activities going forward: Strategies and actions planned for the following year.

Council, staff and committee members will create new terms of reference and workplans for the CCAC and SAG to follow during CAEP implementation and monitoring.

Indicators

High level indicators for CAEP reporting could include:

Table 2: High level indicators	
Reporting Area	**Indicator**
Transit data	• Number of passenger trips by public transit • Number of partnerships established • Number of initiatives and projects implemented from the CAEP
Modelling	• Number of staff trained • Updated GHG reduction projections
Joining Project 'Get Ready'	• Minimum number of new charging stations per year • Energy consumed at each station • Municipal fleet efficient vehicle replacements made
Building energy use	• Energy consumed per building • Fuel switching progress
Forestry	• Hectares of forest added
Land use	• Growth centre population change (population and jobs per hectare) • Housing diversity • Distance of new bicycle lanes • Distance of new paved trails/pathways • Percent of population with 400 metres of transit stops

Indicators per CAEP recommended actions could include:

Table 3: Indicators per CAEP recommended action		
Action	**Annual Indicators**	**Source**
1. Create a transportation planning program		
1a. Implement a Smarter Travel Choices Program	# of personal travel plans developed	North Cowichan data
1b. Establish a Taxi-bus Rural Public Transit System	# of trips provided by tax-bus system	North Cowichan data
1c. Increase community biodiesel purchases	% of total fuel consumption from biodiesel	North Cowichan data
1d. Joint Project Get Ready and transition the municipal fleet to electric vehicles	# of residential electric vehicle charging station permits issued	North Cowichan data
2. Ensure strict implementation of the OCP development guidelines	# of building permits issued outside the UCB	North Cowichan data
3. Employ municipal energy policy mechanisms		
4. Implement a home energy program	# of homes retrofitted	North Cowichan data
5. Establish a community energy organisation	# of kWh of green energy generated	
6. Reduce municipal building energy use	Total energy consumption Total GHG emissions	North Cowichan data
7. Create an agricultural development centre	# of hectares actively farmed	Farming survey
8. Increase North Cowichan's forest area	# of trees planted	North Cowichan data
9. Establish a green revolving loan fund	$ invested in energy efficiency projects	North Cowichan data

4. CEEI update

The CEEI will be updated every two years by the Province. The municipality can track VKT, building-related energy consumption and the results of secondary indicators. A set of 5 comparator municipalities will be identified and North Cowichan can track its GHG emissions in comparison with those comparator municipalities over time. This type of benchmarking allows North Cowichan to get a sense of the broader impacts of provincial and federal policy and learn from any successes achieved by the comparator municipalities. Proposed comparator communities are: Campbell River, Vernon, Courtenay and Langford.

5. GHGProof Review

GHGProof will be updated every second year and calibrated against the CEEI data. This will illustrate whether or not the municipality's overall GHG emissions are on track with the path outlined in the CAEP or not. It will also be an opportunity to gauge the effectiveness of the policies and programs instituted by the municipality.

6. Trip diary

The trip diary will be completed every five years in partnership with the region. It will track the mode split between driving, transit, walking and cycling over time. It will also provide guidance on key destinations in the region, efficacy of the transit system, evolving travel behaviour patterns including number of trips, location of trips and trips by type.

7. Plan review

Every five years, a formal review of the plan will be completed, led by the committee. This will include a public engagement session and a final report to council recommending any changes to the plan.

Appendix 7:
Effective Practices Report

Municipality of North Cowichan
Climate Action & Energy Plan

North Cowichan Climate Action and Energy Plan
Effective Practices Guide

Prepared by

Sustainability Solutions Group

Contents

District energy in Copenhagen

Location: Copenhangen, Denmark
Population: 1.2M
Issue addressed: Combined heating and power generation on a municipal scale

Description:

Copenhagen is considered to have one of the most extensive and successful district heating systems in the world. It supplies 97% of the city with clean, reliable and affordable heating through a 1,500 km double-pipe network. Established in the 1980's, with partnerships between municipalities in the metropolitan area, the DH network connects Combined Heat and Power (CHP) plants, waste incinerators and boiler plants to distribution companies in a one pool-operated system with a total heat production equivalent to about 20% of Denmark's total heating demand. The integration of four DH systems servicing 18 municipalities in the metropolitan region, allows transmission companies the flexibility to choose which production plants to purchase from on a per hour basis to supply heat and energy at the lowest possible cost, incorporating energy taxes and CO2-quota-costs. The system is adaptable to different fuels and technologies. Some CHP plants have converted from coal to natural gas and others have begun incorporating biomass into their feedstock. Future plans include converting more of the plants to biomass, adding a new CHP plant based on renewable energy, continuing to expand and improve the distribution infrastructure, and increasing the heating capacity of the City's demonstration geothermal facility.

About a third of Copenhagen's district heat comes from biomass and waste incineration and the other two-thirds from fossil fuels. Cogeneration of heat and electricity is said to result in around 30% savings compared to the equivalent production in separate heat and power plants. Similarly,GHG emissions reductions of approximately 40% to 50% are said to be achieved by using centralized production plants instead of individual household boilers running on gas or oil. Waste incineration handles about 40% of the city's waste production, a significant redirection of waste from landfill. In Copenhagen less than 2% of waste is directed to the landfill. Furthermore, in 2009, the heating cost for the consumer was calculated to be about 50% less when compared to oil or gas. The infrastructure has proven to be durable with pipes installed during the 1970's still in use today.

Relevance to NC: Heating of houses and commercial space is a key challenge in North Cowichan, with the use of natural gas and heating oil as well as inefficient electric baseboards and wood stoves. The example of Copenhagen demonstrates the viability of an integrated yet decentralised district energy system using biomass and waste as feedstock to generate heat and electricity at high efficiencies with significant GHG reductions. District energy systems also act as development attractors, supporting other community goals related to density and mixed-use development.

How to translate to NC context: The example of Copenhagen cannot be directly translated to North Cowichan, however the technologies and infrastructure used in Copenhagen could be applied to North Cowichan. The first step would be to engage a specialist with expertise in district energy to identify potential applications in the District. In Copenhagen many of the district energy systems are owned by community co-operatives as well as by private companies, both of which are options in North Cowichan.

Source: SSG Case Studies

Revelstoke Community Energy System

Location: Revelstoke BC
Population: ~10,000
Issue addressed: Municipal district heating utility in a smaller community

Description: The City's largest employer, Downie Mills, was faced with potential closure due to air pollution from the local sawmill. In 2000, Natural Resources Canada provided funding to the City for a prefeasibility study of a combined heat and power plant. Although the study supported the development of a $13 million CHP joint venture between the City and Downie, the actual cost for the system came to $18.5 milllion, largely due to the small scale of the project. This proved economically unfeasible and was therefore scaled back to a $5.6-million biomass-fueled and heat-only system. Operating since 2005, the system provides heating energy (space heat and domestic hot water) to ten downtown buildings and process steam for Downie Timber's drying kilns. The Revelstoke Community Energy Corporation (RCEC) is situated next to Downie Timber's mill in central Revelstoke and uses a 1.5 MW biomass boiler for baseload heating needs and a 1.75 MW propane boiler for peaking and backup. Downie has committed to a 20 year biomass fuel supply agreement, beginning in 2005. Total greenhouse gas savings are estimated to be 3,700 tonnes annually, no fly ash is produced from the plant and there was a 90 percent reduction in particulate emissions. RCEC also provides a non-taxable source of city revenue.

The City of Revelstoke is currently exploring an expansion of the district energy system with the potential to reduce a further 2,000 to 13,000 t CO2e per year and as much as 15,700 MWh/year. This will require that new buildings use hydronic heating to facilitate connections to the district energy system.

Relevance to NC: The experience of Revelstoke closely parallels that of North Cowichan, as a smaller, more rural community with extensive natural resources. North Cowichan has potential sources of biomass both through its own community forest and through the community's industrial forestry companies. However, areas with sufficient density to support district energy are likely limited.

How to translate to NC context: North Cowichan can identify potential areas for district energy and then undertake prefeasibility studies. Identification of sufficient biomass or waste is the second step. A key barrier in BC to district energy is the limited use of hydronic heating so North Cowichan would then work with BC Hydro on incentives for hydronic heating systems in new construction and retrofits. Ultimately a service area bylaw could be used to ensure connection to the district energy systems in the relevant locations.

Source: Natural Resources Canada, Compass Resources

Smart Growth Strategy

Location: Ucluelet, BC
Population: 1,700
Issue addressed: Land-use strategies in a small community

Description: Ucluelet has been successful in exchanging density for amenities or parkland, raising $12 million for parkland, fee-simple land and amenities such as a skateboard park and basketball parks. The 2003 OCP included smart growth policies that addressed affordable housing, density bonus systems, LEED guidelines, Alternative Development Standards (ADS), and public access. One of six comprehensive development areas, an eco-industrial park has created the flexibility of mixed residential and industrial land uses (live/work studios) and has created efficiency in terms of one centralized area for shipping and processing of industrial products. The ADS have been successfully implemented in Ucluelet using French Drain technology for drainage, narrower roads, and the retention of natural vegetation in boulevards. Concrete sidewalks were replaced with public paths, which are located away from the roadside and placed within the forest and vegetation. ADS reduces the long-term infrastructure costs and maintenance costs while alleviating heavy storm flows in a very wet ecosystem. Ucluelet has seen a number of new developments that combine both commercial and residential uses, especially within the downtown area. Implementation of Ucluelet's Density Bonusing system has also contributed to average net green space retention of 40-60% of the total natural green space area of development properties, as compared to the provincial minimum subdivision requirement of 5%.

Relevance to NC: Ucluelet is a small coastal community which has experienced considerable growth and an economic transition from resource-based to tourism-based, similar to Chemainus and Crofton. Ucluelet has applied sustainability tools to community development to achieve smart growth and a compact, complete community.

How to translate to NC context: The application of density bonuses, alternative development standards, and minimum building environmental and energy standards can be considered In North Cowichan.

Source: BC Climate Action Toolkit

Sustainable Travel Towns

Location: Darlington, Peterborough and Worcester, UK
Population: 98,000, 173,400 and 94,000
Issue addressed: Land-use in a small community

Description: Darlington, Peterborough and Worcester are all medium-sized, relatively freestanding towns, located in the north and middle of England. Following a competition, they were designated 'Sustainable Travel Towns', implementing a program of measures from 2004 to 2009, intended to reduce car use. Taken together they spent £15 million, of which £10 million was special Government funding provided by the Department for Transport. Baseline surveys in each town in 2004 showed that traffic growth was a significant issue of public concern. The same surveys showed strong public support to give more sustainable transport modes (buses, walking and cycling) a priority in transport policy. Each town spent most investments on personal travel planning (from a third to nearly half of revenue spending), followed by travel awareness campaigns, promoting walking and cycling, and public transport marketing. Smaller amounts were spent on workplace and school travel plans. The main data sources for the towns included detailed travel surveys, smaller interim household surveys in some areas, surveys in schools and workplaces, bus passenger counts, automatic and manual counts of cyclists, manual counts of pedestrians and automatic and manual vehicle counts.

Car driver trips by residents fell by 9% per person, and car driver distance by 5%~7%, according to aggregated household survey results for the three towns. This compares with a fall of about 1% in medium-sized urban areas over the same period. Bus trips per person grew substantially, by 10%~22%, compared with a national fall of 0.5% in medium-sized towns. The number of cycle trips grew substantially in all three towns by 26%~30%. Darlington (which was also a Cycling Demonstration Town) showed the greatest growth. Meanwhile, cycle trips declined in medium-sized towns elsewhere. The number of walking trips also grew substantially, by 10%~13%, compared to a national decline in similar towns.

The number of interventions was substantial and comprehensive, including:

- Workplace travel planning: Support available to employers included: assistance in undertaking surveys; advice on developing a travel plan; access to a travel plan network; employer green travel award; grants for sustainable travel improvements; discounted bus ticket schemes; new bus services (a commuter bus and a shuttle bus to a park-and-ride site); cycle to work promotions; workplace cycle training; cycle loan schemes; a visiting cycle repair service; access to a city-wide car share scheme organised via Liftshare; travel advice sessions; and customised travel guides to key worksites.
- School travel planning included assistance with pupil surveys and writing the school travel plan; a school travel plan award scheme; provision of cycle parking; cycle training; cycling promotion (Bike It); Dr Bike sessions; bikers' breakfasts; cycle loan schemes (for teachers and parent-and-child tandems); pedestrian training; assistance setting up walking buses; promotional activities such as Medal Motion, Walk on Wednesdays, Walk to School Week, Wheelie Wednesdays etc; lesson activities and participation in assemblies; and visiting theatre productions on school travel issues.
- Personal travel planning included: town-wide and neighbourhood walking, cycling and public transport maps or guides, walking information (e.g. leisure walks leaflets, information about walking groups and events, leaflets on walking for health and setting up a walking bus), cycling information (e.g. cycle maps; guides to neighbourhood cycle routes, information about cycle loans, cycle training, taking a bike on the train, choosing a bike and cycle maintenance), cycling services and equipment (cycle training, cycle loan scheme, bike health check, LED cycle lights, cycle trip computer), public transport information (e.g. bus map; area guides to bus services; bus stop-specific timetables, personal journey plans, rail timetables, information about Text and Go service, information about railcards and concessionary fares), a free bus pass for a limited period, travel information for people with mobility problems (e.g. about Shopmobility and transport to healthcare), information about eco-driving and car-sharing; and loyalty scheme pledge cards and challenges.

Relevance to NC: Transportation is the major source of GHG emissions in North Cowichan. While this project took place in the UK, it does provide evidence that a sustained and comprehensive effort to address transportation will yield significant results.

How to translate to NC context: North Cowichan can consider a comprehensive approach to transportation over ten years with multiple interventions and funding from FCM's Green Municipal Fund, municipal sources and other grants.

Source: UK Department of Transport

Taxibus

Location: Rimouski, Quebec
Population: 46,860
Issue addressed: Cost-effective public transportation in low density areas.

Description: After seeking a form of public transit that could serve effectively but within its financial constraints, the City of Rimouski created a successful operation using private taxis. Taxibus and INTER-Taxisbus are demand-responsive services operating on weekdays in Rimouski. Taxibus passengers can travel between any two of 350 designated stop points, sharing taxis that are dispatched in a manner to maximize occupancy. INTER-Taxibus passengers can travel within either of two outer service zones, or between them and the Taxibus zone. All trips are made without transfers and leave within 15 minutes of the scheduled time. A non-profit corporation created by the city administers the service and performs registration, reservation and financial functions. Local taxi drivers have formed a cooperative to dispatch and drive the taxis.

In 2004, Taxibus and INTER-Taxibus served 81,000 passenger trips annually with an average occupancy of 2.9 passengers per taxi, an average fare of $7.40 and a revenue/cost ratio of 45%. The services required a municipal subsidy of about $180,000 annually, a lower per-capita rate than conventional transit services in Quebec communities of a similar size. There are now taxibuses in many communities in Quebec and across Canada.

Relevance to NC: The Taxibus concept is particularly useful for servicing areas of low density that don't warrant regular public transit, for example, much of the rural areas of North Cowichan.

How to translate to NC context: The City of Rimouski has created a comprehensive model for the Taxibus concept and has since added Taxi-bus Plus for longer distances and has integrated the Taxibus with more conventional public transit systems. North Cowichan could work with BC Transit and CVRD to create a similar system.

Source: Transport Canada

Salix Revolving Loan Fund

Location: UK
Population: N/A
Issue addressed: Financing energy efficiency in the public sector

Description: Salix is an independent, not-for-profit company set up by the Carbon Trust in 2004 as an integral part of the UK's Climate Change Programme. It is designed specifically to address the issue of public sector investment capital and annual financing rules. The role of Salix is to help public sector bodies reduce energy costs and carbon emissions and show leadership in tackling climate change by providing funding and expertise. Typically, progress in reducing greenhouse gas emissions from the public sector has been hampered by lack of investment capital and revenue/capital barriers (the 'annuality' problem). Salix is currently working with the higher education sector, National Health Services, local authorities and UK government departments. Start up budget for the first two years was £20 million per annum. Salix stimulates investment by establishing ring-fenced, interest-free funds matched by the public sector. The funds are unique in that they recycle savings back to the organisation. Funding typically ranges from between £100k and £500k, targeted at cost-effective projects with a high persistence and CO2 impact. Projects must comply with either of the following criteria:

- A payback period of 5 years or less which costs less than £100 per tonne life-time carbon saved or;
- A payback period of 7.5 years or less with a cost of less than £50 per tonne life-time carbon saved.

Salix also provides expertise and tracking systems to identify savings.

Relevance to NC: While Salix is the best example of a revolving fund for energy efficiency, other municipalities in BC including those on Haida Gwaii and Peace River Regional District are in the process of developing similar funds. Such a fund can be used both to finance energy efficiency retrofits in municipal operations and in the broader community.

How to translate to NC context: North Cowichan can work with the local credit unions or Federation of Canadian Municipalities to establish a fund initially targeting municipal retrofits. After gaining experience with this effort over several years, North Cowichan can expand the effort to include residential and commercial buildings.

Source: Salix Finance

Children's Trails

Location: Sandes, Norway
Population: 56,000
Issue addressed: Supporting youth and children in non-vehicular modes of travel

Description: Sandes has a burgeoning population and has adopted a policy of densification to accommodate growth. In order to protect existing local environments, the city made a systematic effort to identify young people's use of urban areas. The Children's Trails program was launched as a way to improve the environment in which children and young people grow up, and to strengthen their interest in city planning. The program is a joint venture between the Department of Culture, Department of Parks and Outdoor Environment and the Department of Education. It is funded by the Ministry of Children and Family Affairs. As part of the initiative, children 8-13 years old at all schools recorded on maps their informal play areas, paths and trails. In all, the children identified 1265 play areas, 550 short cuts, 130 reference areas for schools and 185 reference areas for nurseries. The information was transformed into digital form and made available through the municipal mapping program. Consideration of the Children's Trails report is a permanent routine in all physical planning.

Relevance to NC: This is a mechanism to broadly engage the community in transportation issues and to ensure safe accessibility for a population that is not served by traditional transportation infrastructure.

How to translate to NC context: North Cowichan can develop a partnership with Vancouver Island Health Authority and the School District to undertake this project.

Source: Provincial Health Services Authority

King County Green Tools

Location: Washington State
Population: 1.9 million
Issue addressed: Barriers to green building

Description: King County's GreenTools Program provides a comprehensive suite of tools and support to green building projects including:

- A dedicated Green Track for green building and low impact development projects. Building and development proposals in this track are assigned to a green team, composed of selected King County staff with expertise in alternative green design and construction techniques and Built Green and Leadership in Energy and Environmental Design (LEED) programs. Assistance is offered on green (vegetated) roofs, alternative energy systems such as solar, wind and geothermal, rainwater collection systems, resource efficient framing, recycled materials, low impact development amongst other areas.
- Incentives for residential projects achieving a Built Green 4-star or 5-star level and LEED Silver or Gold level. This includes priority processing and a customized review schedule with an assigned project manager, at no extra charge. The Project Manager provides customers with a single point of contact to help keep the review process efficient, predictable and coordinated.
    - Built Green 5-star or LEED Gold/Platinum single family home, under 1,500-sf: 8 hours of free project management: priority processing
    - Built Green 5-star or LEED Gold/Platinum single family home, under 5,000-sf: 5 hours of free project management: priority processing
    - Built Green 5-star multi-family project: 15 hours of free project management: priority processing
    - Built Green 4-star or LEED Silver single-family home, under 5,000-sf: 3 hours of free project management: priority processing
- Free green building technical consulting service.
- Free low impact development consulting services
- Cost-sharing and fee discounts are available for use of low impact development best management practices (BMPs). Cost sharing is available for sites that convert existing impervious surfaces to native-vegetated landscape, compost-amended lawn or grass, or modular-grid pavement. Surface water fee discounts are available for both residential and commercial sites that incorporate BMPs, use pervious pavement, or install stormwater flow control or water quality treatment facilities.
- Residential Built Green Grant Incentive. The King County/Seattle Built Green incentive provides funding for single-family residential, multi-family and community development projects to help offset the cost of certifying and designing innovative green projects throughout Seattle and King County with incentives up to $20,000. Commercial, institutional and multifamily projects seeking LEED certification are eligible for grant awards between $15,000- $30,000 depending on performance level achieved.

Relevance to NC: King County's green building program helps builders and homeowners overcome key barriers such as capital costs and knowledge. A scaled back program would help support green building, reduce municipal infrastructure costs, improve quality of living, and support public transit. In BC, District of Saanich offers green building incentives but without the broader support system developed in King County.

How to translate to NC context: North Cowichan could partner with LiveSmart BC and the CVRD to offer a similar program. The incentives could be tied to specific locations that are easily accessible to key destinations and public transit. Building inspectors could be trained to provide guidance to builders on green building strategies or local expertise could be contracted to provide support. A priority processing process for green building projects could be implemented. Innovation can be supported by created a panel of expertise to help homeowners by signing off on projects that are not building code compliant.

Source: King County, WA

HRM Solar City

Location: Halifax Regional Municipality
Population: ~400,000
Issue addressed: Barriers to solar hot water installation

Description: HRM identified an opportunity to scale up the installation of solar hot water systems in Halifax through a co-ordinated purchasing and installation effort. The Solar City project was designed to address three issues: complexity of technology options, complexity of financing and the fragmented solar industry. HRM would act as a financial administrator and contracting agent to install an initial 1,000 to 1,500 panels on 500 to 700 homes within one year. The project would be financed through a low-interest loan through the FCM Green Municipal Fund and residents would be able to repay the cost at a schedule that would match the energy savings on their tax bills. Recognizing that there were only 800 solar hot water installations in Canada last year, this was anticipated to be a difficult target, but in the initial call the City received 2000 names of individuals wishing to participate. The project is expected to generate over 75,000 person hours of employment, 30-40 new green collar jobs, $250-700 in annual savings per resident and annual GHG reductions of 2,000 tonnes. One major challenge was that it was necessary for the Province of Nova Scotia to amend the HRM Charter to enable security of financing of energy conservation via lien authority.

Relevance to NC: The project illustrates the possibilities of scaling up solutions when key barriers are addressed. North Cowichan has a better solar resource that Halifax.

How to translate to NC context: It is not possible to directly apply this project to North Cowichan because the opportunity to attach additional payments to municipal taxes doesn't exist in BC. However, a municipal corporation could be established which externally finances a similar type of program.

Source: Halifax Regional Municipality

ComPASS

Location: CIty of Vancouver and University of British Columbia
Population: 1 million+
Issue addressed: Cost-effective public transportation

Description: UBC provided students, staff and faculty with a universal transportation pass, U-Pass. The university wanted to know if residents in adjacent communities would use a similar type of pass to reduce single vehicle traffic, based on a concept pioneered in Boulder, Colorado, known as ComPASS. In Boulder, if a majority of households in a given area votes in favour of monthly fees, all households are provided a transit pass at a considerably lower fee. UBC and the City of Vancouver tested the concept by providing 140 families with free transit passes and their transit use increased by 65% over a control group. The study also showed that the appeal of ComPASS increased if it included access to recreational and community facilities. A ComPass in the university area would cost $25 per household in comparison to the standard per person cost of $63 to $120. The increase in transit usage also increases the feasibility of more frequent transit. Simon Fraser University has since launched a ComPASS program for 1,500 residents in the Univer-City neighbourhood in Burnaby.

Relevance to NC: ComPASS is a potential strategy to significantly increase the feasibility and functionality of public transit in North Cowichan.

How to translate to NC context: North Cowichan could consider piloting the concept in one neighbourhood. Gordon Lovegrove in the School of Engineering at UBC Okanagan is willing to provide ideas and support to investigate the concept.

Source: Federation of Canadian Municipalities

City of Vancouver - Electric Vehicles Program

Location: City of Vancouver
Population: 1 million+
Issue addressed: Electric vehicle deployment

Description: In February 2012, the City launched its $800,000 Charge And Go Vancouver electric vehicle infrastructure trial that will install at least 67 chargers for use at home, work and 'on-the-go' by the end of 2013. The trial, funded by the Federation of Canadian Municipalities, the Province of BC, BC Hydro and the City will provide knowledge and understanding of different charge stations, their installation needs and the suitability of different sites, while increasing the opportunity for EV owners to charge their vehicles - which will help inform future work. Through Project Get Ready Vancouver, a collaboration between BCIT, the Rocky Mountain Institute and the City of Vancouver, a 'menu of actions' has been developed to guide the City's efforts in removing barriers to wide-scale use of electric vehicles. The local car co-op Modo has included a Nissan Leaf in their car share network to be used by both City staff and Modo members. The City has installed the electric vehicle charger and owns a Mitsubishi iMieV that was used to test out car sharing using EVs with City staff. All new single-family homes and off-street bicycle storage rooms are required to have dedicated electric plug-in outlets and new condo buildings require charging infrastructure for 20% of all parking stalls.

Relevance to NC: Transportation is the major source of GHG emissions in North Cowichan. Beginning December 1, 2011 the BC Government announced a $5,000 incentive for purchases of electric vehicles and rebates of $500 for residential EV charging stations. These incentives create opportunities for NC to support the deployment of electric vehicles. Natural Resources Canada has published Charging Infrastructure Deployment Guidelines for British Columbia to ensure standard installations.

How to translate to NC context: North Cowichan can follow the City of Vancouver's lead and require dedicated outlets for electric vehicles in new construction. Purchasing an electric vehicle for municipal use will serve both to demonstrate the municipality's commitment and as an opportunity for staff to experience the implications of electric vehicle technology. North Cowichan may also consider partnering with BC Hydro to install public charging stations.

Sources: City of Vancouver, BC Hydro, Natural Resources Canada

Modo- the car coop

Location: Vancouver, BC
Population: 1 million+
Issue addressed: Car-sharing

Description: Modo is a not-for-profit co-operative with about 8,000 members sharing 250 vehicles in Metro Vancouver. Modo has a diverse fleet that includes hatchbacks, hybrids and minivans and the same rate is charted regardless of the type of car that is booked. Booking occurs over a secure website. Modo members typically drive only 1,400 kilometres a year, while the average driver in the Lower Mainland drives 6,000 - 24,000 kilometres a year. Members purchase a one-time refundable share of $500 to join Modo, and a $20 non-refundable Registration Fee is also collected to pay for a member binder, a fob and a credit check. In addition, members pay a small monthly administration fee to cover some of the service's fixed costs, and low hourly and per kilometre usage fees set up in a variety of plans designed to meet the needs of members. Other characteristics of Modo are:

- Modo cars are permitted to park in any Permit Zone in Vancouver. Members of Modo are also entitled to use car share parking spaces at a growing number of SkyTrain stations.
- Members do not pay for vehicle maintenance or gas; vehicles are outfitted with gas payment cards that operate as credit cards at any gas station.
- All insurance, cleaning, maintenance, BCAA Membership, plus permanent and permit parking are included in the rate plans.
- Modo cars are insured for both work and pleasure use with the co-op holding the insurance under a fleet plan option. As with privately owned vehicles, car costs can be claimed as business expenses when the vehicle is used for work purposes.
- Modo members also have access to reduced public transit costs and other car co-operatives around the world.

Modo can also be useful for organisations. A Vancouver courier company called Novex uses Modo cars in order to avoid purchasing new vehicles.

Relevance to NC: The car-sharing option is particularly useful for people who can easily access key destinations without driving and is less appropriate for suburban areas. Duncan and Chemainus would be two potential locations.

How to translate to NC context: North Cowichan can partner with the City of Duncan and Cowichan Bio-diesel Co-op to support the development of a car co-operative. Incentives such as free parking, municipal use of the car co-op and other strategies can be used to support the development.

Sources: Modo, Co-operative Secretariat

Broadmoor Neighbourhood Service Centre Guidelines

Location: City of Richmond
Population: ~200,000
Issue addressed: Land-use planning to support GHG emissions reductions

Description: In April 2010, Council adopted the Broadmoor Neighbourhood Service Centre Master Plan after an extensive public consultation process with the community. Broadmoor shopping centre is the first mixed use neighbourhood service centre of the 8 shopping centre sites outside City Centre. The vision for the Centre Vision is: "A vibrant, accessible and sustainable mixed use hub where people will be able to live, work and meet their daily needs. The Guidelines support mixed-use development, pedestrian transportation and require comprehensive green building and infrastructure strategies that address on-site rainwater management, energy efficiency and renewable energy production, potable water conservation and waste minimization. The Broadmoor Service Centre will design buildings and site infrastructure that:

a) Minimize the use of energy and reduce Greenhouse Gas Emissions;
b) Use less potable water;
c) Use resources efficiently and incorporate sustainable building materials;
d) Mitigate, manage, and clean as much rainwater onsite as possible;
e) Reduce the generation of waste through careful design and construction practices;
f) Incorporate ways to improve indoor air quality, noise, noxious emissions and dust; and
g) Consider opportunities for urban agriculture on the site.

Relevance to NC: BC municipal governments are able to use Development Permit Areas (DPA) to mandate GHG reductions and the character of built form under the BC Local Government Act. Broadmoor Service Centre Guidelines are an example of how Development Permit Area guidelines can be used to support GHG reductions.

How to translate to NC context: North Cowichan can consider using this approach for any major development proposals

Source: City of Richmond

Intervale Farm

Location: Burlington, VT
Population: N/A
Issue addressed: Support for local agriculture

Description: In the 1980s, a river valley on the edge of Burlington that used to be a farm had fallen into disuse. Will Raap started a small garden shop on the edge of the valley and identified the potential to grow 10% of Burlington's fresh food at the Intervale. The Intervale now houses a huge web of businesses including the Gardener's Supply, Burlington Electric's McNeil Generating Station, the Sugarsnap Café, and the Stray Cat Flower Farm and Market. The Intervale Center is a non-profit organisation that runs the 350 acres including a dozen farms, Community Supported Agriculture (CSA) programs, a compost project, a conservation nursery, produce and farm product distribution and storage enterprises, and farm consulting services.

The Intervale Center is a nonprofit that engages local farmers and eaters at every step of the supply chain of local food, from pre-production planning to post-consumer waste disposal. It has a local food education program for young people, a farm enterprise business incubator for new farmers, business consulting services for established farmers, and a land preservation initiative.

The Farm Incubator Program has provided start up support for emerging and small organic farmers since 1995. Incubator farms get subsidized rates and access to equipment and mentoring. The fees start low and only rise as the farmers' independent businesses expand and they reach enterprise status after three years. The Intervale is a platform for young aspiring farmers to take a risk and launch an enterprise, and when they emerge from incubator status they are prepared to pay market rates to continue.

Relevance to NC: Local food production is widely support in North Cowichan, much like Burlington. North Cowichan also has a farming history and the municipality has agricultural land that could support a similar project. In Burlington, the municipality played a key role in helping Intervale start, through funding and access to land. There are existing organisations that could play a lead role.

How to translate to NC context: North Cowichan can work with the local credit unions or Federation of Canadian Municipalities to establish a fund initially targeting municipal retrofits. After gaining experience with this effort over several years, North Cowichan can expand the effort to include residential and commercial buildings.

London, Ontario: Flooding, Rainwater Management and Climate Change Adaptation Planning

Context

The City of London, Ontario's foray into climate change adaptation was instigated by the release of a study from the local University of Western Ontario, which outlined increases to flood risk would in a changing climate. In response, the City engaged UWO researchers to analyze current IDF curves in use by the City, in light of climate change projections. The findings of that preliminary analysis determined that intensity and frequency of rainfall events in the historical record (1965 to 2001) had increased over time. Given future climate change projections, peak flows for rainfall events shorter than 90 minutes were estimated to increase 10-15%, and those longer than 90 minutes would increase by up to 30 percent. This led to development of specific measures to manage this increasing risk, and to recommendation that more comprehensive climate change adaptation planning be conducted with a focus on flooding.[1]

Adaptation measures

- Detailed analysis and update of City's IDF curves, used for setting key infrastructure design criteria
- Feasibility study evaluating short-term capacity increases of 15-20% in the stormwater management system to incorporate climate change
- Risk & consequences analysis of storm events on municipal infrastructure
- Changes to stormwater infrastructure design
- Changes to floodplain maps
- Transferred responsibility for construction of all stormwater infrastructure from developers to the municipality, to enable an integrated systems approach[2]
- Development of a "Green Infrastructure Plan" that integrates natural ecosystem functions into design standards to improve water quality, reduce runoff, and maintain the water balance[3]
- Have long had a "Stormwater Utility Fee" (public service charge based on area of impervious surface)[4]
- London's stormwater infrastructure includes around 100 facilities, with 2 engineered wetlands and 60 engineered wet ponds. Around 80 additional wet ponds are planned for construction in the next one or two decades[5]
- The Stoney Creek restoration project—involving channel restoration and remediation, and construction of an adjacent wetland—demonstrates the City's movement towards ecological/green infrastructure[6]
- Downspouts are not permitted to be connected to the sanitary sewer system[7]

Impact and risk reduction effects

- Proactive measures to accommodate increases in rainfall intensity and frequency in infrastructure design over time
- Flood risk mitigation through planning, infrastructure and policy
- Identification of range of impacts and adaptation measures through comprehensive studies and planning
- Support adaptation of species and habitat through ecological restoration
- Cooling, water and air quality effects of natural features mitigates some health impacts of climate change

Innovations or success factors

- Collaboration between local university researchers and the City
- Start with issues that are already impacting the municipality, with increasing risk due to climate change
- Phased approach for short-term "transition" and long-term adaptation strategy development and implementation
- Requires high quality local data (incomplete data lengthened data gathering and analysis phase)
- Foundational changes and comprehensive planning to support a shift in approach (eg: transfer of responsibility for SW infrastructure to the municipality; develop a green infrastructure plan)

[1] Richardson 2010
[2] Richardson 2010
[3] Podolsky and MacDonald 2008
[4] Cirillo and Podolsky 2012
[5] Podolsky and MacDonald 2008
[6] Richardson 2010
[7] Podolsky and MacDonald 2008

Basic information[8]

- **Cost**
  - $1.3 million from city budget for first steps (including infrastructure risk & consequences analysis and updating IDF curves)
- **Timeline**
  - Initiated in 2007
  - Transitional adaptation steps completed in 2010 and 2011
  - Target of 2013 for broader, longer-term adaptation planning to be complete

Related benefits (eg: climate change mitigation, social, economic, environmental)

- carbon storage and sequestration
- reduce social and economic impacts over the long-term through flood risk mitigation measures
- social, health and educational benefits of proximity to natural spaces
- economic benefits of increased property values and taxation revenue
- reduce long-term maintenance or replacement costs of stormwater infrastructure
- restore and enhance environmental values such as:
  - water quality
  - biodiversity and species habitat
  - air quality
  - cooling effects of natural features (waterways, support for vegetation)

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[8] Richardson 2010

Malmo, Sweden: Green Infrastructure and Economic Regeneration[9]

Context

In the early 1990s, the City of Malmo in Sweden hit the rock-bottom of its decline from its status as a once- important industrial city, losing one-third of its jobs in just three years. Just over a decade later it had re-invented itself into an internationally recognized sustainability leader. The socioeconomic downturn was a key driver of change, along with concerns about flood risk management, waste management and biodiversity.

In particular, the neighbourhood of Augustenbourg is renowned for its bold and innovative approaches to building a sustainable community, which also has climate change adaptation benefits. Prior to the turnaround, this neighbourhood was plagued by annual flooding from its old sewage drainage system during intense rainfall events. Issues such as flooding have been addressed through an integrated and diverse array of green and blue infrastructure measures. The redevelopment is also notable for the degree of community participation in design and implementation, which also helped to manage potential impacts on residents of the area.

Adaptation measures

- Extensive integration of green and blue infrastructure, particularly for flooding and rainwater management. For example: green roofs, open storm water channels leading to ponds, rain gardens, parks and green spaces
- 6km of canals & water channels, 10 retention ponds, and a series of open ditches, ponds, wetlands
- Reduction of impervious surfaces
- Green roofs planted with drought tolerant vegetation
- District heating, solar, and wind energy production

Impact and risk reduction effects

- 20% reduction in annual runoff volume (compared to conventional system), and lower peak flows
- Significant reduction flood risk
- Local, alternative energy sources reduce reliance on centralized source
- Green roofs contribute to cooling, helping to mitigate health risks

Innovations or success factors

- Collaboration between the City and a social housing company
- High degree of involvement of community in design and implementation; low opposition to the project
- Decentralized decision-making and supporting innovative leadership by staff[10]
- Vision and leadership, commitment to developing a new civic culture[11]
- Focus on solutions offering multiple benefits
- Although the system was not designed based on climate change projections, there is some evidence that it is performing better than the intended design standard (withstanding a 50-year rainfall event, although designed for a 15-year event)

Basic information

- **Cost**
  - Around 200 million SEK (~ $30 million Cdn at 2012 rates). Around half was invested by the social housing company, with contributions from various Swedish government agencies, local authorities and the EU making up the balance
- **Time**
  - The regeneration efforts in Augustenborg were concentrated between 1998 and 2002

[9] European Commission 2010, Kazmierczak and Carter 2010
[10] Hambleton 2008
[11] Hambleton 2008

Related benefits (eg: climate change mitigation, social, economic, environmental)

- Reduced carbon emissions and waste generation
- Enhanced environmental values from green and blue infrastructure
- Biodiversity increase of 50%
- Cooling effects of green roofs compared to conventional materials
- Food production, including honey and fish, from green roofs
- More attractive neighbourhood with decreased tenancy turnover rate
- Space for personal food production and social gathering
- More engaged residents
- Cost savings from improved efficiencies
- Tourism and education benefits from state-of-the-art facilities and showcasing innovation
- Launch of three spin-off businesses

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Kimberley and Elkford, BC: Climate Change Adaptation Planning in Small Communities

Context[12]

In 2008, the Columbia Basin Trust (a provincial crown corporation) initiated a program to support communities in the Basin to begin planning for climate change impacts. The District of Elkford and the City of Kimberley were the first communities chosen to engage in a year-long climate change adaptation planning process. For both communities, wildfire risk was a key concern. In addition, Elkford identified water availability and flooding as top priorities, while the vulnerabilities for water and forests, municipal buildings and tourism were highlighted in Kimberley.

Elkford was the first community in BC to integrate climate change adaptation into their OCP. A set of 4 goals, 9 objectives and 26 actions were developed and incorporated into the OCP, which was adopted by Council in May 2010. This plan employed a seven-step process involving a risk evaluation approach, public engagement and community evaluation of risk tolerance. A community advisory committee was used to guide the process and ensure community perspectives and priorities were central to the plan.

In Kimberley, adaptation planning followed a "learn, share, plan" process that integrated climate science with local observations and priorities, involved the community in interpreting potential impacts, and combined this into an action plan with short- and long-term adaptation measures. The participatory process was guided by a Steering Committee and used working groups to conduct vulnerability assessments and generate actions.

Adaptation measures (identified)[13]

- Review and update zoning and infrastructure bylaws
- Upgrade existing dike
- Review development cost charges to increase green spaces for flood water retention
- Develop community wildfire risk management measures and a community evacuation plan
- Develop a drought plan
- Conduct risk & vulnerability studies where more information is needed to inform action planning
- Cooperate with partners on planning & implementation as required (eg: forestry companies for wildfire measures)
- Incorporate impacts and adaptation measures into future OCP review and infrastructure plan

Impact and risk reduction effects

- Improved mitigation of, and preparedness for, wildfires
- Reducing flood risk to critical infrastructure, property and human life
- Enhanced awareness and integration of future climate information into planning and decision-making processes

Innovations and success factors[14]

- Integration of CCA into a concurrent OCP review
- Central role of public engagement
- Collaboration with climate scientists and other levels of government
- Multiple CCA processes occurring in the Columbia Basin allows for unique peer-to-peer knowledge sharing
- Adjusting existing risk assessment and decision-support tools rather than developing something new
- Using future-oriented information in development of community plans, to complement historical information
- Use of visualization tools, through involvement of UBC's Collaborative for Advanced Landscape Planning[15]

[12] Richardson 2010, Columbia Basin Trust undated a, b
[13] Columbia Basin Trust undated a, b
[14] Richardson 2010, Columbia Basin Trust undated a, b
[15] City of Kimberley (undated)

- The coordinated, longer-term approach to adaptation planning in the Columbia Basin has built capacity and enabled knowledge to be shared across communities in various formats. Eg: http://adaptationresourcekit.squarespace.com/

Basic information[16]

- **Cost**
  - Elkford's adaptation plan cost $31 000 plus 85 in-kind hours from the consulting team
  - Kimberley's adaptation plan was budgeted at $29 000 plus $23 000 of in-kind time and resources
- **Timeline**
  - Elkford's assessment and adaptation planning began in 2008 and lasted about one year. The CCA strategy was integrated into the OCP and adopted in May 2010.
  - Kimberley's adaptation planning process also began in 2008 and lasted a year. An implementation plan is being developed.

Related benefits (eg: climate change mitigation, social, economic, environmental)

- Increased awareness of climate change impacts communicates importance of mitigation measures
- Building local and regional relationships and capacity to adapt
- Improving coordination across agencies, stakeholders, institutions
- Addressing risks to critical infrastructure and core economic sectors (eg: tourism) for long-term economic benefit
- Health, safety, and economic benefits of managing risks and enhancing response to extreme events such as wildfires, droughts and floods

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[16] Columbia Basin Trust (undated) a, b

Municipality of

North Cowichan

Climate Action & Energy Plan