



Fraser Valley Regional District
Clean Economy Study

Final Report



DISCLAIMER

The information, concepts, and recommendations expressed in this document are based on information available at the time of the preparation of this document. Action or abstinence from acting based on the opinions and information contained in this document are the sole risk of the reader and Delphi shall have no liability for any damages or losses arising from use of the information and opinions in this document. All information is provided “as is” without any warranty or condition of any kind. The document may contain inaccuracies, omissions, or typographical errors.

Contact Information:

602 W Hastings St, Suite 500
Vancouver, BC V6B 1P2
Canada

Tel.: (613) 562-2005

Fax: (613) 562-2008

www.delphi.ca

Project Contact:

Paul Shorthouse,

Senior Director

pshorthouse@delphi.ca

Direct: 1-604-338-9941

Cover image: UFV Agriculture Student Work Practicum (photo by Rick Collins)

Acknowledgements

The Delphi Group would like to thank the following companies, government agencies, and industry organizations. These key stakeholders and industry leaders provided important resources, insights and / or data to support this study.

Abbotsford Economic Development Team	District of Mission
Algra Bros	Evolved Consulting
BC Hydro	FortisBC
BC Ministry of Agriculture	Fraser Valley Regional District
BC Transit	Microsoft
BLDRS Collective Inc.	Redux Nutrition
Catalyst Agri-Innovations Society	Sto:lo Community Futures
Chilliwack Economic Partners Corporation	Structurecraft
City of Abbotsford	University of the Fraser Valley
City of Chilliwack	XLRator
District of Kent	

Preface

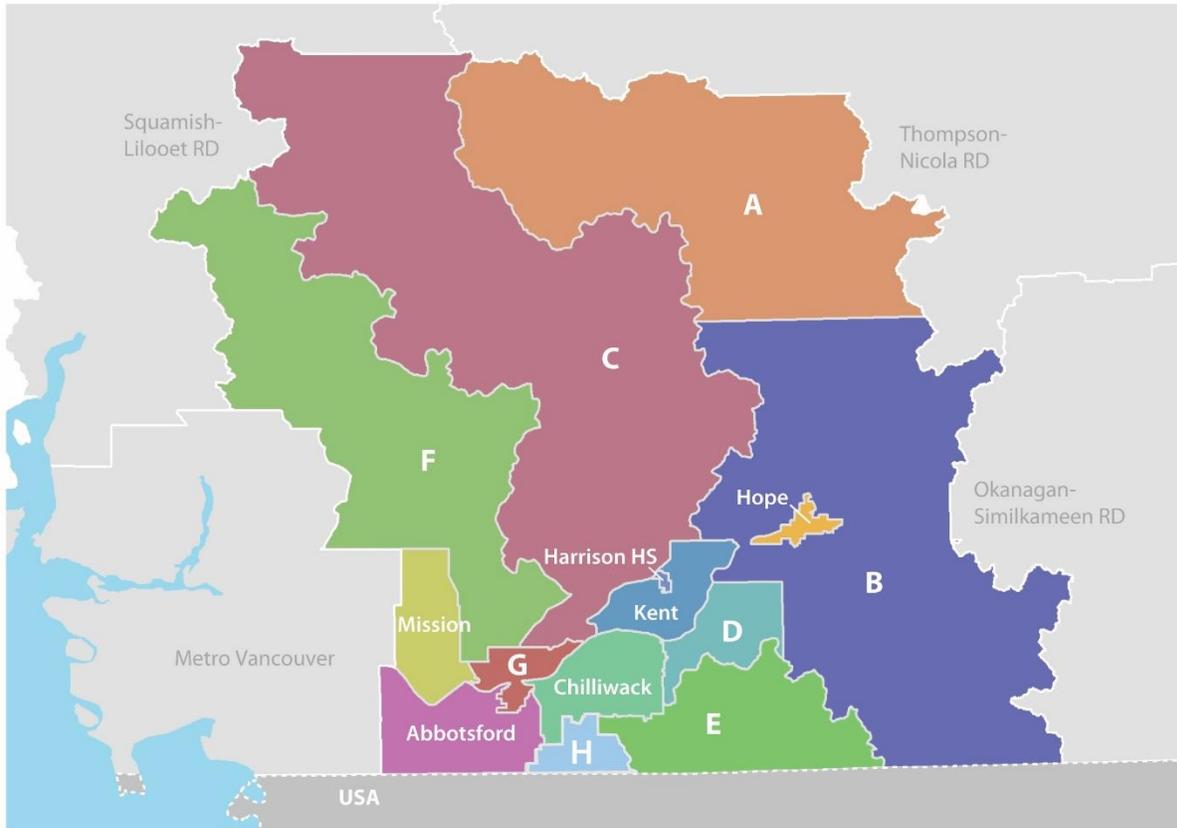
The Fraser Valley Regional District (FVRD) engaged The Delphi Group in the Fall of 2018 to undertake research and analysis designed to better understand the existing capacity and competitive strengths related to the Fraser Valley region’s clean economy. The Delphi Group has produced this report to support the FVRD, local governments, and other regional stakeholders with the identification of clean economy sector opportunities. This report also identifies opportunities for alignment with federal and provincial policy priorities (e.g., the Province’s CleanBC Climate Plan).

Secondary and primary research for this study included a review of major industry trends, policy drivers, and growth opportunities. Sector profiles were developed based on data collection and an analysis of statistical sources in order to estimate clean economy sector employment and gross domestic product (GDP); compiling lists of relevant companies, projects, investments, and research activities; and undertaking an assessment of existing strengths, weaknesses, and gaps.

Consultation was also undertaken through a series of 13 key informant interviews with industry leaders and a focus group that brought together stakeholders from business, academia, and government to discuss the local opportunities and challenges for growing the Fraser Valley’s clean economy.

It is hoped that the outcomes from this project will be used to grow the Fraser Valley’s clean economy sectors, to support the Fraser Valley Regional District’s Regional Growth Strategy process with relevant information, and to encourage the development of strategic partnerships that will help position the Fraser Valley as a growing clean economy leader.

A note on geography and terminology: The scope of this study is the Fraser Valley Regional District and includes the municipalities of Abbotsford, Chilliwack, Harrison Hot Springs, Hope, Kent, and Mission, as well as the eight unincorporated electoral areas (see Figure 1). The jurisdiction covered by these areas is referred to in this report collectively as the “Fraser Valley” or the “region”.



Source: Fraser Valley Regional District

Figure 1: Fraser Valley Regional District Municipalities and Electoral Areas.



Table of Contents

EXECUTIVE SUMMARY	i
INTRODUCTION	1
MACRO OVERVIEW	4
SECTOR PROFILES	8
SUMMARY	33
APPENDICES	38



List of Acronyms

4IR: Fourth industrial revolution

CMA: Census metropolitan area

CN: Canadian National (railway)

CNG: Compressed natural gas

CP: Canadian Pacific (railway)

EV: Electric vehicle

GDP: Gross domestic product

GHG: Greenhouse gas

HVAC: Heating, ventilation, and air conditioning

ICT: Information and communications technology

IoT: Internet of things

LNG: Liquefied natural gas

NRCan: Natural Resources Canada

OEM: Original equipment manufacturer

RGS: Regional Growth Strategy

RNG: Renewable natural gas

SDG: Sustainable Development Goals

SWMP: Solid Waste Management Plan (FVRD)

UFV: University of the Fraser Valley

YXX: Abbotsford International Airport

ZEV: Zero-emissions vehicle

Executive Summary

In this study, the “clean economy” is an economy that aims at reducing environmental risks and ecological scarcities, and that aims for sustainable development without degrading the environment. The following definition of the “green economy” from ECO Canada is used to guide this study:

The clean economy is “the aggregate of all activity operating with the primary intention of reducing conventional levels of resource consumption, harmful emissions, and minimizing all forms of environmental impact. The [clean] economy includes the inputs, activities, outputs, and outcomes as they relate to the production of clean products and services.”¹

This study, for the Fraser Valley Regional District (FVRD), sought to develop a better understanding of how to support the growth of the clean economy sectors in the Fraser Valley in line with traditional industrial economy strengths across the region, identify federal and provincial policies that could be leveraged for growing the clean economy, and identify the necessary types of supporting hard and soft infrastructure that support sustainable growth.

The research conducted in this study included establishing an overarching framework for the region’s clean economy, data gathering, undertaking a statistical analysis of existing economic and employment activities, developing SWOT and gap analyses, and engaging with key stakeholders through interviews and a focus group session.

The clean economy in the Fraser Valley is described in five sectors in Figure 2. The Fraser Valley has many underlying strengths upon which to build prosperity across the clean economy, as highlighted below.



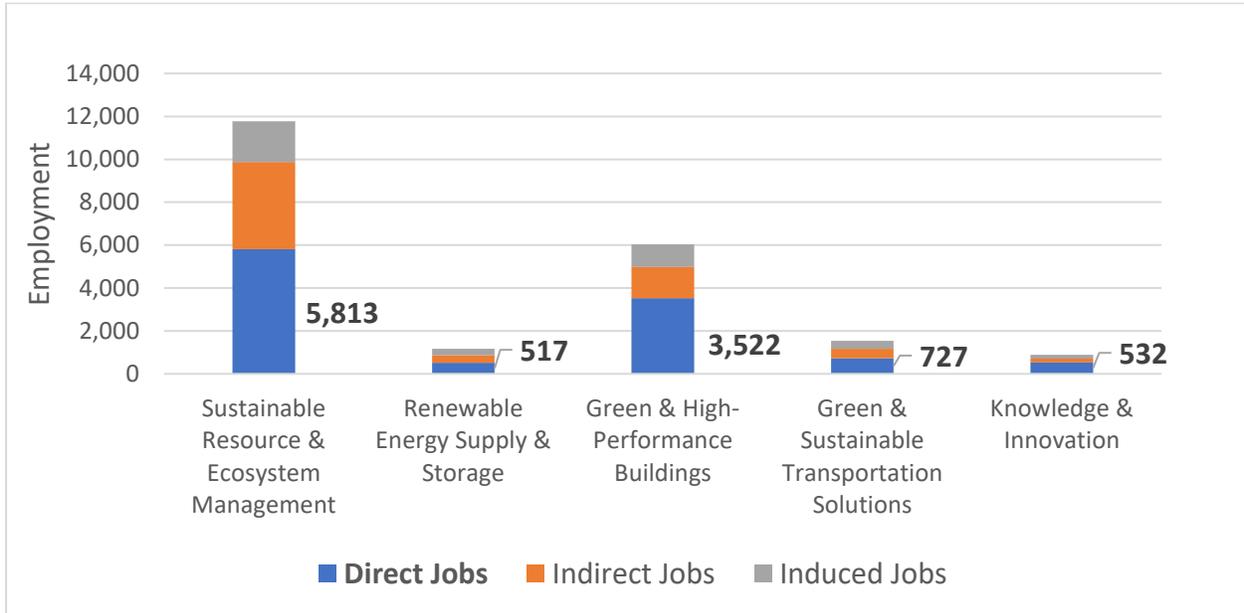
Figure 2: Framework for the Clean Economy in the Fraser Valley

Clean Economy in the Fraser Valley

The economic contribution of the clean economy across the region is already significant. It is estimated that the Fraser Valley’s clean economy was responsible for generating \$1.17 billion in direct GDP in 2016.

¹See: <http://www.eco.ca/pdf/Defining-the-Green-Economy-2010.pdf>

This study also estimates that approximately 11,100 direct jobs existed in the Fraser Valley’s clean economy in 2016; equal to 7.4% of the region’s workforce (see Figure 3). Most of these jobs are in the Sustainable Resource and Ecosystem Management and Green and High-Performance Buildings sectors.



Source: The Delphi Group

Figure 3: Clean Economy Employment in the Fraser Valley (2016).

Sector-specific Opportunities

In the Sustainable Resource and Ecosystem Management sector, well-established agriculture operations have the potential to increase value-added food processing and waste-to-resource projects, including the production of renewable natural gas and bioproducts (such as organic fertilizers and compost). Adoption and application of precision agriculture technologies and data-driven crop management can optimize the use of inputs and help address labour shortages.

In the Green and Sustainable Transportation sector, smart mobility solutions and more efficient goods movement supported by information and communications technology (ICT) infrastructure present an opportunity for the region. The presence of an international airport and proximity to nearby population centres form a solid foundation for taking advantage of global and regional trends in vehicle electrification, logistics hubs, and renewable fuels.

Modular construction and pre-fabrication solutions and local wood products manufacturing contribute to the growth of the Green and High-Performance Buildings sector, as do higher performing and energy efficient products and materials, including windows / doors, insulation, and building control systems. These products and

technologies are increasingly important as policies such as the BC Energy Step Code are adopted and an emphasis is placed on energy efficient building retrofits.

In the Renewable Energy Supply and Storage sector, existing generation facilities and geothermal energy capacity provide an opportunity to develop sustainable energy solutions, including emerging smart grid and energy storage technologies that can help better manage and modernize the region's energy infrastructure. It also presents opportunities for collaboration and new partnerships with the region's First Nations communities.

Knowledge and Innovation sector assets include the University of the Fraser Valley and technology-focused accelerators, with the power to attract talent and deploy local products and solutions across the clean economy.

Growing the Fraser Valley's Clean Economy

While this research highlights many sector-specific opportunities for growing the Fraser Valley's clean economy, some common themes and cross-sector opportunities emerged as well. These include:

- Advancing partnerships between governments, business, and educational institutions to promote information sharing, both in terms of open data portals and local expertise on clean economy solutions.
- New opportunities for green building and transportation solutions through enhanced land use planning practices that encourage transit-oriented development and energy-efficient multi-unit residential and mixed-use commercial / light industrial buildings.
- Continuing to build the critical underlying infrastructure in telecommunications and information technology, as well as water and energy distribution, in order to support modernization and clustering of industrial and commercial activities across the clean economy sectors.
- Industrial and commercial activities that can be further supported by facilitating waste-to-resource and circular economy partnerships, linked closely to the region's agricultural-based feedstocks.
- Fostering partnerships with local First Nations and building a broader understanding of Indigenous worldviews that can lead to innovation in the management of ecosystem health and natural assets.

This study confirms that the Fraser Valley has a solid foundation and set of underlying strengths to grow the region's clean economy. While there are numerous opportunities, there are challenges related to workforce capacity, industrial land supply, education, internet connectivity and transportation that need to be addressed. Through the process of updating the FVRD's Regional Growth Strategy and advancing related initiatives and partnerships with key stakeholders, it will be possible to realize both short-term successes and long-term sustainable prosperity for the region and local residents.

Introduction

A global shift to a clean or low-carbon economy is underway, being driven by international climate change concerns, an exploding population which is transitioning from poverty to middle-class, and an improved business case for renewable energy and related clean technology. Given the colliding forces of resource scarcity, population growth, technology trends, and policy drivers under the climate action agenda, the way forward presents an exciting suite of new and expanded business, investment, and job creation opportunities for local governments, businesses, and residents across the Fraser Valley.

Federal policy. To determine whether the Paris Agreement will be met, participating nations are requested to submit Nationally Determined Contributions (NDCs) that outline long-term climate actions post 2020. Canada's NDC sets a 30% economy-wide greenhouse gas (GHG) emissions reduction target below 2005 levels by 2030.² Canada's long-term goal is to reduce emissions by 80% from 2005 levels by 2050.³ While much effort has been put into individual actions and projects to reduce GHG emissions, a low carbon economy will ultimately be required to achieve the significant GHG emission reductions required to reach these goals.

In 2016, the federal and provincial governments adopted the Pan-Canadian Framework on Clean Growth and Climate Change (i.e., the "Framework"),⁴ which includes commitments to carbon pricing complemented by policies and programs for reducing GHG emissions. These policies will increase the cost of fossil fuels and make renewables more competitive. The Framework will develop a series of policies and regulations to promote collaboration of electricity grid interconnections, building codes, and a zero-emissions vehicle strategy. Other outcomes of the Framework will include new programs for green infrastructure investments and deepening clean technology innovation and implementation.⁵

Provincial policy. At the provincial level, the Government of BC introduced its CleanBC Climate Plan in December 2018 with the following key aspects:

- Directing a portion of B.C.'s carbon tax paid by industry into incentives for cleaner operations;
- Helping communities to achieve 95% organic waste diversion for agricultural, industrial, and municipal waste;
- Making industrial natural gas consumption cleaner by putting in place a minimum requirement of 15% to come from renewable gas;
- Expanding job training, research, and commercialization for electric and other zero-emission vehicles;
- Developing training programs for Energy Step Code and Certified Retrofit Professionals.

² See: <http://www4.unfccc.int/ndcregistry/PublishedDocuments/Canada%20First/Canada%20First%20NDC-Revised%20submission%202017-05-11.pdf>

³ See: <https://www.newswire.ca/news-releases/government-of-canada-sets-ambitious-ghg-reduction-targets-for-federal-operations-665237843.html>

⁴ See: <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html>

⁵ See: https://www.canada.ca/content/dam/themes/environment/weather/climatechange/PCF-FirstSynthesis_ENG.pdf

The Government of BC has shown a commitment to CleanBC in its 2019 budget. \$902 million over the next three years is designated for CleanBC programming with \$354 million in operating funding, \$299 million for new programs, \$26 million in capital investments, and \$223 million to increase the climate action tax credit.⁶

Regional policy. The FVRD adopted its first **Regional Growth Strategy** (RGS) in 2004 and is updating the plan to readjust the long-term strategic plan to reflect changes in legislation, growth, and demographics. Based on the review, the updated draft RGS is structured under the following pillars:

1. Collaboration
2. Economic Strength and Resiliency
3. Living Well
4. Community Building
5. Ecosystem Health
6. Transportation and Mobility
7. Infrastructure and Services
8. Energy and Climate Change

Based on the opportunities identified through this research, these eight pillars align well with the clean economy themes and position the FVRD for success as it moves forward with finalizing and implementing the RGS.

Also contained in the draft RGS are GHG reduction targets of 20% per capita by 2020 and 50% per capita by 2050, relative to 2007 levels. The FVRD is a signatory to the B.C. Climate Action Charter, which commits to becoming carbon neutral in their corporate operations, measuring their community-wide GHG emissions, and building compact, complete, more energy efficient rural and urban communities.

The FVRD's **Solid Waste Management Plan** (SWMP) also provides a strong foundation for growing the clean economy in the region. Waste-to-energy initiatives discussed in this report are consistent with the SWMP's rejection of incineration as a tool in the zero waste strategy.

Definition of Clean Economy Sub-sectors

For the purposes of this research, the clean economy can be grouped into the following five sectors:

- 1) **Sustainable Resource and Ecosystem Management:** Including a focus on the region's sustainable industry practices and clean technologies for the agriculture and other resource sectors (e.g., food processing, etc.), waste management / recycling, waste-to-resource / circular economy opportunities, and the restoration of air, water, and land ecosystems (e.g., water monitoring and treatment, natural asset management, carbon capture, sequestration, and utilization, etc.).
- 2) **Green and Sustainable Transportation:** Including electric and autonomous vehicles, public transit, alternative fuels (e.g., biofuels, hydrogen, renewable natural gas), smart transportation systems and technologies, and related integrated land use planning.

⁶ See: https://www.bcbudget.gov.bc.ca/2019/pdf/2019_Backgrounder_2_CleanBC.pdf

- 3) **Green and High-Performance Buildings:** Including products, services, and building materials related to energy efficient and high-performance building design, construction, renovation, and operations such as building envelope products (pre-fabricated walls and building components, windows / doors, insulation), mechanical systems (e.g., HVAC, hot water), lighting and control systems, and other products (engineered wood, etc.).
- 4) **Renewable Energy Supply and Storage:** Including wind, solar, geothermal, hydro, biomass, district energy, waste heat to power, anaerobic digestion, as well as energy storage / battery technology, smart grid, and related energy management technologies.
- 5) **Knowledge and Innovation:** In particular, educational institutions for workforce skills development, investment, research and development, and centers of excellence that build on the knowledge base of the clean economy.

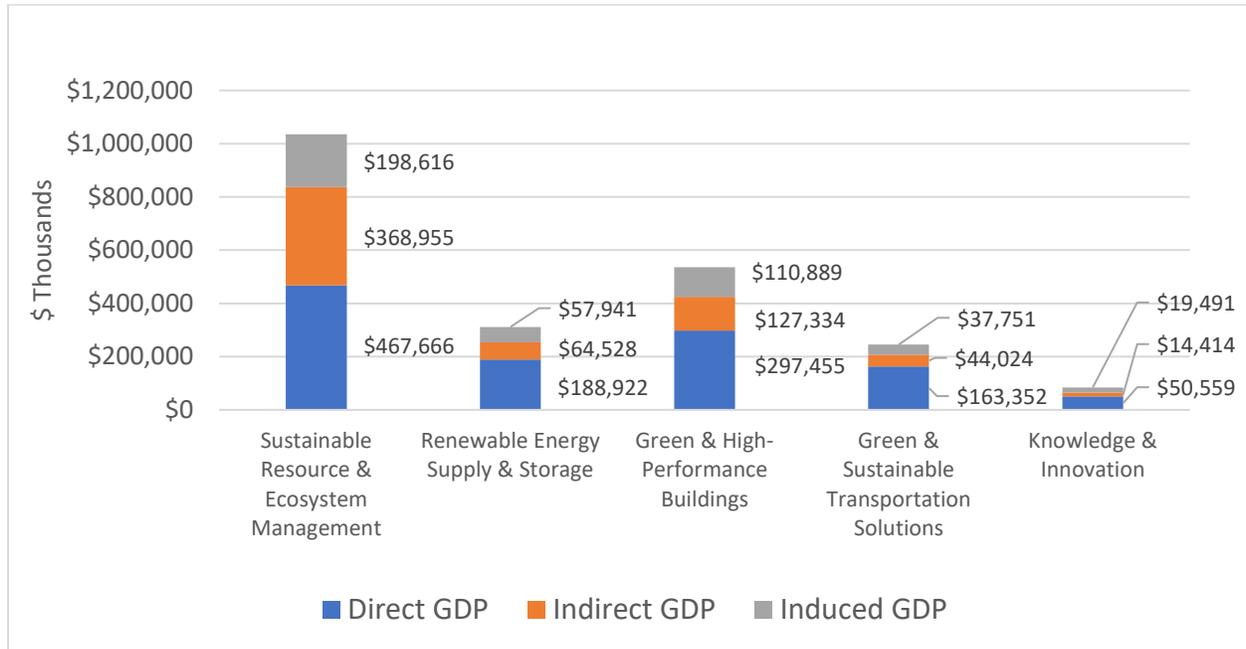
The sections that follow showcase some of the Fraser Valley's key players, projects, and activities; identify potential opportunities for growth and further investment based on existing value chain strengths and gaps; and provide strategic considerations that will help the region maximize its opportunities and minimize its risks. The report is broken out into the following sections:

- **Macro Overview:** Provides an overview of the Fraser Valley's clean economy at a macro-level.
- **Sector Profiles:** Provides more detailed profiles of the Fraser Valley's five clean economy sectors.
- **Summary:** Highlights potential opportunity areas and key conclusions from the research.

In addition, Appendices include a SWOT and Gap Analysis (Appendix A), Macro Trends Summary (Appendix B), Policy Overview (Appendix C), and summary notes from the Focus Group of key stakeholders (Appendix D).

Macro Overview

It is estimated that the Fraser Valley’s clean economy was responsible for generating \$2.45 billion in gross output⁷, \$1.17 billion in gross domestic product (GDP), and employed approximately 11,100 people (equal to 7.4% of the Fraser Valley’s workforce) in 2016 (see Figure 4 below).⁸



Source: The Delphi Group

Figure 4: Clean Economy GDP in the Fraser Valley (2016).

By leveraging the growing public interest to make the most of natural resources, reduce environmental impacts, improve energy affordability and resilience, and improve transportation, the five sectors profiled in this report present a strong foundation upon which the Fraser Valley can continue to grow sustainable prosperity related to the clean economy (See Table 1 below).

The Fraser Valley’s clean economy value chain has strengths across all five sectors. These strengths include research, design, engineering and technical services, construction and manufacturing, natural asset management, and broader ecosystem supports (such as finance and government policy).

⁷ Gross output measures total economic activity in the production of new goods and services in an accounting period. It is more representative of ‘revenues’ and is a much broader measure of the economy than GDP, which is limited mainly to final output (finished goods and services).

⁸ Direct impacts are related to the specific industry, while indirect impacts relate to activities that support or supply the industry. Induced impacts are those that are a result of direct / indirect spending in the local economy outside of the industry (i.e. the economy as a whole).

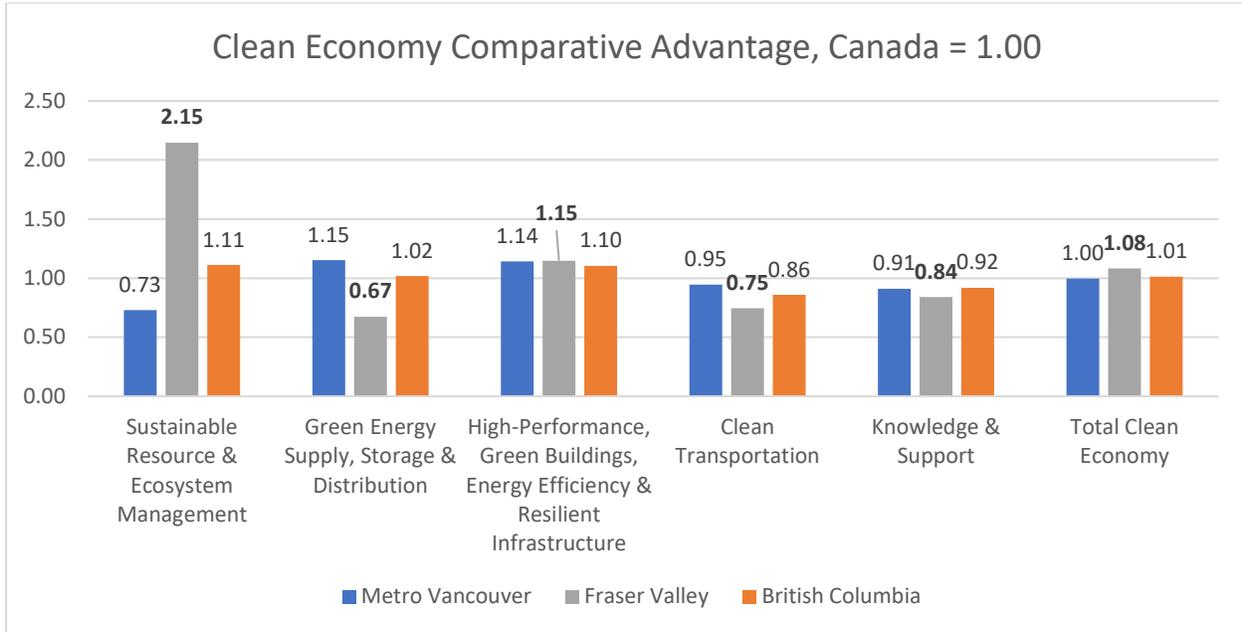
Table 1: Clean Economy Jobs and GDP by Sector in the Fraser Valley (2016)

Clean Economy Jobs	Direct Jobs	Indirect Jobs	Induced Jobs	Total Jobs
Sustainable Resource & Ecosystem Management	5,813	4,060	1,900	11,774
Green & Sustainable Transportation Solutions	727	447	360	1,533
Green & High-Performance Buildings	3,522	1,459	1,057	6,038
Renewable Energy Supply & Storage	517	355	299	1,171
Knowledge & Innovation	532	170	186	888
Total	11,111	6,492	3,801	21,404
Clean Economy GDP (thousands \$)	Direct GDP	Indirect GDP	Induced GDP	Total GDP
Sustainable Resource & Ecosystem Management	\$467,666	\$368,955	\$198,616	\$1,035,236
Green & Sustainable Transportation Solutions	\$163,352	\$44,024	\$37,751	\$245,127
Green & High-Performance Buildings	\$297,455	\$127,334	\$110,889	\$535,678
Renewable Energy Supply & Storage	\$188,922	\$64,528	\$57,941	\$311,391
Knowledge & Innovation	\$50,559	\$14,414	\$19,491	\$84,463
Total Clean Economy (thousands \$)	\$1,167,954	\$619,254	\$424,687	\$2,211,895

Source: The Delphi Group

Opportunities exist to further diversify and strengthen the Fraser Valley’s clean economy by developing transferable skills and knowledge within the existing workforce. Careers in management, professional services, engineering, science, project management, information and communications technologies (ICT), construction, trades, and manufacturing all have elements that can be applied to strengthen the Fraser Valley’s clean economy and its key sectors.

Figure 5 below illustrates the clean economy comparative advantage of the Fraser Valley, Metro Vancouver, and province of British Columbia when compared to Canada as a whole (where Canada = 1.00).



Source: The Delphi Group

Figure 5: Fraser Valley’s clean economy comparative advantage.

In the Sustainable Resource and Ecosystem Management sector, the Fraser Valley has existing strengths in its well-established agriculture sector, this includes farming, greenhouse growing, food processing, and waste-to-energy operations. These strengths serve as the foundation for developing further opportunities in line with industry trends in areas such as precision agriculture, crop management, next-generation food processing, and bio-products (see Appendix B for more information on macro trends).

Strengths in Renewable Energy Supply and Storage include electric power generation facilities, geothermal energy capacity, and current and potential future sources of biogas from agriculture and forestry waste. Together these strengths provide an opportunity to leverage broader trends in smart grid, energy storage, and demand for renewable fuels.

The Fraser Valley has established capacity in many aspects of the Green and High-Performance Buildings sector. Modular, pre-fabricated, and wood construction products already being manufactured locally will be key to the growth of this sector as policies like the BC Energy Step Code drive the industry toward higher energy efficiency standards.

In the Green and Sustainable Transportation sector, the Fraser Valley’s strengths include its location relative to nearby large population centres, a major transportation corridor running through the valley, and the presence of an international airport. These are all assets that can be leveraged to take advantage of global and regional trends in smart mobility, vehicle electrification, logistics hubs, and renewable fuels.

Anchored by the University of the Fraser Valley, research and trades training in the region includes centres of excellence, technology-focused accelerators, and professional innovation networks that can be leveraged to attract investment, build knowledge, and bring new talent to the region.

The following Sector Profiles section looks at each of the five clean economy sectors and dives deeper into the Fraser Valley's local capacity and comparative strengths in line with global macro trends.

Sector Profiles

Sustainable Resource & Ecosystem Management

On a global level, the drive toward sustainable development is being guided by the United Nations 17 Sustainable Development Goals (SDGs).⁹ The SDGs are an effort to establish a shared blueprint that focuses both on social and environmental priorities as a means to sustainably grow economies worldwide. Governments, including Canada's federal government, are aligning their sustainable development priorities and strategies with the UN SDGs. For Canada this includes a focus on maintaining or improving the health of water and land resources, reducing air pollution, and reducing waste, including a special focus at the moment on addressing plastic waste.¹⁰

Partnerships and organizations such as the Canadian Agricultural Partnership¹¹, and Canada's innovation superclusters¹² for Advanced Manufacturing and the Protein Industry are examples of where market trends and investments are heading in response to the global trend toward the efficient and sustainable production, use, and re-use of natural resources and their end products.

Within the agriculture sector, activity is growing around the collection of data to optimize the management and operation of farms. For example, companies (such as Famers Edge) are applying new technologies in the area of precision agriculture. Precision agriculture technology companies specialize in the collection and processing of large quantities of big data (e.g., soil and water quality, weather conditions, performance of farm equipment) through satellite imagery and in-field sensors that they provide to farmers to help them improve productivity and yields while reducing operational costs and drive efficiencies.¹³

What is Sustainable Resource & Ecosystem Management?

This sector is focused on the region's sustainable industry practices and clean technologies across:

- Agriculture (including food processing) and other natural resource sectors;
- Waste management and recycling;
- Waste-to-resource and circular economy opportunities; and
- Restoration of air, water, and land ecosystems through water monitoring and treatment; natural asset management; and carbon capture, sequestration, and utilization).

⁹ See: <https://sustainabledevelopment.un.org/sdgs>

¹⁰ See: http://www.fsds-sfdd.ca/downloads/Draft_FS_DS_2019-2022.pdf

¹¹ See: <http://www.agr.gc.ca/eng/about-us/key-departmental-initiatives/canadian-agricultural-partnership/?id=1461767369849>

¹² See: <https://www.ic.gc.ca/eic/site/093.nsf/eng/00008.html>

¹³ See: <https://www.theglobeandmail.com/report-on-business/rob-commentary/big-data-and-ai-are-poised-to-transform-our-natural-resources-sector/article38287125/>

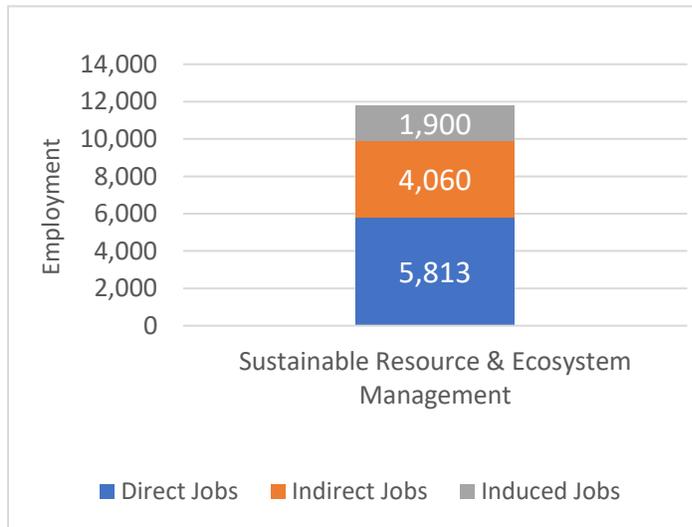
Fraser Valley Sector Snapshot

The Fraser Valley’s clean economy comparative advantage is firmly rooted in its Sustainable Resource and Ecosystem Management sector, particularly in the agriculture space. This is largely due to the existing infrastructure, business experience, and well-established workforce that has advanced the region’s key sectors in agriculture and the production of related products that serve global markets. More specifically, the region has a strong base of infrastructure in Chilliwack and Abbotsford related to advanced and niche manufacturing for food processing and in Mission for steel fabrication, plastics, and wood products manufacturing.

Policy Drivers in Sustainable Resource & Ecosystem Management

- Low Carbon Leadership Fund
- Clean-tech Innovation Strategy for the Forest Sector
- Clean Growth Program for Industry
- Innovative Clean Energy Fund
- Agritech Innovation Challenge
- CAP Innovation Program
- Canada-BC Agri-Innovation Program

It is estimated that the Sustainable Resource and Ecosystem Management sector was responsible for 9,873 direct and indirect jobs (5,813 direct and 4,060 indirect) \$1,035,236 in GDP in 2016. Jobs within this sector are largely related to farm operations and greenhouse production, food manufacturing, and the processing of wood products.¹⁴



Source: The Delphi Group, based on Statistics Canada 2016 Census data.

Figure 6: Sustainable Resource and Ecosystem Management Employment in the Fraser Valley (2016).

Local Capacity & Comparative Strengths

The region’s relatively affordable industrial land, burgeoning ICT sector¹⁵, existing workforce, high quality of life, and knowledge-based economy (i.e., local university and research centres) collectively create the ideal conditions for showcasing and expanding emerging technology opportunities and best practices in sustainable agriculture and advanced manufacturing. In addition, these industries provide valuable waste-to-resource streams that could be reused or recycled as value-added inputs to other local industries or as an export commodity to other parts of B.C., Canada, and/or U.S.-based markets.

The Fraser Valley is home to some of the richest soils in Canada which generated 39% of the province’s gross farm receipts in 2015.¹⁶ Farmers benefit from the moderate climate,

¹⁴ See: Statistics Canada. 2016 Census.

¹⁵ See: <https://xlrator.ca/technology-sector-strengthens-regional-east-fraser-valley-outlook-by-formalizing-strategic-partnership-between-xlrator-and-chilliwack-tech/>

¹⁶ See: <http://www.fvrd.ca/assets/Government/Documents/AgricultureSnapshot.pdf>

plentiful water resources, and access to a local market that is expected to reach a population of 3.6 million by 2041.¹⁷

These conditions also create an ideal environment for research, testing, and deployment of innovative solutions. Leading research facilities include the University of the Fraser Valley's (UFV) Food and Agriculture Institute and the Pacific Agri-Food Research Centre in Agassiz (Federal Government). Many individual farmers are actively involved with the development and testing of sustainable agriculture best practices (including waste reduction, re-using waste streams, and nutrient management) while contributing to the rich local knowledge base.

In addition, there are several projects throughout the region that exemplify the business case for sustainable resource management and build on the region's strengths, including:

- Net Zero Waste Inc.'s food and agricultural waste commercial composting facility in the City of Abbotsford.
- Molson Coors new brewery in Chilliwack where an anaerobic digester will be installed to treat wastewater and collect biogas for power generation.
- Abbotsford's Bakerview EcoDairy biogas generator which consumes approximately 1.6 million litres of manure and produces 170,000 kilowatts of electricity, preventing about 150 tonnes of GHGs from entering the atmosphere per year.¹⁸
- Fraser Valley Biogas which is currently producing approximately 350 GJ/day of renewable natural gas (RNG) from 20+ farms in the region, many of which are in close proximity to one another, creating further opportunities for collaboration and shared resources.
- A cluster of companies in Mission specializing in soil remediation and returning former brownfields into revitalized industrial land.

Existing barriers and gaps related to this sector include a lack of:

- Industrial land to expand manufacturing operations.
- Skilled high-tech workers to operate complex machinery and software used for both manufacturing and agriculture operations.
- Water resources and water/sewage infrastructure which has caused businesses to be turned away in some parts of the region.
- Awareness amongst farmers on the evolving business case and opportunities related to agriculture clean technology (e.g., RNG production, precision agriculture, etc.).

Table 2 below provides a snapshot of the Fraser Valley's current strengths in line with relevant macro-level trends.

¹⁷ See: <http://www.fvrd.ca/assets/Government/Documents/AgricultureSnapshot.pdf>

¹⁸ See: <http://www.vancouversun.com/technology/manure+powers+businesses/8555845/story.html>

Table 2: Fraser Valley Strengths in line with Macro Trends in Sustainable Resource and Ecosystem Management.

Macro Trend	Alignment with Local Strengths	Potential Project Opportunities	Key Stakeholders
Precision Agriculture: Data driven crop management maximizes outputs, optimizes the use of inputs (water, fertilizer and other nutrients).	The region is the agricultural capital of Canada, home to the most productive soils in the country and well positioned to showcase leading crop management technologies.	<ul style="list-style-type: none"> • Spatial AI Technology: Manipulate and forecast land use changes and plan for allocation of land resources. • Agriculture Data Portal: Forecast and plan land use and allow local industry to collect and consume data related to terrain, soil, clean water, contaminated water. 	<ul style="list-style-type: none"> • Local technology accelerators • Local R&D leaders and universities Other community and regional stakeholders
Mechanization: Data collection, automation and sensors boost productivity, create efficiencies, and address labour/skills shortages while creating opportunities to train existing workforce on high-tech systems.	Local manufacturing and food processing businesses have expertise and experience in updating and advancing their systems and infrastructure to keep pace with market demands, making them well positioned for future technological shifts.	<ul style="list-style-type: none"> • Advanced Manufacturing Cluster and Skills Development: A targeted initiative to upgrade infrastructure across the region’s manufacturing facilities while leveraging trades and training programs through local universities to build capacity among the local community to operate advanced manufacturing software and machinery. 	<ul style="list-style-type: none"> • Local technology accelerators • Local R&D leaders and universities • Economic development team leaders • First Nation community organizations • Other community and regional stakeholders • <i>Note: Key case study reference: Advanced Manufacturing Supercluster program, Southern Ontario</i>
Circular Economy: Diverting waste streams to create new resources	<p>Strong political will exists across municipalities to increase recycling and composting infrastructure and programs.</p> <p>Mattress Recycling, based in Hope, BC, is the first and largest dedicated mattress recycling company that breaks down used mattresses into its basic components and recycled into new uses.</p>	<ul style="list-style-type: none"> • Waste to Resource Stakeholder Matchmaking: Create a platform for local farmers and other businesses to connect waste streams with resource gaps and apply technologies (e.g. anaerobic digesters producing biogas). • Circular Economy Feasibility Study: 	<ul style="list-style-type: none"> • Local government • Business leaders from existing waste-to-resource companies • Local R&D leaders and universities • First Nations community organizations

	<p>Local commercial operations such as Net Zero Waste Inc., Bakerview EcoDairy and the Molson Coors Brewery demonstrate the business case for using waste as a resource.</p>	<p>Continue to explore the feasibility of a material separation facility. This could result in more circular economy and renewable energy opportunities per the FVRD SWMP.</p>	
<p>Land Use & Densification: Maximizing the utilization of available resources</p>	<p>A cluster of soil and brownfield remediation companies in Mission that specialize in technology that cleans and processes contaminated land.</p>	<ul style="list-style-type: none"> • Land Remediation Program: Apply local expertise in soil remediation technology to transform parcels of land into project sites that provide development opportunities for industry. 	<ul style="list-style-type: none"> • Local technology accelerators • Local R&D leaders and universities • First Nations community organizations

Green & Sustainable Transportation

On a global scale, there is a shift happening to decarbonize transportation through increased electrification, deployment, and adoption of zero emissions vehicles, low carbon fuels, and implementing infrastructure to reduce the number of vehicles on the road and move people and goods through more efficient and alternative forms of mobility.¹⁹ Sustainable modes of transportation are becoming increasingly common across Canada as governments at the federal, provincial, and local levels look to green transportation solutions to reduce emissions, create jobs, and spur economic growth.^{20 21}

The solutions being emphasized by governments²² include the implementation of electric vehicle and low-carbon fuel infrastructure, regulation and testing of autonomous vehicles, implementation of clean fuel standards for vehicles, and the piloting and deployment of low-carbon solutions, including electrification and biofuels, for long-haul trucking, rail, marine, and aviation.²³

At a local level, the focus is on smart mobility and land use planning that enables sustainable multi-modal options (e.g., transit, walking, cycling, car share) and avoids locking citizens into carbon-intensive patterns or habits (e.g., single occupancy vehicle trips exacerbated by urban sprawl).²⁴ Recent findings from Statistics Canada show that in 2016, nearly one-third of Canadians used a mode of sustainable transportation as part of their primary mode of commuting.²⁵ The statistics also show that cycling and public transit experienced the highest growth of any mode between 1996 and 2016.

Trends in car ownership are also showing a shift toward sustainable transportation modes, especially in urban centres. For example, the City of Vancouver is experiencing a steady decline in car ownership due to the rising cost of operating a vehicle alongside parking fees.²⁶ The decline is also being driven by the City's success in encouraging citizens to take different modes of transportation by providing more frequent and integrated transit service (e.g.,

What is Green & Sustainable Transportation?

The Green and Sustainable Transportation sector includes:

- Electric and autonomous vehicles
- Public transit and rail
- Alternative fuels (e.g., biofuels, hydrogen, renewable natural gas)
- Smart transportation systems and technologies, and related integrated land use planning.

¹⁹ See: <https://www.pembina.org/blog/global-momentum-clean-transportation-lets-bring-it-canada>

²⁰ See: <https://www.pembina.org/blog/global-momentum-clean-transportation-lets-bring-it-canada>

²¹ See: <https://www.tc.gc.ca/eng/future-transportation-canada.html>

²² See: <https://www.tc.gc.ca/eng/future-transportation-canada-green-innovative-transportation.html>

²³ See: <https://www.canada.ca/en/natural-resources-canada/news/2018/08/challenging-canadian-innovators-to-develop-cleaner-aviation-fuel.html>

²⁴ See: <https://www.pembina.org/blog/global-momentum-clean-transportation-lets-bring-it-canada>

²⁵ See: <https://www12.statcan.gc.ca/census-recensement/2016/as-sa/98-200-x/2016029/98-200-x2016029-eng.cfm>

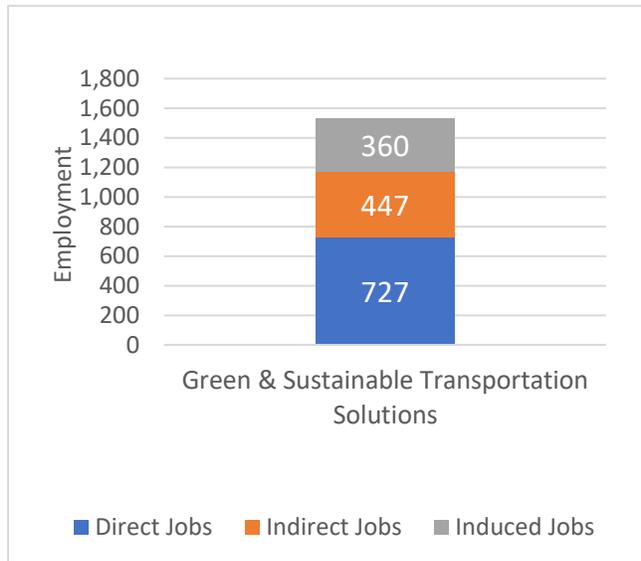
²⁶ See: <https://biv.com/article/2017/01/car-ownership-declining-city-vancouver>

expanded and more frequent bus and rail services, ease of payment, apps integrating real time transit, and car sharing programs), as well as safer infrastructure for cyclists and pedestrians.²⁷

There are also green transportation trends emerging around the efficient and sustainable movement of goods. Supply and distribution companies are pushing toward cloud-based digital platforms that allow them to track real-time data as goods move along the supply chain, pinpoint inefficiencies, enhance responsiveness to problems, and deliver better overall client service.²⁸ Distribution companies are also moving toward zero or low-emissions

Policy Drivers in Green & Sustainable Transportation

- Investing in Canada Infrastructure Program
- Clean Energy Innovation Program (NRCan)
- Federal Clean Fuel Standard
- CEV Advanced Research & Commercialization
- Renewable & Low Carbon Fuel Requirements Regulation
- BC Clean Vehicle Program
- BC ZEV Legislation



Source: Delphi Group, based on Statistics Canada 2016 Census data.

Figure 7: Green and Sustainable Transportation Employment in the Fraser Valley (2016).

transportation (22.7%) due to a high proportion of car pooling (16.5%). However, it had one of the lowest proportions of public transit commuters (2.5%) and the lowest proportion of commuters using active transportation (3.7%).³¹ It is important to note that since 2007, transit ridership in the region has increased by 43%

vehicles as a means of implementing sustainable practices. Walmart, for example, will have 20 new Tesla trucks operating from its Surrey, B.C. distribution centre by 2022.²⁹ The movement of goods and people via rail is also moving to decarbonize their operations through electrification of urban rail transit and use of alternatives fuels such as liquified natural gas (LNG) in the freight railway sector³⁰ and compressed natural gas (CNG) for conventional transit.

Fraser Valley Sector Snapshot

It is estimated that the Green and Sustainable Transportation sector was responsible for 727 direct jobs, 447 indirect jobs and \$245,127 in direct GDP in 2016. Jobs in this sub-sector are concentrated largely in repair and maintenance, scientific and technical consulting, and rail and urban transportation systems. (See Figure 7)

Statistics Canada revealed that in the Fraser Valley Abbotsford–Mission CMA had the highest proportion of commuters using sustainable

²⁷ See: <https://biv.com/article/2017/01/car-ownership-declining-city-vancouver>

²⁸ See: <https://www.mixmove.io/blog/these-are-the-5-key-logistics-trends-in-2019>

²⁹ See: <https://www.newswire.ca/news-releases/walmart-canada-commits-to-100-per-cent-alternatively-powered-fleet-vehicles-by-2028-692578051.html>

³⁰ See: https://sencanada.ca/content/sen/committee/421/ENEV/Briefs/2016-10-25RailwayAssociationofCanada_Brief_e.pdf

³¹ See: <https://www12.statcan.gc.ca/census-recensement/2016/as-sa/98-200-x/2016029/98-200-x2016029-eng.cfm>

through the expansion of municipal systems and the introduction of the Fraser Valley Express.³² While progress has been made, the low proportion of commuters using active transportation and transit options reflects the challenge that the region faces in diverting commuter traffic away from single occupancy vehicle trips. This also presents an opportunity to move quickly toward solutions based in sustainable transportation technologies across transit, electric vehicles and micro-mobility (e.g. sharing programs for cars, bikes and electric scooters).

The economic performance of the Green and Sustainable Transportation sector could be improved through further investment in electrifying transit fleets, producing or purchasing biofuels for both air and ground travel, and updating infrastructure and smart city applications to enable walking, transit service, cycling and car sharing. The latter is key in addressing the challenge around “last mile”³³ or the distance between a transit hub and a passenger’s final destination that is common in suburban and rural areas.³⁴

Local Capacity & Comparative Strengths

The Fraser Valley’s proximity to Metro Vancouver, the U.S. border, and the Cascadia Corridor is a key strength that promotes the flow of goods, people, and business. Moving forward, the region can apply sustainable transportation planning and adopt new opportunities related to smart mobility services, technology, and infrastructure to improve the flow of traffic and mitigate congestion. The Fraser Valley is one of the regions in B.C. with the highest potential for growth and innovation in green and sustainable transportation as it is currently expanding and improving transit services to meet the needs of a growing population and greater movement of goods and people.³⁵

Other key strengths that exist in the region are the presence of two major airports: Abbotsford International Airport and Chilliwack Airport, each offering valuable connections to national and international markets. They also have the potential to serve as hubs for research and development on technologies that reduce the carbon footprint of aviation (such as biofuels, IoT and automation technologies, electrification of ground-based vehicles and equipment, energy efficient systems to support amenities at the main terminal).

Regarding rail infrastructure, the Fraser Valley is serviced by both passenger and freight rail. VIA Rail offers passenger service to several FVRD communities, including Abbotsford and Chilliwack³⁶, while Southern Railway of BC (SRY), CN, and CP provide freight rail service to the Fraser Valley with stations in Mission, Abbotsford, and Chilliwack.³⁷ TransLink’s West Coast Express service provides commuter rail service between Mission and downtown Vancouver on the north side of the Fraser River. As the Fraser Valley’s population grows, there are opportunities around passenger rail service between the Fraser Valley and Metro Vancouver on the south side of the Fraser, however this remains a long-term goal as governments and local stakeholders continue to strategize around infrastructure and cost-benefit analysis.³⁸

³² See: Fraser Valley Regional District Draft Regional Growth Strategy 2018 Monitoring Report.

³³ The final distance between transit hubs and commuters’ final destination (i.e. house or work).

³⁴ See: Key informant interview with provincial transit provider.

³⁵ See: Key informant interview with provincial transit provider.

³⁶ See: <https://www.viarail.ca/en/explore-our-destinations/stations/rockies-and-pacific/list>

³⁷ See: <https://www.sryrailand.com/about-us/overview/>

³⁸ See: https://www2.gov.bc.ca/assets/gov/driving-and-transportation/reports-and-reference/reports-and-studies/transit/summary_strategic_review_fraser_valley_summary.pdf

Existing gaps within the Fraser Valley's Green and Sustainable Transportation sector include:

- Lack of transportation options or routes to bypass the traffic congestion on the main Highway 1 corridor (currently this main corridor is designed to prioritize cars and commercial vehicle traffic and not for transit or other modes);
- Inter-connected transit service between municipalities and from main hubs to final destinations in residential or industrial areas;
- Patchwork of EV charging stations available across municipalities;
- Safe cycling and pedestrian routes connecting transit hubs to "last mile" destinations;
- Relatively low population density creates challenges around cost of building out rail transportation to the region.³⁹

While these gaps represent challenges around the efficient movement of people and goods, they provide an avenue for municipalities to work together on a regional level to implement more integrated, regionally-focused sustainable transportation strategies. As an example, there are approximately 10 projects currently underway to upgrade road infrastructure to provide more access to HOV lanes and transit routes, with the goal of reducing congestion.⁴⁰

The region is also benefiting from the following projects that are expanding transit service, zero emission bus fleets, electric vehicle infrastructure, and applying software platforms to inform and update transit users:

- BC Transit's new transit facility in the region will store and maintain an expanding bus fleet that will be converted to compressed gas natural gas by 2020;⁴¹
- Potential to replicate Vancouver Island's electric bus pilot program in the Fraser Valley;⁴²
- The Smart Bus Next Ride Program which is under development and expected to be launched in the Fraser Valley in the coming years to provide customers with real time bus schedules and locations to improve rider service among municipalities;
- Abbotsford's membership with the Intelligent Communities Forum is driving smart city best practices and projects across intelligent transit corridors, alongside related smart infrastructure and digital solutions to optimize the movement of people.⁴³

Table 3 below provides a snapshot of the Fraser Valley's current strengths in line with macro trends in green and sustainable transportation.

³⁹ See: https://www2.gov.bc.ca/assets/gov/driving-and-transportation/reports-and-reference/reports-and-studies/transit/summary_strategic_review_fraser_valley_summary.pdf

⁴⁰ BC Major Projects Inventory Q2 2018 <http://maps.gov.bc.ca/ess/hm/bcea/?catalogLayers=5178> and Fraser Valley Regional District Draft Regional Growth Strategy.

⁴¹ See: <https://bctransit.com/central-fraser-valley/transit-future/corporate-infrastructure-initiatives/transit-operations-maintenance-facility>

⁴² Key informant interview with provincial transit provider.

⁴³ See: <https://caed.abbotsford.ca/locate-here/smart-city-abbotsford/>

Table 3: Fraser Valley’s Strength in line with Global Macro Trends in Green and Sustainable Transportation.

Macro Trend	Alignment with Local Strengths	Potential Project Opportunities	Key Stakeholders
<p>Electrification of Transportation: from domestic EVs to electric airlines, electrification of transportation is a key tool to achieve emission reduction targets.</p>	<p>The region and its municipalities are aligned with province-wide goals to install EV charging stations and promote the electrification of transit and fleets across municipal governments and businesses.</p>	<ul style="list-style-type: none"> • EV Charging Stations: Municipalities and the FVRD have already begun installing EV charging stations, and opportunity lies in expanding this process and applying lessons learned around maintenance, location, ease of use. • Electrification of Rail and Air Travel: A strategy for the medium-long term to further reduce emissions. • EV Mechanics: Updating the skillsets and knowledge of automotive repair and maintenance will be a key investment opportunity to support the growth of EVs. 	<ul style="list-style-type: none"> • Private businesses • Local government • Local transit providers • R&D leaders and universities • Other community and regional stakeholders
<p>Autonomous Vehicles: Self parking, self braking, and self driving, the use of autonomous vehicle technology will be road ready by 2025.</p>	<p>As the region looks to address transit and congestion issues, it is well positioned to begin adapting infrastructure and transportation projects to support autonomous vehicles.</p>	<ul style="list-style-type: none"> • Autonomous Vehicle Piloting: The Abbotsford International Airport can be looked to as a key location to trial autonomous vehicles within the airport boundaries (e.g. transporting luggage from plane to terminal) or moving passengers from the airport to their destination. 	<ul style="list-style-type: none"> • Abbotsford International Airport • Local tec accelerators • Local universities
<p>Smart Mobility and Logistic Hubs: Application of sensors and software enable intelligent traffic management and keep drivers and transit users informed before, during and after their trip.</p>	<p>There is a growing digital and information and communication technologies (ICT) base in the region that can serve as a foundation for building software-based solutions for transportation.</p> <p>Activity is already underway in this area through Abbotsford and its partnership with the Intelligent Community Forum to</p>	<ul style="list-style-type: none"> • Micro-mobility / Sharing Programs: A solution to close the distance between commercial and residential destinations from transit hubs (e.g. sharing programs for electric scooters, bicycles, etc.). 	<ul style="list-style-type: none"> • Local government • Local transit providers • R&D leaders and universities • Private businesses • Other community and regional stakeholders

	<p>develop an intelligent transit corridor.⁴⁴</p> <p>The region has pocket transit hubs that can act as launch points for micro mobility⁴⁵ (i.e., bike share car share programs).</p>		
<p>Renewable Fuels</p>	<p>The region is well positioned to support the provincial government mandate on low carbon fuels as a means to achieve emission reduction targets.</p>	<ul style="list-style-type: none"> • Low Carbon Fleets: Corporate strategy to require the use of low carbon fuels across all light and heavy duty vehicles used for municipal operations. • Biofuel R&D: Partnerships between local universities and the Abbotsford International Airport to test and pilot biofuels can generate high tech and knowledge-based jobs (i.e., a UFV Aviation Centre of Excellence). This could facilitate hydrogen-based aviation research at YXX. 	<ul style="list-style-type: none"> • Local governments • Abbotsford International Airport • Local universities • Private businesses

⁴⁴ See: https://www.abbotsford.ca/city_hall/smart_cities_challenge.htm

⁴⁵ This term refers to the use of small personal transportation options, such as bicycles, electric scooters, or small electric cars. These are available to commuters to travel from a transit hub to their final destination.

Green & High-Performance Buildings

Both Canadian and global building markets are experiencing a clear shift toward green buildings and infrastructure. The drivers for green building projects across residential and commercial construction include client demands, environmental regulations and building codes, and the value placed in healthy buildings.⁴⁶

Canada’s green building sector contributed \$23.45 billion in GDP in 2014 and this level of output is only expected to grow as the market recognizes the value of green buildings and more provinces and municipalities enact building codes that drive high performance building construction (e.g., BC Energy Step Code).⁴⁷ As an example, a recent report by McGraw Hill Construction points to a growing recognition of the business case for green buildings which is encouraging investment in both related building construction and supply of products and materials.⁴⁸

What are Green and High-Performance Buildings?

The Green and High-Performance Building sector includes products, services, and building materials related to energy efficient and high-performance building design, construction, renovation, and operations such as building envelope products (pre-fabricated walls and building components, windows / doors, insulation), mechanical systems (e.g., HVAC, hot water), lighting and control systems, and other products (e.g., engineered wood, etc.).

Policy Drivers in Green & High-Performance Buildings

- Low Carbon Leadership Fund
- Green Municipal Fund
- BC Energy Step Code
- BC Building Code
- EfficiencyBC Incentives
- CleanBC Strategy

The Fraser Valley is well-positioned to be active in this space through its strengths in local manufacturing and presence of developers experienced in sustainable building construction methods. Population growth forecasts and the pressure of the housing market in nearby Metro Vancouver create an opportunity for green building construction best practices to be deployed in order to accommodate new residents in a sustainable built environment. Modern green building design practices also create benefits with respect to both comfort and operational savings.

⁴⁶ See: https://www.cagbc.org/cagbcdocs/advocacy/World_Green_Building_Trends_2018_SMR.PDF

⁴⁷ Green Building in Canada: Assessing the Market Impacts and Opportunities. Canada Green Building Council.

⁴⁸ See: https://www.cagbc.org/cagbcdocs/advocacy/World_Green_Building_Trends_2018_SMR.PDF

Fraser Valley Sector Snapshot

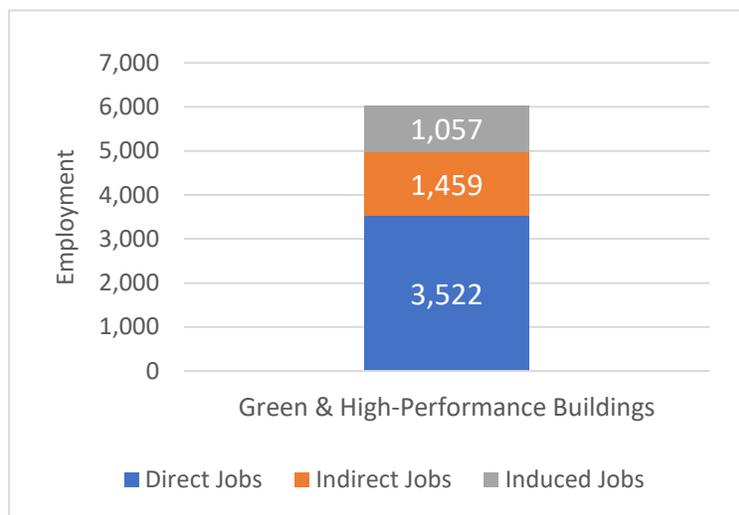
In B.C., there has been a 38% increase in investment in larger green buildings, totalling \$10.6 billion in 2016, spurring on job growth for green building products.⁴⁹ The Fraser Valley’s Green and High-Performance Building sector is no exception. In 2016, the sector was responsible for 3,522 direct and 1,459 indirect jobs and a GDP contribution of \$297,455 (See Figure 8). The established workforce base represents an opportunity to use existing skillsets to expand knowledge and skills in high performance building design, construction and installation of energy efficient mechanical and building envelope components.

Local Capacity and Comparative Strengths

There are several builders and developers in the region that represent a key source of expertise that can be applied to the development of green building infrastructure in the region.

The Fraser Valley is also home to many manufacturing companies that implement green building principles and technologies and are well-positioned to adapt to the evolving high-performance building code in B.C. Examples of local industry leaders include Westeck Windows, Structurecraft, Algra Brothers, and Ram Construction.

The Fraser Valley can use the strengths of companies who offer manufacturing and construction services to partner with training institutions in order to grow local talent and skills. UFV’s research and trades training provides modern programs for building talent in areas such as architectural drafting and design, carpentry, welding, electrical, and electronics, automation, and robotics.⁵⁰



Source: The Delphi Group, based on Statistics Canada 2016 Census data.

Figure 8: Green Building sector employment in the Fraser Valley (2016 estimate).

This sector also stands to benefit from the growth of modular and pre-fabricated building components; part of a global trend taking place across construction markets. Manufacturers of pre-fabricated building components are well-suited to utilize affordable, small-scale and cost-effective industrial land to establish manufacturing operations that can connect local suppliers and construction sites.

⁴⁹ See: <https://www.pembina.org/op-ed/growing-green-building-sector>

⁵⁰ See: <https://www.ufv.ca/programs/>

Structurecraft is one example of a leading manufacturer that moved to the Fraser Valley to take advantage of affordable industrial land and serve the growing market for engineered wood products. The company’s new 50,000 square foot facility manufactures Dowel Laminated Timber (DLT) and has strengthened the local supply chain around pre-fabricated walls and roof panels. As demand continues to grow for such products in line with the B.C. Energy Step Code and other high-performance building codes, the Fraser Valley stands to become a hub for micro-manufacturers who can benefit from the region’s proximity to key local and international markets.

In terms of construction, the Canada Education Park, U-District, and neighbourhoods built by SonBuilt Homes exemplify the region’s knowledge and capabilities in delivering high-performance buildings.

Local green builders and developers in the Fraser Valley include:

- Algra Brothers
- Island West Coast Developments
- Kindred Construction Ltd.
- Maclean Homes Ltd.
- Major Homes Ltd.
- Monolith Design Build Ltd.
- Optimum Solution Design Build Ltd.
- Ram Construction
- RJR Construction Management Ltd.
- Silver Valley Homes Ltd.
- SonBuilt Custom Homes

- **Canada Education Park**, located in Chilliwack, has led the planning and development of commercial and institutional buildings that implement sustainable building design and technology (examples of projects include the Prospera multiplex arena, Chilliwack General Hospital, Cheam Leisure Centre, and Garrison Crossing).⁵¹
- **The U-District** represents a collaboration between the University of Fraser Valley and City of Abbotsford to showcase the concept of sustainable neighbourhoods built around centres through densities, public spaces, multi-modal transportation network, and servicing / green infrastructure strategies.⁵²
- **SonBuilt Homes** led the construction of The Vine, a master planned neighbourhood of 16 high performance homes built to R-2000 standards and with ENERGY STAR approved windows and heating/cooling systems.⁵³

Table 4 below provides a snapshot of the Fraser Valley’s current strengths in line with macro trends in Green and High-Performance Buildings.

⁵¹ See: <http://businessinchilliwack.com/major-projects/>

⁵² See: https://www.abbotsford.ca/city_hall/plan_for_200K/neighbourhood_plan_-_udistrict.htm

⁵³ See: <http://sonbuilthomes.com/thevine/>

Table 4: Fraser Valley’s Strengths in line with Global Macro Trends in Green and High-Performance Buildings.

Macro Trend	Local Strengths	Opportunity for Investment	Key Stakeholders
<p>“Envelope First” Approach, Next Generation Material and Wood Construction, and the BC Building Code: Increasing demand for high-performing windows, doors, insulation, and engineered wood products.</p>	<p>The region is home to many local business leaders in building construction that have aligned with the shift to energy efficient and high-performing buildings.</p> <p>Leading manufacturers in the region produce engineered wood products and energy efficient windows and are well positioned to meet increased demand for energy efficient building construction.</p>	<p>Municipal governments can encourage local businesses to innovate in green building technology. By applying the higher steps of the building code to municipal buildings, builders can showcase the envelope first approach and realize subsequent savings in heating and cooling costs.</p>	<ul style="list-style-type: none"> • Local building developers • Municipal governments • Manufacturers of high-performance building products and materials (i.e., windows and doors, insulation, wood products, pre-fabrication) • Local universities
<p>Growth of Pre-fabrication & Modular Construction</p>	<p>Low-cost and accessible industrial land offers pre-fabrication or modular construction operations valuable space to develop their business and support the growth in building construction across the region.</p>	<p>Local governments can provide support micro manufacturers wishing to locate on affordable industrial land near transportation corridors to serve the Fraser Valley and Metro Vancouver regions.</p>	<ul style="list-style-type: none"> • Municipal governments • Economic development agencies • Local modular home developers • Other community and regional stakeholders

Renewable Energy Supply & Storage

There is a global transition underway to clean and low carbon sources of energy, driven by the growing understanding of the pollution and GHG emissions created through the combustion of fossil fuels. Countries, cities, businesses, and citizens are increasingly exploring renewable and alternative forms of energy as technology advances lead to affordability and reliability of new energy sources.

The International Energy Agency estimates that over 70% of the world’s energy supply investment comes from governments and their policies, and these policies shape improvements in energy efficiency and technology innovation.⁵⁴

The growing field of smart grid / grid modernization leverages advances in computing and telecommunications technology to embed intelligence into the grid. By using these new technologies to monitor and control the grid, utilities can enable energy storage and grid optimization, capacity for electric vehicles, integration of renewable energy sources, and improved reliability. Natural Resources Canada estimates a \$70 billion investment opportunity to apply smart grid technologies over the next 20 years.⁵⁵

In Canada, renewable energy sources provided 66% of total generating capacity in 2016.⁵⁶ Canada’s commitment to the Paris Agreement led to the Pan-Canadian Framework for Climate Change and Clean Growth and includes new policies and incentives to reduce GHG emissions and transition to renewable energy. (see policy sidebar)

Policy Drivers in Renewable Energy

- Pan-Canadian Framework for Climate Change and Clean Growth
- Low Carbon Economy Fund
- Clean Energy Innovation Program (NRCan)
- CleanBC Communities Fund
- BC Clean Growth Program for Industry
- Innovative Clean Energy (ICE) Fund
- Canada-BC Agri-Innovation Program

What is Renewable Energy Supply and Storage?

The Renewable Energy Supply and Storage sector includes wind, solar, geothermal, hydro, biomass, district energy, waste heat to power, anaerobic digestion, as well as energy storage / battery technology, smart grid, and related energy management technologies.

British Columbia’s electricity generation is dominated by clean hydroelectricity, resulting in close to 95% clean electricity for the province.⁵⁷ This backbone of clean electricity in B.C. provides an added benefit for reducing GHGs through the electrification of other sectors such as electric vehicles in transportation, the heating and cooling of buildings, and industrial operations.

At a local level, governments in B.C. are increasingly taking the lead on developing and managing sources of renewable energy. For example, Revelstoke District Energy⁵⁸, Surrey Biofuel Facility⁵⁹, and the Salmon Arm

⁵⁴ See: <https://webstore.iea.org/download/summary/190?fileName=English-WEO-2018-ES.pdf>

⁵⁵ See: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/SmartGrid_e_acc.pdf

⁵⁶ See: <https://www.neb-one.gc.ca/nrg/sttstc/lctrct/rprt/2017cndrnwblpwr/2017cndrnwblpwr-eng.pdf>

⁵⁷ See: <https://www.neb-one.gc.ca/nrg/sttstc/lctrct/rprt/2016cndrnwblpwr/prvnc/bc-eng.html>

⁵⁸ See: <http://www.revelstokecommunityenergy.ca/sustainability.html>

⁵⁹ See: <https://www.surreybiofuel.ca/>

Landfill Gas Capture⁶⁰ are models of local government-led renewable energy projects with the potential to be replicated in other parts of the province. More locally, the JAMES wastewater treatment plant in Abbotsford⁶¹ has three digesters generating methane gas which is used as a fuel to produce heat and electricity at the plant.

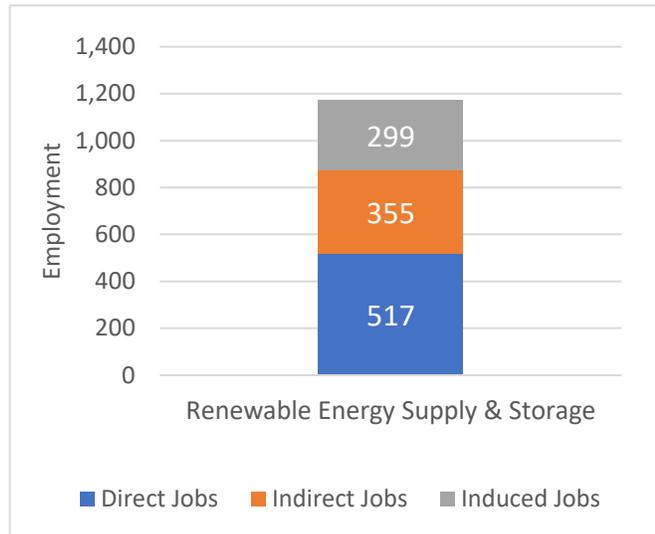
Fraser Valley Sector Snapshot

The importance of this sector to the region’s clean economy is significant. Power supply and storage is an enabling tool for many other clean economy initiatives in the region.

The Fraser Valley’s power supply comes from relatively clean sources due to the abundance of nearby hydroelectricity facilities. There are 5 new small-scale hydroelectricity projects proposed or underway in the region, representing over 90 MW of new electricity supply. This additional supply can help to support the growth of electric vehicles, energy efficiency upgrades in buildings, and electrification of large industrial operations.

The region’s agriculture sector is well established, and associated waste products provide an opportunity for increased production of renewable natural gas (RNG) as an energy source.

It is estimated that the Renewable Energy Supply and Storage sector was responsible for 517 direct jobs, 355 indirect jobs, and \$188,922 in direct GDP in 2016 (see Figure 9). Jobs in this sector are concentrated in specialty trades, engineering, and scientific and technical consulting services.



Source: The Delphi Group, based on Statistics Canada 2016 Census data.

Figure 9: Renewable Energy Supply and Storage sector employment in 2016.

⁶⁰ See: <https://www.toolkit.bc.ca/Success-Story/Columbia-Shuswap-Regional-District-Landfill-Methane-Gas-Capture>

⁶¹ See: https://www.abbotsford.ca/city_services/wastewater/wastewater_faqs.htm

Local Capacity & Comparative Strengths

The Fraser Valley region has a significant amount of energy capacity and future potential across multiple energy sources. Hydro projects are being developed across the region, with two construction-stage facilities combining for approximately 50MW of run-of-river hydroelectricity near Harrison Lake.

District energy and geo-exchange systems also provide new investment and GHG reduction opportunities for the region. UFV has been a leader in this space, having installed a geo-exchange system as part of a broader suite of energy efficiency technologies in one of its new campus buildings. The project demonstrated a leading-edge system for the region and the carbon intensity of the building is 68% less than other buildings on campus.⁶²

The abundance of agriculture waste and other biomass gives the Fraser Valley a comparative advantage in the growing field of biogas production. Fraser Valley Biogas converts agricultural waste into biogas that is further upgraded to RNG. The facility produces 90,000 GJ of RNG per year, enough to heat more than 1,000 homes.

Awareness of the RNG program is growing, but FortisBC relies on technology providers and engineering consultants to help build renewable energy literacy among farmers and other potential biogas producers. Coordination between FortisBC, consultants, and training institutions could help potential producers better understand the project development process, available technology, and best sources of information.

Hydrogen fuel cells are another source of renewable power that represent an opportunity for the region. Terrella Energy Systems, located in Mission, is a local leader in the manufacturing of corrosive-resistant graphite plates, a key component of hydrogen fuel cells. Related research is underway at UFV to optimize the production of hydrogen fuel and improve its economic viability to benefit companies, both regionally and province-wide.

Table 5 below provides a snapshot of the Fraser Valley's current strengths in line with current macro trends in renewable energy supply and storage.

⁶² See: <https://ufv.ca/media/assets/energy-management/energy-management/UFV-SEMP-2017-2018.pdf>

Table 5: Fraser Valley’s Strengths in line with Global Macro Trends in Renewable Energy Supply and Storage.

Macro Trend	Alignment with Local Strength	Potential Project Opportunities	Key Stakeholders
Renewable Power Supply – Hydroelectricity and Solar PV	The region is home to existing and planned hydroelectricity infrastructure.	<ul style="list-style-type: none"> • Proposed run-of-river hydroelectricity infrastructure: four projects are currently in the proposal stage and new opportunities for the deployment of solar PV installations exist throughout the region, including through partnerships with First Nation communities. 	<ul style="list-style-type: none"> • Local utility providers • First Nation community organizations
Renewable Energy Supply – Biogas and RNG	An abundance of biomass from agriculture and forestry creates the potential for biogas and renewable natural gas (RNG) production.	<ul style="list-style-type: none"> • Community-Scale Digester Facilities: agricultural operations can feed organic waste into community-scale facilities that are near existing gas infrastructure. 	<ul style="list-style-type: none"> • Local utility providers • Local First Nations • Local governments • Local agriculture operations / farmers • others
Energy Storage and Grid Infrastructure Modernization	Distributed energy sources and remote communities provide opportunities for grid modernization and expansion.	<ul style="list-style-type: none"> • Smart Grid Applications: an opportunity to manage the efficient distribution of electricity throughout municipalities through software solutions • Micro Grids: a valuable tool that can be applied to the region’s remote communities, creating opportunities to boost resiliency and develop projects on land that was otherwise inaccessible to electricity infrastructure. 	<ul style="list-style-type: none"> • Local utility providers • Local universities • Local governments • First Nation community organizations

Knowledge & Innovation

At a national, provincial and regional level, the Knowledge and Innovation sector of the clean economy is a key driver of solutions and best practices in sustainable resource management, green transportation, green buildings, and renewable energy. This sector underpins the innovation required to advance the transition to a low-carbon economy and is comprised of an ecosystem of R&D institutions, universities, centres of excellence, industry partners, and tech accelerators. Collectively, the sector is responsible for piloting and scaling clean technological solutions, collection and analysis of big data, policy and regulatory design, and implementation of programs that encompass each aspect.⁶³

This technological shift is known as the Fourth Industrial Revolution (4IR) and is characterized by technologies that bring together the physical, digital and biological worlds in real-time.⁶⁴ These technologies include artificial intelligence, robotics, internet of things (IoT), 3D printing and additive printing, data analytics, nano-technology, and materials science.⁶⁵ Collectively these technologies are disrupting nearly every industry by boosting productivity, connectivity, and responsiveness to disruptions or advances in the market place.⁶⁶ These advanced technologies are also driving the creation of new jobs across business and industry and demanding new skillsets and areas of expertise from college and university faculty and graduates.⁶⁷

Increasingly, the knowledge and innovation space within the clean economy (and specifically cleantech) is focused on the collection and analysis of data to optimize operations and better understand trends.⁶⁸ In 2017, the federal government recognized this growing trend and announced a \$14.5 million investment to establish a Pan-Canadian Clean Technology Data Strategy.⁶⁹ The goal of the strategy is to transform data into insight and visualize impacts to better understand the emerging trends and opportunities as governments at all levels plan for the transition to a clean economy.⁷⁰

The trend around big data comes from the idea that “what gets measured, gets managed”, and there are applications of this across manufacturing, agriculture, transportation, buildings, and energy. The process of implementing digital systems to collect and analyze data is further strengthened through collaboration between industry and the knowledge base at R&D institutions.

What is Knowledge and Innovation?

The Knowledge and Innovation sector includes:

- Educational institutions for workforce and skills development
- Finance and investment support;
- Research and development (R&D) institutions;
- Centers of excellence that build on the knowledge base of the clean economy.

⁶³ See: http://globe.ca/wp-content/uploads/2012/10/wcce_report_web_final.pdf

⁶⁴ See: <https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab>

⁶⁵ See: <https://medium.com/@jessicasmith/what-4ir-is-all-about-and-why-everyone-needs-to-know-ab2d64094a7d>

⁶⁶ Ibid.

⁶⁷ Ibid.

⁶⁸ See: <https://institute.smartprosperity.ca/sites/default/files/cleantechologyandbusinessinnovationwp30-07.pdf>

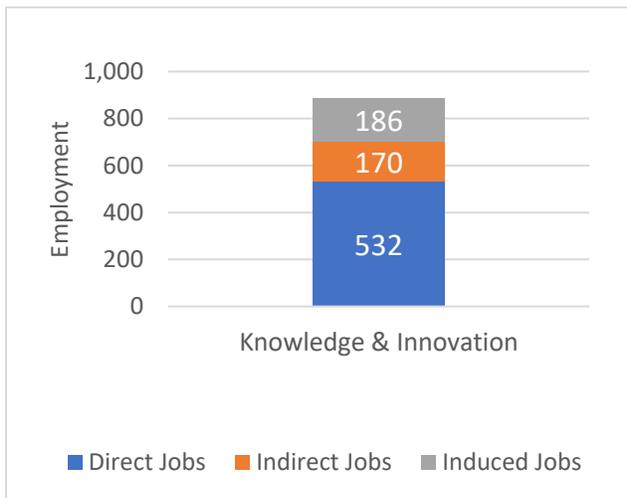
⁶⁹ See: <https://www.newswire.ca/news-releases/federal-data-measures-economic-contribution-of-clean-technology-in-canada-for-the-first-time-663948093.html>

⁷⁰ See: <https://www.newswire.ca/news-releases/federal-data-measures-economic-contribution-of-clean-technology-in-canada-for-the-first-time-663948093.html>

This type of collaboration ensures that current technology is used for data collection, and that results are properly analyzed to inform the challenges faced by industry, governments and other key stakeholders.⁷¹

Fraser Valley Sector Snapshot

The Fraser Valley’s local governments and leading industries, partnered with the network of post-secondary institutions, tech accelerators, and centres of excellence, can together create a valuable niche for collaboration to implement region-wide strategies for data collection and analysis. This creates opportunities not only to implement new systems and technologies, but to develop skillsets and a local knowledge base in data analysis; a common need across Canada.⁷²



In 2016, it is estimated that the Knowledge and Innovation sector was responsible for 532 direct and 170 indirect jobs, the bulk of which are employed across management, scientific and technical consulting services, business, professional and labour organizations, and financial investment services. In terms of GDP, in 2016 the sector generated \$50,559 in direct GDP and \$84,463 in total GDP contribution (See Figure 10). Given the land constraints faced by the Fraser Valley, building out the knowledge economy presents a key investment strategy that is not land intensive, can be coupled with the densification and sustainable design of new building construction, and capitalizes on national and global trends in the development and deployment 4IR technologies.

Source: The Delphi Group, based on Statistics Canada 2016 Census data.

Figure 10: Knowledge and Innovation sector employment in the Fraser Valley (2016).

Local Capacity & Comparative Strengths

The Fraser Valley is home to valuable R&D institutions and technology accelerators that are generally focused on agriculture and digital innovation. Table 6 below showcases key leaders in this space.

Table 6: Fraser Valley’s Key Leaders in Agriculture and Digital Innovation

Knowledge and Innovation Leaders	Alignment with Clean Economy Innovation
XLRator	A non-profit organization led by a select group of technology executives, industry partners and high education institutions, XLRator is working to attract technology-based investment to the region. The team is committed to growing out the economic potential of the region’s clean economy through digital innovation around agri-tech and geospatial artificial intelligence.

⁷¹ See: <https://institute.smartprosperity.ca/sites/default/files/cleantechnologyandbusinessinnovationwp30-07.pdf>

⁷² See: https://www.sas.com/en_ca/insights/articles/analytics/local/analytics-skill-gap.html

University of Fraser Valley Trades and Technology Centre	<p>The UFV Centre for Trades and Technology is a fundamental resource in the region that is dedicated to building a workforce equipped with skills in robotics, automation, 3D printing, additive manufacturing, and many other technical and digital skillsets relevant to each of the clean economy subsectors.⁷³</p>
Canada Education Park	<p>This park was launched by the City of Chilliwack, the Chilliwack Economic Partners Corporation, and Canada Lands Company in 2003 to provide facilities and human resources to develop a sustainable economic base for Chilliwack in the knowledge-based sector. Projects include the construction of compact efficient community hubs that provide walkable, green hubs and LEED certified buildings.⁷⁴</p>
University of Fraser Valley Agriculture and Food Institute	<p>The \$5 million Agriculture and Food Institute (AFI), includes a 250-square-metre demonstration barn, a 400-square-metre glass greenhouse, and two traditional poly-houses. The AFI has undertaken the following studies as examples: <i>Innovative Crops: Diversifying production on agricultural lands in Southwestern British Columbia</i>; <i>Dairy 2.0: Exploring policy implications and public perceptions of cellular agriculture</i>; and <i>Farming for the future: Maximizing the return on investment of agricultural land preservation</i>.⁷⁵</p>
Pacific Agri-Food Research Centre	<p>The Pacific Agri-Food Research Centre located in Agassiz, studies the flows, interactions and impacts of agriculture systems within populated areas and agroecosystem resiliency. Through its R&D the centre has developed solutions to help farmers apply sustainable practices such as an online computer model for farmers to obtain real time decision support for precise management of nitrogen.⁷⁶</p>
Chilliwack Innovation Network	<p>A standing committee tasked with developing opportunities, partnerships, projects and events that foster innovation, specially those focused on technological solutions. The committee is comprised of stakeholders from academia, industry, local governments and business representing strengths and leadership from across the Fraser Valley.⁷⁷</p>
WestGen	<p>A leader in Western Canada on genetics and reproduction, WestGen (located in Abbotsford) conducts leading edge research and delivers advanced technology solutions that support the sustainable development of Western Canada’s dairy and beef industries. Their research epitomizes the 4IR shift towards data and productivity driven solutions.⁷⁸</p>

⁷³ <https://www.ufv.ca/trades/>

⁷⁴ <http://businessinchilliwack.com/canada-education-park/>

⁷⁵ <https://www.ufv.ca/food-agriculture-institute/projects-partnerships/current-research-projects/>

⁷⁶ <http://www.agr.gc.ca/eng/science-and-innovation/agriculture-and-agri-food-research-centres-and-collections/british-columbia/agassiz-research-and-development-centre/?id=1351005326819>

⁷⁷ See: <http://businessinchilliwack.com/chilliwack-innovation-network/>

⁷⁸ See: <https://westgen.com/about/the-westgen-group/>

The food production supply chain is one of the region's assets where digital innovation can be applied. The UFV Food and Agriculture Institute, for example, is part of a collaboration working on building an integrated food hub network in the region using a platform that enables open-source farm management software and diversified farming systems. Both initiatives overlap with sustainable resource management but also require a knowledge base in digital operations and offer a space for training, learning and innovation to take place.

UFV's Digital Innovation Hub is working with Stantec, a global engineering and professional services company to design and develop the Digital Hub, a high-tech facility located on the Abbotsford Campus.⁷⁹ The Digital Hub will deliver technologically advanced learning for students and industry and will provide access to flexible power grids, digital communication platforms, leading-edge audio-visual equipment and industry standard digital tools.⁸⁰ This initiative aligns with the BC Tech Strategy and will ultimately look to attract talent to the Fraser Valley to create a tech hub beyond Metro Vancouver.

UFV's Trades and Technology Centre is also a hub for training and innovation where faculty are building skills and knowledge across:

- Robotics;
- Automation;
- Architectural drafting using industry standard technology in virtual reality;
- 3D printing; and
- Computer numerical control (CNC) routers.

Interest has also been garnered around creating training partnerships with local companies to advance skillsets in technology and practices used to manufacture engineered wood products. This type of collaboration is a key example of how the region can leverage its strengths across industry, education, and the existing workforce to create pockets of innovation and niche technical and digital skillsets that enable the sustainable and efficient production and management of resources.

Another key advantage for the Fraser Valley is access to the Cascadia Corridor, spanning from Vancouver, British Columbia, to Portland, Oregon. The initiative formed out of the jurisdictions' shared culture, geography, and growing economies as well as common strengths in sciences, cleantech, and advanced agricultural and forestry sectors.⁸¹ The trading relationship rooted in these shared strengths is also a fundamental aspect of each jurisdiction's prosperity. Given these existing synergies, the initiative provides a platform for leaders from the Fraser Valley to participate in collaborative partnerships and grow technological and economic development across:

- Life Sciences;
- Financial and Retail Innovations;
- Transportation, Housing, and Connectivity;
- Sustainable Agriculture;
- Transformative Technologies (AI/Cloud/MR/VR/AR); and
- Post-Secondary Education and Research.

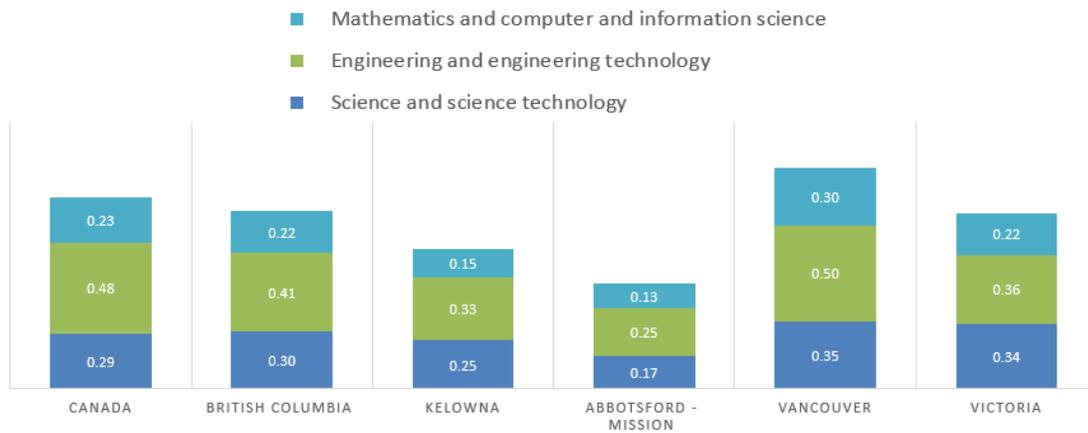
⁷⁹ See: <https://blogs.ufv.ca/blog/2017/01/ufv-hires-stantec-to-hone-digital-hub-vision/>

⁸⁰ Ibid.

⁸¹ https://www.bcbc.com/content/4058/BC-Washington_Linkages_FINAL.pdf

Potential gaps in the region in the Knowledge and Innovation sector include:

- Lack of workforce capacity to provide highly skilled technical workers for advanced manufacturing jobs and the ICT sector; relative to the other regions of BC, the Fraser Valley region lags behind in the total number of STEM occupations (see Figure 11).
- “Last mile” challenges, relating to business parks in the region that are operating on slower internet connections and have yet to connect to TELUS fibre upgrades.
- Lack of 5G internet; while some of the region has improved connectively through TELUS, there is still a gap before reaching 5G.
- Lack of internet services in some rural areas that hinders potential for economic development in these areas.



Source: Statistics Canada, December 2016.

Figure 11: Comparison of Fraser Valley Stem Occupations

Table 7 below provides a snapshot of the Fraser Valley’s current strengths in line with macro trends in the Knowledge and Innovation sector.

Table 7: Fraser Valley’s Strengths in Line with Global Macro Trends in Knowledge and Innovation

Macro Trend	Alignment with Local Strengths	Potential Project Opportunities	Key Stakeholders
Artificial Intelligence: Machine learning, cognitive computer, smart workspace.	The UFV’s Trades and Technology Centre, XLRator, and WestGen are examples of stakeholders who are working to in this space and present opportunities to focus their training and technology on challenges across all sectors.	<ul style="list-style-type: none"> • Agrifood and ICT cluster: Create a merging/cluster along the agriculture value chain – agriculture foods, land and ICT- can form a strategic hub for logistics and distribution and leverage the Fraser 	<ul style="list-style-type: none"> • Local tech accelerators • Local R&D leaders and universities • Other community and regional stakeholders

<p>Digital Platforms: Blockchain⁸⁷, IoT and big data relay chain of custody information for businesses and can track real time conditions across supply chains.</p>	<p>Key players in the region such as XLRator and Sumas Consortium on High Tech (SRTec) are active in building up the high-tech skills and knowledge base related to collection, tracking and analysis of data.</p>	<p>Valley's proximity to the Cascadia Innovation Corridor.</p> <ul style="list-style-type: none"> • Data Scientist⁸² Program: Develop training in data science that would equip students with the skills to analyze and communicate insights from collection of large amounts of data.⁸³ • Cascadia Innovation Corridor: Leverage the Cascadia's Innovation Corridor's binational steering committee⁸⁴ composed of the region's top business, research and community leaders, including Microsoft, Amazon⁸⁵ and Boeing⁸⁶ who have already leveraged the workforce and infrastructure offered by the corridor between Seattle and Vancouver. 	
<p>Biotechnology & Advanced Materials: Underpins the bioeconomy / circular economy concept. The product of advanced materials from waste includes nano-materials and carbon fibre applications across ceramics, glasses, and metals.</p>	<p>UFV's Food and Agriculture Institute, Net Zero Waste Inc., and Bakerview EcoDairy are all active in the use of circular economy principles by reusing waste and creating closed loop systems.</p>		
<p>Additive Manufacturing: 3D and 4D printing are changing traditional supply chains, bring manufacturing opportunities closer to home.</p>	<p>UFV's Trades and Technology Centre offers programs that train students on 3D printing, robotics, automation and other skills relevant to manufacturing software programs that are increasingly demanded by industry leaders.</p>		

⁸⁷ Blockchain is a decentralized and public digital ledger that tracks information on transactions (i.e. date, time, and dollar amount) and stores this information for various users (i.e. supplier or business owner).

⁸² A person employed to analyze and interpret complex digital data, such as the usage statistics of a website, especially to assist a business in its decision-making.

⁸³ <https://www.ept.ca/2017/02/york-university-responds-canadas-talent-shortage-big-data/>

⁸⁴ <https://www.newswire.ca/news-releases/canadian-us-business-leaders-announce-joint-framework-for-cross-border-growth-693169641.html>

⁸⁵ <https://www.nytimes.com/2016/10/03/technology/next-big-tech-corridor-between-seattle-and-vancouver-planners-hope.html>

⁸⁶ <https://www.newswire.ca/news-releases/new-regional-effort-aims-to-establish-cascadia-innovation-corridor-594174321.html>

Summary

The goals of this study were to gain a better understanding of the Fraser Valley’s existing strengths, gaps, and opportunities as they relate to the clean economy, identify supportive federal and provincial policies, and identify the necessary types of infrastructure to lay the foundation for sustainable growth. This section presents the most evident cross-sector themes and opportunities that emerged in the research, followed by specific opportunities in each of the five clean economy sectors.

Table 8: Summary of the Fraser Valley’s Clean Economy Cross-Sector and Sector-Specific Opportunities

CROSS-SECTOR OPPORTUNITIES	
Agriculture and manufacturing are the backbone of the region’s economy, provide many education and employment opportunities, and can be the focus for advancing economic strength and resiliency.	
Collaboration between jurisdictions, industry, and post-secondary institutions in information sharing and open data portals can inform decision making and progress toward common goals.	
Land use planning practices that enable transit-oriented development can create compact, complete, energy efficient communities, improve public health, and provide further opportunities for local manufacturers.	
Policies that facilitate waste-to-resource and circular economy partnerships between industrial users create an opportunity to create efficiencies in infrastructure and services.	
Further development of biogas / RNG from agriculture and forestry operations can increase renewable energy production and reduce GHG emissions.	
Fostering community partnerships with First Nation communities in land use, infrastructure, and skills development can also lead to innovation in management of natural assets and ecosystem health.	
SECTOR-SPECIFIC OPPORTUNITIES	
Sustainable Resource and Ecosystem Management	<ul style="list-style-type: none"> Growing concerns over waste management coupled with an increasing appetite for renewable energy encourages waste-to-energy projects consistent with the FVRD’s SWMP (e.g., biogas capture for energy production, anaerobic digestion and RNG production for input into the FortisBC pipeline and/or fueling transportation fleets). The Fraser Valley has the highest concentration of livestock in the province which produces large amounts of waste that can support RNG production. Private agriculture operations have the potential to expedite RNG project development.

	<ul style="list-style-type: none"> • Application of water, soil, and nutrient management strategies to maintain the region’s rich agricultural land informed by a centralized database that is open to land planners and farmers (including data about soil type and quality, water quality) • The BC Organics Conversion Initiative is a five-stage plan to drive resource efficiency solutions in the bioeconomy. This plan comes from a group of local technology entrepreneurs (Catalyst Agri-Innovations Society). • Leveraging local businesses that specialize in soil remediation to further rehabilitate brownfields as a means of revitalizing under-utilized industrial land. • Precision agriculture and data-driven crop management technologies can be applied to the region’s crop production and harvesting operations, including the application of AI and sensors to track water, air and soil quality and robotics (e.g., the use of on-farm robot harvesters) to address labor shortage issues. • Blockchain solutions for improving safety and transparency of sustainable resource product supply chains could be applied to other companies operating in the Fraser Valley (for example, IBM Food Trust, a blockchain in food safety initiative that is being used extensively by major global brands such as Walmart and Coca Cola). • Developing partnerships with organizations like the Municipal Natural Assets Initiative that work with local governments to develop strategies focused on protecting natural assets (e.g., bioswales, water filtering marshlands, etc.) in place of the need to invest in new infrastructure. • Focusing on the higher value end of the supply chain and making the Fraser Valley a hub of locally sourced, sustainably harvested/processed foods. • Continuing to explore the feasibility of a material separation facility that could lead to the development of more circular economy and renewable energy opportunities. • Developing an agriculture data portal open to government, industry and universities to make satellite and GIS data available to key stakeholders and inform decision making (i.e. better understand where the opportunities and challenges exist across agricultural land). • Partnering with First Nation communities who possess valuable skillsets and traditional ecological knowledge that could act as a launch pad for sustainable agriculture and other resource development projects.
--	--

<p>Green and Sustainable Transportation</p>	<ul style="list-style-type: none"> • Micro-mobility as a solution to close the distance between commercial and residential destinations from transit hubs (e.g. sharing programs for electric scooters, bicycles). • Moving toward a larger and more energy efficient bus fleet to reduce emissions and reduce the number of cars on the main corridors in the region. • Electrification of fleets as a tool to achieve GHG emission reduction targets and show corporate leadership. • Electrification of rail is an emerging trend alongside the electrification of air travel expected to take off by 2030. • Planning for the growth of autonomous vehicles in road and city infrastructure; 80% of top OEMs have announced plans for highly autonomous technology road-ready by 2025. • Leveraging the CleanBC Communities Fund, a federal-provincial initiative that supports cost-sharing of infrastructure projects that align with renewable energy, access to clean energy transportation, improved energy efficiency of buildings, and generation of clean energy. • Exploring the potential for hydrogen-based aviation research at YXX through a UFV Aviation Centre of Excellence. • Continuing to expand EV infrastructure by installing more EV charging stations across the region. • Pairing reverse logistics and smart mobility solutions with new development of residential and industrial areas (e.g., transit-oriented residential and industrial development). • Implementing transit software platforms to allow transit users to easily interact with payment, schedules, and real-time updates.
<p>Green and High-Performance Buildings</p>	<ul style="list-style-type: none"> • The BC Energy Step Code emphasizes an envelope-first approach to boost energy efficiency in buildings and will create demand from the region’s manufacturers and suppliers for high-performance windows, insulation, heat recovery ventilators, and other building envelope products. • The Energy Step Code also presents an opportunity for the region to build capacity in energy advisors and train its trade base in best practices around the proper installation of high-performance windows, mechanical systems, and building envelope

	<p>components. Contractors can look to the Home Performance Stakeholder Council for training resources related to the BC Energy Step Code.</p> <ul style="list-style-type: none"> • As the Fraser Valley region plans for population growth, the green building sector can benefit from land use planning processes and zoning bylaws that encourage densification of residential and commercial areas with interconnected transit options. • Existing buildings also represent an opportunity to replace inefficient and older windows, furnaces, boilers, and insulation with high-efficiency models and apply healthy building concepts to improve tenant well-being. • Building architects and construction firms in the region can incorporate advanced building controls and technologies that are increasingly being built into residential and commercial construction to optimize the use of energy and efficiency of lighting, HVAC, security and sprinkler systems. • Construction companies in the region can collaborate with local waste management companies to find pathways for recycling and reuse of waste streams from construction sites across the region. • The region can build on the supply chain that is developing through Structurecraft’s new facility to advance the production and use of next-generation materials and wood construction. • The manufacturing of prefabricated building components utilizes small scale and cost-effective industrial land to establish micro-manufacturers that can close the gap between suppliers and construction sites. Municipalities can position themselves as hubs for micro-manufacturing or prefab operations given their access to relatively affordable land and transportation corridors. • The construction industry stands to benefit from adapting current trends taking place across technology, materials and tools given they tend to lag behind other industries (such as the automotive industry) that have already undergone a digital transformation. Construction operations in the Fraser Valley can use this an opportunity to become leaders in applying tools such as 3D printing, smart and life-cycle optimizing equipment, semi-automatic equipment, and enhanced contract and employee management software.
<p>Renewable Energy Supply and Storage</p>	<ul style="list-style-type: none"> • The combination of waste management challenges and an increasing demand for renewable energy to meet provincial low-carbon energy targets could fuel new waste-to-energy projects and infrastructure consistent with the FVRD’s SWMP.

	<ul style="list-style-type: none"> FortisBC has a voluntary target to increase the amount of RNG in its system, with a goal under CleanBC of having 15% of natural gas consumption in the province coming from RNG. Provincial regulations have given FortisBC an expanded procurement price cap of \$30 per GigaJoule for RNG, allowing the utility to take a more expanded view of projects that were previously not economically viable for farmers and other biogas producers. The electricity grid will require upgrades to support the increasing electrification of vehicles. As such, there is an opportunity to develop more small-scale renewable energy generation, micro grid, and energy storage solutions to meet this future demand. Also related to grid modernization is the significant investment opportunity to use energy storage solutions to increase grid reliability and resilience in the face of climate change and extreme weather events There are opportunities to develop increased renewable energy capacity (e.g., deployment of solar PV and energy storage solutions) within local First Nation communities. These opportunities could be advanced through a community partnership model with training institutions, technology providers, and other First Nations with renewable energy project experience.
<p>Knowledge and Innovation</p>	<ul style="list-style-type: none"> Building vertically instead of horizontally via technology and the knowledge-based economy with a focus on leveraging local capacity and filling the gap in the region’s skilled technical workforce. Leveraging and attracting local expertise to educate and implement new technologies, policies, and projects (e.g., home energy assessments). There are opportunities for government in linking new policies and incentives to local experts and suppliers. Expressing clear priorities to UFV for certain skillsets (e.g., data scientists, engineers) to help mobilize funds and develop relevant programs in line with local clean economy business strengths and industries. Creating a forum with UFV, XLRator, and local municipalities (and/or regional economic development agencies), to strategize around high-tech skilled workers and which skills need targeted training and development.

Appendices

- A. SWOT and Gap Analysis
- B. Macro Trends Analysis
- C. Policy Overview
- D. Focus Group Summary Notes

Clean Economy in the Fraser Valley

Appendix A: SWOT & Gap Analyses

SWOT Analysis

The list below is a summary of strengths, weaknesses, opportunities, and threats (SWOT) designed to help better understand the current state of the FVRD's clean economy sub-sectors. This list was created based on secondary research, feedback obtained from industry stakeholders during consultation, as well as a review of current industry and market trends, government policy, and investment priorities.

STRENGTHS

- The Fraser Valley region has a base of infrastructure related to advanced and niche manufacturing (e.g., Chilliwack and Abbotsford for food processing; Mission for steel fabrication, plastics, and wood products manufacturing).
- The Fraser Valley's agriculture sector is well-established and home to some of the richest soils in Canada.
- There is a growing digital and information and communication technologies (ICT) base in the region that can serve as a foundation for building a larger knowledge-based economy.
- TELUS PureFibre has been installed across four of the six municipalities within the FVRD; this can improve business operations and enable residents to work remotely and serves as a foundation for progress to 5G.
- Relatively affordable housing and industrial lands are important strengths for attracting more jobs and talent to the region.
- The region has the advantage of an established workforce across food processing, manufacturing, farming, engineers and building contractors, and workers are less transient compared to cities where land and housing costs can push workers and businesses to move to more affordable areas.
- The region has several Centres of Excellence, technology-focused accelerators, and professional innovation networks that can be leveraged for research and development (R&D), as well as talent attraction to the region. These include WestGen, Ministry of Agriculture's BC Agriculture Centre (Abbotsford), University of the Fraser Valley (UFV) and its Food and Agriculture Institute, UFV's Trades and Technology Centre, XLRator, Canada Education Park, Pacific Agri-Food Research Centre, Chilliwack Innovation Network, Sumas Consortium on High Tech.
- There are key R&D, demonstration, and business initiatives, such as Abbotsford's Bakerview EcoDairy and the new Molson-Coors brewery in Chilliwack, that are utilizing waste streams as a means of producing electricity and for capturing other resources.
- The Abbotsford International Airport is a valuable component of the region's transportation system that supports connectivity to other regions of BC, Canada, and the United States.
- The region is home to companies that specialize in soil and brownfield remediation.

- Anchor companies (such as Structurecraft and its new manufacturing facility) can be leveraged to grow local talent and skills.
- UFV's R&D and trades training provide modern knowledge-focused programs for building talent, including in the areas of architectural drafting, automation and robotics, and electronics.¹

WEAKNESSES

- Lack of workforce capacity to fill low-skilled or labour-intensive jobs as well as skilled technical workers for advanced manufacturing jobs and the ICT sector.
- Lack of industrial land for business expansion and value-added activities may force businesses elsewhere.
- "Last mile" challenges, relating to business parks in the region that are operating on slower internet connections and networks since some have yet to connect to TELUS's fibre upgrades.
- Lack of 5G internet; while the region has improved its connectivity through TELUS, there is still a gap before reaching 5G.
- Lack of highspeed internet in rural areas is limiting the ability to revitalize economic activity outside the region's urban centres.
- Insufficient water resources and water/sewage infrastructure has caused businesses to be turned away in some parts of the region.
- Highway 1, the main corridor into the Fraser Valley region, is designed for cars with single occupants and commercial vehicles and not for mixed use (i.e., transit); this is a main cause for lengthy congestion delays due to high volume and lack of alternate routes.
- The transit system serving the Fraser Valley region struggles with offering reliable rider service and interconnectivity among municipalities.
- Relative to the other regions of BC, the Fraser Valley region lags behind in the total number of STEM occupations.
- Lack of awareness among farmers on the evolving business case and opportunities related to agriculture clean technology (e.g., RNG production, precision agriculture, etc.).

OPPORTUNITIES

General

- Eco tourism is a means of promoting and preserving the region's access to outdoor activities. It is also an opportunity to showcase the application of high-performance buildings that efficiently use and re-use energy, waste, and are designed to promote sustainable transportation options.
- Global megatrend toward the 'digitalization' and automation of the energy, building, and transportation sectors.
- Increasing application of geomatics, GIS, and sensors-based expertise to resource management (i.e. energy, agriculture) including remote sensing, real-time monitoring, and asset optimization.

¹ See: UFV Trades and Technology Programs <https://www.ufv.ca/programs/>

Programs & Funding

- The Provincial Government’s CleanBC climate plan aligns with four focus areas all relevant to the FVRD including transportation, buildings, industry, and waste.
- Leverage the CleanBC Communities Fund, a federal-provincial initiative that supports cost-sharing of infrastructure projects that align with renewable energy, access to clean energy transportation, improved energy efficiency of buildings, and generation of clean energy.²
- Utilize the Canada-BC Agri-Innovation Program that offers \$14 million in funding (CAP) over five years. FVRD municipalities can access this fund to support projects that combine clean technology with agriculture, waste management, and transit solutions.³
- The region’s agriculture, forestry and manufacturing sectors provide valuable waste streams that could be reused or recycled as value added inputs to other local industries or as an export to BC or US based markets.

Sustainable Resource & Ecosystem Management

- Growing concerns over waste management coupled with an increasing appetite for renewable energy encourages waste-to-energy projects (e.g., biogas capture for energy production, anaerobic digestion for fueling municipal fleets, etc.)
- The Fraser Valley has the highest concentration of livestock in the province that produces large amounts of waste that can be transformed into RNG to support the province’s low carbon energy goals. Supporting private agriculture is a means of expediting project development to kickstart biogas/RNG production.
- Apply water, soil and nutrient management strategies to maintain the region’s rich agricultural land informed by a centralized database that is open to land planners and farmers (includes data around soil type and quality, water quality, etc.)
- Leverage local businesses that specialize in soil remediation to use brownfields as a means of building out industrial land.
- Precision Agriculture and data-driven crop management technology, can be applied to the region’s crop production and harvesting operations through the application of sensors, big data analytics, and robotics. This can include the expanded use of robotics to address existing labour shortages.
- Blockchain solutions provide opportunities for local farmers to improve food safety, transparency (chain of custody), and sustainability which can also have environmental benefits.
- Partnerships with organizations such as the Municipal Natural Assets Initiative⁴ that work with local governments to develop strategies focused on valuing natural capital assets and ecosystem services in place of traditional investments in infrastructure such as wastewater treatment.

² See: Investing in Canada Infrastructure Program - British Columbia – Green Infrastructure - Climate Change Mitigation – CleanBC Communities Fund <https://www2.gov.bc.ca/gov/content/transportation/funding-engagement-permits/funding-grants/investing-in-canada-infrastructure-program/green-infrastructure/cleanbc-communities-fund>

³ See: Canada-B Agri-Innovation Program <http://iafb.ca/funding-opportunities/innovation/>. Further details on policies and programs are available in the FVRD Policy Overview document.

⁴ See: see www.mnai.ca

Green & Sustainable Transportation Solutions

- Micro-mobility as a solution to close the distance between commercial and residential destinations from transit hubs (e.g. sharing programs for electric scooters, bicycles, etc.).
- Move toward a larger and more energy efficient bus fleet to reduce emissions and reduce the number of cars on the main highway arteries in the region.
- Electrification of fleets (e.g. municipal vehicles) as a tool to achieve regional GHG emission reduction targets.
- Electrification of rail is an emerging trend alongside the electrification of air travel expected to take off by 2030 that should be incorporated in long term planning for the region.
- Autonomous vehicles are another key emerging trend; 80% of top OEMs have announced highly autonomous technology road-ready by 2025.

Green & High-Performance Buildings

- The manufacturing of prefabricated building components utilize small scale and cost-effective industrial land to establish micro manufacturers that can close the gap between suppliers and construction sites.
- The region can build on the supply chain being created around Structurecraft's new facility to advance the production and use of next-generation materials and wood construction.
- Building architects and construction firms in the region can incorporate advanced building controls and technologies that are increasingly being built into residential and commercial construction to optimize the use of energy and efficiency of lighting, HVAC, security and sprinkler systems.
- As the Fraser Valley region plans for population growth, continue to support land use planning processes and zoning bylaws that encourage densification of residential and commercial areas with interconnected transit options.
- The BC Energy Step Code is an envelope first approach to boosting energy efficiency in buildings will create the demand for high efficiency windows, insulation, heat recovery ventilators (HRVs) and other building envelope products.
- The trend toward green, efficient buildings in new construction across BC will also create demand for low-carbon materials and engineered wood products to reduce the carbon footprint of buildings.
- Healthy buildings are another key trend that is focused on creating high quality indoor environment through the use of naturally-based, low-VOC paints, natural light, ventilation, and noise reduction.

Renewable Energy Supply & Storage

- Grid modernization and deployment of smart grid (e.g., sensors and internet of things) and energy storage solutions in the region is an opportunity for BC Hydro and grid operators more efficiently manage the efficient supply and demand of electricity as well as improve overall grid resiliency to extreme weather events.

- The development of micro grids can be valuable when deployed in the region to improve resiliency.
- Solar photovoltaic installations in First Nations communities provide opportunities for electricity self-sufficiency, skills training, and capacity building.

Knowledge & Innovation

- Given the Fraser Valley's land constraints, there is an opportunity for the region to focus on its knowledge-based economy to increase efficiency and productivity across key sectors such as manufacturing, agriculture, and food processing through the further application of technologies such as automation, instrumentation, blockchain, IoT, and cloud technology.
- Create a merging/cluster along the agriculture value chain – agriculture foods, land and ICT- can form a strategic hub for logistics and distribution and leverage the Fraser Valley's proximity to the Cascadia Innovation corridor including Metro Vancouver, US, and rest of BC.
- Leverage the Cascadia's Innovation Corridor's binational steering committee⁵ composed of the region's top business, research and community leaders, including Microsoft, Amazon⁶ and Boeing⁷ who have already leveraged the workforce and infrastructure offered by the corridor between Seattle and Vancouver.

THREATS

- Inefficient political processes and tensions around the ALR can hinder progress towards collaboration and communication of alternative land use planning.
- Senior levels of government have jurisdiction over the main transportation corridor (Highway 1) and their strategic plans are not always aligned with the Fraser Valley region's. This is a barrier to addressing congestion and making the movement of goods and people more efficient.
- Integration of renewables without effective smart grid and energy storage infrastructure in place could have a negative impact on grid reliability.
- Future changes to provincial or federal government priorities and mandates could change the policy landscape in BC, removing some of the drivers and/or incentives for developing more green energy economy projects.
- Push-back from the public and/or lack of public support for renewable energy projects that are in line with the FVRD SWMP may create challenges with 'NIMBYism'.
- The evolution of technology and/or breakthrough products or processes could render current investments in today's technology obsolete and/or more costly in the long-run.
- Climate change impacts may affect certain technologies more than others (e.g., changes to hydrological cycles could impact on the availability of water for hydroelectricity generation).
- Brain drain, or the loss of those educated in green economy to other jurisdictions where green economy jobs and companies are more prominent.

⁵ See: Canadian, US business leaders announce joint framework for cross-border growth <https://www.newswire.ca/news-releases/canadian-us-business-leaders-announce-joint-framework-for-cross-border-growth-693169641.html>

⁶ See: <https://www.nytimes.com/2016/10/03/technology/next-big-tech-corridor-between-seattle-and-vancouver-planners-hope.html>

⁷ See: <https://www.newswire.ca/news-releases/new-regional-effort-aims-to-establish-cascadia-innovation-corridor-594174321.html>

Gap Analysis

This gap analysis is part of a project to study the existing capacity, competitive strengths, and opportunities related to the clean economy in the Fraser Valley Regional District. The analysis is structured based on the five clean economy sub-sectors and informed by background research and conversations with key industry stakeholders.

Based on the analysis of FVRD's key industry, infrastructure, and workforce strengths and gaps, recommendations are put forward to identify opportunities for capacity building, investment attraction, and local growth.

Overall, there is an opportunity to increase economic prosperity through development of the clean economy, by increasing collaboration between the public and private sector at a regional scale. This can include scaling successful initiatives up to a regional level to address common challenges or taking advantage of the existing strengths and unique landscapes throughout the region. This challenge becomes more important when dealing with senior levels of government and attracting investment to the region.

Gap Analysis by Clean Economy Sub-sector

Sustainable Resource & Ecosystem Management

- A limited supply of industrial land presents barriers to value-added food processing and other agriculture-supporting industries. With higher lease rates in Metro Vancouver, food processing and related businesses may move to the valley if land is available.
- Secondary uses for agricultural land may not be pursued because of lack of information and knowledge, or because of the administrative requirements associated with approvals in the ALR.
- Providing an accessible and reliable supply of water to municipalities and businesses is important for agriculture and other industries. Conservation and grey water initiatives may be a complementary solution to upgrading current infrastructure.

Green & Sustainable Transportation Solutions

- Mobility and alternative transportation solutions are desired for Highway 1. Alternative routes and methods of travel provide an incentive for businesses and employees.
- Transit systems are treated as separate systems in each municipality and are not integrated from a customer perspective. Harmonizing the customer experience and providing infrastructure that prioritizes efficient public transit would help this.
- Last mile / micro-mobility solutions can provide people with an incentive to take public transit. For example, there may be an opportunity to combine bike share or electric scooter programs with public transit.

Green & High-Performance Buildings

- Program and training support from local Universities would help local engineering and manufacturing companies fill positions for skilled trades and advanced machinery operators.
- A lack of knowledge and incentives for home heating companies leads to outdated practices and lower energy efficiency of buildings. There is an opportunity here for training programs and industry-led knowledge exchange.

Renewable Energy Supply & Storage

- Awareness of biogas and the RNG program is outside of traditional farm skills and knowledge. Fortis now has a procurement price cap of \$30/GJ for RNG, which may increase the feasibility for some projects that were previously not viable.
- Distributed energy generation, batteries, and grid infrastructure provide backup power to industrial operations. These technologies can scale efficiently when companies are clustered around industrial land.

Knowledge & Innovation

- Lack of high-speed internet is a barrier for some businesses. The federal and the provincial governments have connectivity infrastructure programs available to internet service providers.
- There is a labour shortage in both entry-level and skilled positions in manufacturing and Information and Communication Technology.
- The structure of funding relationships between Universities and senior government is not optimal for applied research.
- One interviewee highlighted a gap in willingness of businesses to innovate. This may be due to lack of knowledge or a fear of negatively affecting productivity.

Clean Economy in the Fraser Valley

Appendix B: Macro Trends Analysis

Sustainable Resource & Ecosystem Management (Agriculture)

Precision Agriculture and Data-Driven Crop Farm Management

Policy drivers and government programs supporting precision agriculture include:

- The Canadian Agricultural Partnership Canada-BC Agri-Innovation Program¹
- Agricultural Clean Technology Program² (Federal)
- BC Ministry Guidelines and Resources for Farm Mechanization³ (Provincial)

Industry drivers include:

- Enterprise Machine Intelligence and Learning Initiative (EMILI) supercluster in Manitoba accelerating agribusiness through AI and R&D.⁴
- Bell MTS \$500K grant to U of Manitoba for focussed development on Internet of Things (IoT) for agriculture solutions.
- Protein Industries Canada⁵ – Manitoba-based supercluster focussing on plant-based proteins. This initiative is expecting to generate up to \$500M in new economic activity and 4.7K new jobs across Canada, mainly in rural communities.

Bioproducts

Bioproducts represent a large potential in the renewable natural gas space due to B.C.'s abundant agriculture and forestry assets.

Methane from waste potential is 1.3B cf/year, which is almost ½ of Canada's current consumption of 2.5B cf/year.

Biomass to Energy: B.C.'s current production is at roughly 600 MW for pulp and paper and 30 MW for plywood mills, but has a total potential on the order of 2,300 MW.⁶

¹ <https://iafbc.ca/agri-innovation/>

² <http://www.agr.gc.ca/eng/programs-and-services/agricultural-clean-technology-program/>

³ <https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/business-market-development/structures-mechanization/farm-mechanization>

⁴ <http://emilicanada.com/>

⁵ <https://www.proteinindustriescanada.ca/>

⁶ <https://www.cleanenergybc.org/about/clean-energy-sectors/biomass>

The global Bioplastics sector is poised for significant growth as plastic pollution policies come into effect. This includes an EU-wide plastics strategy⁷ as part of the circular economy agenda, and a large-scale research project from Synbiomics⁸ on next-generation green chemistry bioproducts.

Blockchain Applications

The rise of Blockchain technology has led to emerging trends and developments in the agriculture sector.

Cryptocurrencies like Pavo⁹ have been created to allow consumers to purchase directly from farmers, and allow farmers to pre-sell crops under smart forward contracts.

IBM is also using Blockchain for food safety and traceability, a system being used extensively by major global brands like Walmart and Coca-Cola.¹⁰

Blockchain is helping to build trust in the food industry through accurate and timely food recalls, product labelling assurance, and by providing farmers and distributors with real-time commodity market information.

Next-Generation Food Manufacturing

New food manufacturing techniques using 3D printing technology food manufacturing represent opportunities with potential for highly personalized nutrition, on-demand food production, and customization of food supply chain.¹¹

Next-generation food manufacturing is in use for defence and space markets, with new use cases emerging across the spectrum of residential, commercial, and industrial applications.¹²

3D printing is also being used for meat alternatives and non-animal leather for fashion industries.¹³

⁷ http://europa.eu/rapid/press-release_IP-18-5_en.htm

⁸ <http://www.synbiomics.ca/>

⁹ <https://pavocoin.com/>

¹⁰ <https://www.ibm.com/blogs/blockchain/category/blockchain-in-food-safety/>

¹¹ <https://www.sciencedirect.com/science/article/pii/S2351978915010574>

¹² <https://www2.deloitte.com/insights/us/en/focus/3d-opportunity/3d-printing-in-the-food-industry.html>

¹³ <http://modernmeadow.com/>

Mechanization

Mechanization is of prime importance in developing nations to ease the burden of manual labour and dramatically increase the output efficiency of farm lands¹⁴. Tech start-ups like Hello Tractor¹⁵ are enabling farmers in Kenya and Nigeria to rent tractors through a smartphone app.

Advances in AI, sensors, and robotics are facilitating the use of on-farm robot harvesters for crops like bell peppers and strawberries¹⁶.

Technical and mechanical innovation in agricultural storage is a key for reducing spoilage, infestation, and other post-harvest crop loss¹⁷.

Sustainable Resource & Ecosystem Management (Waste & Circular Economy)

Bioeconomy

Several leading jurisdictions have bioeconomy or circular economy roadmaps to transform their economies. This includes B.C.¹⁸, the U.K.¹⁹, Germany²⁰, and Finland²¹.

Canadian initiatives that are part of the global movement to mitigate plastics pollution include the Ocean Plastics Charter²², and the CCME Strategy for Zero Plastic Waste²³.

Waste as a Resource

Relevant policy drivers for utilizing waste as a resource include the Environmental Management Act, Organic Matter Recycling Regulation, and Waste Discharge Regulation.

¹⁴https://www.researchgate.net/publication/324542258_Current_Status_and_Future_Prospects_of_Agricultural_Mechanization_in_Sub-Saharan_Africa_SSA

¹⁵<https://www.hellotractor.com/home>

¹⁶<https://www.nature.com/articles/544s21a>

¹⁷<https://www.forbes.com/sites/forbestechcouncil/2018/09/20/how-agro-tech-is-helping-farmers-around-the-world/#74167d30b2bf>

¹⁸<https://www2.gov.bc.ca/gov/content/industry/forestry/supporting-innovation/bio-economy>

¹⁹<https://www.gov.uk/government/publications/bioeconomy-strategy-2018-to-2030>

²⁰https://ec.europa.eu/knowledge4policy/publication/national-research-strategy-bioeconomy-2030_en

²¹<https://www.sitra.fi/en/projects/leading-the-cycle-finnish-road-map-to-a-circular-economy-2016-2025/>

²²<https://g7.gc.ca/en/official-documents/charlevoix-blueprint-healthy-oceans-seas-resilient-coastal-communities/>

²³https://www.ccme.ca/en/current_priorities/waste/waste/strategy-on-zero-plastic-waste.html

Other industry drivers include China's import ban on contaminated recycling, new technologies that capture CO₂ to cultivate value-added biomass²⁴, and significant opportunities in the remanufacturing sector²⁵.

Canada's National Industrial Symbiosis Program is aimed at redirecting waste from one sector into feedstock for other sectors²⁶.

Designing Waste out of Products

Extended producer responsibility (EPR) is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. In 2009, the Canadian Council of Ministers of the Environment created a Canada-wide Action Plan for EPR and a Canada-wide Strategy for Sustainable Packaging²⁷.

Industry is also driving innovative approaches to eliminating waste products through Cradle-to-Cradle principles for biological and technical cycles²⁸, emergence of new markets for secondary materials²⁹, increasing the use of repurposed fibres in textile and fashion industries³⁰, and the use of "Biomimicry" design principles³¹.

Advanced Materials

The emergence of 3D printing, nanoparticles, production automation, advanced chemistry are driving the use of advanced materials and innovation with recycled products. Renewable materials like carbon fibre are replacing resource intensive materials like steel and aluminium³². Other materials like pulverized recycled glass are being used as a carbon neutral cement additive³³.

Product-as-a-Service

The success of the SaaS (Software as a Service) business model has paved the way for PaaS (Product as a Service). This shifts the model from "buy-own-use-discard" to "plan-lease-repair-replace"³⁴. For example:

²⁴ <https://www.pondtech.com/>

²⁵ <http://www.ourpositiveplanet.com/how-the-remanufacturing-industry-is-giving-new-life-to-old-products/>

²⁶ <https://nispcanada.ca/>

²⁷ https://www.ccme.ca/en/resources/waste/extended_producer_responsibility.html

²⁸ <https://www.epea.com/cradle-to-cradle/>

²⁹ <https://marketplacehub.org/>

³⁰ <https://www.ellenmacarthurfoundation.org/our-work/activities/make-fashion-circular>

³¹ <https://www.wbdg.org/resources/biomimicry-designing-model-nature>

³² <https://3dfortify.com/composites-replace-traditional-materials/>

³³ <https://www.ellenmacarthurfoundation.org/case-studies/the-circular-economy-and-the-promise-of-glass-in-concrete>

³⁴ <https://circular-impacts.eu/library/1250>

- Michelin Tires leases tires to fleet customers who pay per miles driven.
- Philips Lighting provides commercial and municipal customers with lighting plans, efficient designs, and fixture lease plans.
- Amazon.com offers “textbooks as a service”.

The manufacturing sector is moving towards a PaaS model to nurture and deepen customer relationships³⁵. Sustainability pioneer Interface flooring has employed PaaS for years, resulting in the growth of an ‘ecosystem’ of circular business partners³⁶.

³⁵ <https://www.psfk.com/2017/08/5-future-of-manufacturing-scenarios.html>

³⁶ <https://sustainablebrands.com/brands/interface-1>

Green & Sustainable Transportation

Electrifying Transportation

A suite of provincial policies is driving the electrification of the transportation sector under the broader “CleanBC” climate strategy, which aims to reduce greenhouse gas emissions by 18.9 Mt by 2030. Policy drivers include targets toward zero emission vehicle (ZEV) sales³⁷, point-of-sale incentives through the Clean Energy Vehicle Program³⁸, and funding for commercialization of new services and technologies through the Advanced Research and Commercialization (ARC) Program³⁹.

Electrification of transportation is supported by the continued global trend of battery costs decreasing as much as 65% in the past five years⁴⁰. E-buses are the fastest growing segment of the EV market at 100% growth since 2013⁴¹, with China leading the way.

By increasing design efficiency or reducing manufacturing cost, original equipment manufacturers (OEM) have announced launches of more than 100 new battery EV models by 2024⁴². The trend toward more affordable EV options for consumers is expected to continue.

EasyJet is aiming for a fleet of electric planes for short-haul routes by 2030⁴³, and new EU standards for reducing marine transport emissions is spurring innovation in electric and hybrid marine craft⁴⁴.

Autonomous Vehicles

Autonomous vehicles (AV) are being developed throughout the transportation sector. Self-driving transportation is already used in applications like the Skytrain, Seattle airport, and Toronto LINK Train, and 80% of top OEMs have announced highly autonomous road-ready technology by 2025.

³⁷ <https://news.gov.bc.ca/releases/2018PREM0082-002226>

³⁸ <https://www.cevforbc.ca/clean-energy-vehicle-program>

³⁹ <https://arcbc.ca/about/>

⁴⁰ <https://about.bnef.com/new-energy-outlook/>

⁴¹ <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/fast-transit-why-urban-e-buses-lead-electric-vehicle-growth>

⁴² <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/what-a-teardown-of-the-latest-electric-vehicles-reveals-about-the-future-of-mass-market-evs>

⁴³ <https://www.reuters.com/article/easyjet-ceo-electric/easyjet-makes-progress-with-electric-aircraft-plan-idUSL8N1X93FY>

⁴⁴ <https://www.greenbiz.com/article/europe-sails-towards-electrified-shipping-fleets>

Other trends include autonomous heavy-hauling in mining sectors⁴⁵, and China is developing significant capacity for self-driving buses and mass transit⁴⁶. AVs are currently in use for warehouse operations, with ideal on-road applications in “middle mile” solutions where there is the least navigational complexity⁴⁷.

Smart Mobility

Shared mobility has a significant growth opportunity with less than 1% of current passenger miles; in 2017 the market saw US\$32B invested in ridesharing start-ups alone⁴⁸, and connected cars are emerging as key components of an intelligent transportation network.

Cycling is the norm in most EU cities and is growing in North America by 7.5% annually as the economic and health benefits become better understood⁴⁹.

Intelligent mobility is becoming more prevalent in Smart Cities, by enabling users to make informed transportation choices based on real-time situation data⁵⁰, and by coordinating and optimizing the movement of freight and people across multiple modes through intelligent transportation systems⁵¹.

Land-use & Logistics Hubs

In developing countries, rail has become the preferred mode for new transportation infrastructure due to limited land use and high volume potential⁵².

Efficient land use practices encourage density and spatial interaction, often at odds with growth patterns of widely dispersed suburban development⁵³.

Logistics hubs are appearing more frequently due to the significant increase in e-retailing resulting in the need for local distribution points, and apps and other mobile technologies have enabled a proliferation of last-mile solutions⁵⁴.

⁴⁵ <http://www.mining.com/web/caterpillar-rio-tinto-retrofit-cat-trucks-autonomous-operation-marandoo-mine-australia/>

⁴⁶ <https://www.scmp.com/magazines/post-magazine/long-reads/article/2142449/chinas-self-driving-vehicles-track-take-global>

⁴⁷ <https://www.accenture.com/ca-en/insight-autonomous-vehicles>

⁴⁸ <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-automotive-revolution-is-speeding-up>

⁴⁹ <https://www2.deloitte.com/insights/us/en/industry/public-sector/smart-mobility-trends-bike-commuting.html>

⁵⁰ https://www.researchandmarkets.com/research/5zx8ks/future_of_smart

⁵¹ <https://www.information-age.com/intelligent-transportation-smart-cities-123473979/>

⁵² https://transportgeography.org/?page_id=5721

⁵³ <http://parisinnovationreview.com/articles-en/urban-transportation-trends-challenges-and-opportunities>

⁵⁴ <http://www.kennisdclogistiek.nl/nieuws/the-future-of-last-mile-delivery-10-most-important-trends>

Other important trends in logistics and transportation include driverless trucks, the use of Blockchain in logistics to ensure accuracy and capacity monitoring, and Amazon's successful trial of drone delivery⁵⁵.

Renewable Fuels

Biofuels comprised 2.8% of renewable fuels for transport as of 2015 and global ethanol production increased 2.5% in 2017⁵⁶.

Launched at COP22, the Biofuture Platform is a 20-country effort aimed at advancing low-carbon fuels and bioeconomy solutions⁵⁷. Mission Innovation recently announced a Sustainable Biofuels Innovation Challenge to develop ways to produce widely affordable, advanced biofuels for transportation and industrial applications⁵⁸.

BC-based Canfor and Australian-based Licella are developing a biocrude facility at Canfor's Prince George mill with expected output of 500K barrels of biocrude per year⁵⁹, making it one of the largest 2nd generation bio-refineries in the world.

City of Vancouver, US Department of Energy, and Pacific Northwest National Laboratory are partnering on a pilot project on Annacis Island to convert sewage sludge from a wastewater treatment plant into biocrude⁶⁰.

Investment in hydrogen derived from water via electrolysis is growing around the world; if current projects come online in the next two years, cumulative capacity will rise from 55MW in 2017 to over 150MW in 2020⁶¹.

⁵⁵ <https://stfalcon.com/en/blog/post/transportation-industry-trends>

⁵⁶ <http://www.ren21.net/gsr-2018/>

⁵⁷ <http://biofutureplatform.org/>

⁵⁸ <http://mission-innovation.net/our-work/innovation-challenges/sustainable-biofuels/>

⁵⁹ <https://www.licella.com.au/pulp-paper/>

⁶⁰ <https://www.labmanager.com/research-specific-labs/2017/06/pacific-northwest-national-lab-moves-forward-with-sewage-to-fuel-research>

⁶¹ <https://www.iea.org/tcep/energyintegration/hydrogen/>

Green Buildings & Infrastructure

Envelope First Approach

High performance building exteriors result in lower lifetime cost of buildings and enable Net Zero and Passive House design principles. Policies that are driving high performance envelopes include the BC Energy Step Code⁶², the LEED rating system⁶³, and NRCan's High Performance Buildings Program⁶⁴.

Forecast demand for high-performing windows, doors, insulation, air sealing products, and heat recovery ventilation shows promise for sustained business to 2028 and beyond⁶⁵.

Due to improvements in energy efficiency, the International Energy Agency forecasts energy use in buildings to remain flat until 2040 even with 60% additional floorspace being added worldwide⁶⁶.

Healthy Buildings = Productive Occupants

A recent report written for the World Green Building Council illustrates the cost-savings linkages between resource-efficient building design and operation, and from reduced staff turnover and employee productivity⁶⁷. Other research has shown that cognitive function scores increase significantly in green buildings⁶⁸.

The 300/30/3/sqft measure is often used to calculate overhead: \$300 for staffing, \$30 for rent, and \$3 for utilities. This illustrates most office expenses are on labour so small improvements in productivity can have significant financial implications. A report from the National Research Council of Canada states that modest improvements in employee productivity can yield higher cost savings than large improvements in building performance⁶⁹.

Growth of Prefabrication & Modular Construction

CanmetENERGY, a research agency of NRCan, is fostering innovation in housing and construction through a series of government incentives and programs⁷⁰.

⁶² <https://energystepcode.ca/>

⁶³ <https://www.cagbc.org/CAGBC/LEED/CAGBC/Programs/LEED/LEED.aspx>

⁶⁴ <https://www.nrc-cnrc.gc.ca/eng/solutions/collaborative/hpb.html>

⁶⁵

https://www.cagbc.org/CAGBC/Advocacy/Green_Building_in_Canada_Assessing_the_Market_Impacts_Opportunities.aspx

⁶⁶ <https://webstore.iea.org/market-report-series-energy-efficiency-2018>

⁶⁷ <https://www.worldgbc.org/news-media/doing-right-planet-and-people-business-case-health-and-wellbeing-green-building>

⁶⁸ <https://sustainablebrands.com/read/new-metrics/new-study-links-green-buildings-to-higher-cognitive-function>

⁶⁹ <https://nrc-publications.canada.ca/eng/view/object/?id=9cae7920-03d1-459e-ab14-2fef54016a92>

⁷⁰ <https://www.nrcan.gc.ca/energy/efficiency/housing/research/13628>

The Canadian Construction Association created the Lean Construction Institute which encourages continuous improvement and endorses off-site/prefab/modular construction as key for transforming the construction industry⁷¹.

A recent report by KPMG research indicates off-site/modular construction can save up to 7% of total project costs⁷².

Permanent modular construction accounted for 3.18% of the value of new commercial construction in North America in 2016⁷³. The modular construction market is valued at US\$106B in 2017 and is expected to reach US\$157B by 2023⁷⁴.

Advanced Building Controls & Technologies

Buildings are often constructed with key systems already in place (lighting, HVAC, water, security, fire), often with stand-alone controls. Systems Integration and Automation services harmonize and standardize controls, and the market is expected to reach \$981M by 2025, up from \$90M in 2016⁷⁵.

Key trends in building automation include Building2Grid platforms, IoT energy management, AI for asset management, and standardizing cybersecurity⁷⁶. Other emerging trends include the ability to order products from inside a building information model, the integration of 3D laser scans and drone footage to provide 100% accurate base layers, and 3D printing of model sub-components for rapid prototyping or for sharing with manufacturing partners⁷⁷.

Many other digital applications are now being used in construction, such as VR/AR, wearables, drones, cloud computing, and robotics⁷⁸.

Next-Generation Materials & Wood Construction

B.C.'s Wood First Initiative is supporting the growth of value-added wood products and innovation in the built environment⁷⁹.

⁷¹ <http://www.lcicanada.ca/>

⁷² <https://home.kpmg/tr/en/home/insights/2016/04/smart-construction-report.html>

⁷³ <https://news.thomasnet.com/featured/exploring-the-increase-in-modular-construction-demand/>

⁷⁴ <https://www.marketsandmarkets.com/Market-Reports/modular-construction-market-11812894.html>

⁷⁵ <https://www.greentechmedia.com/articles/read/what-does-the-future-of-building-control-look-like#gs.hNvmU9Vl>

⁷⁶ <https://emerj.com/ai-sector-overviews/ai-building-automation-current-applications/>

⁷⁷ <https://www.navigantresearch.com/reports/10-trends-for-intelligent-buildings-in-2017-and-beyond>

⁷⁸ <http://www.constructionworld.org/top-10-construction-technology-trends-2018/>

⁷⁹ <https://www2.gov.bc.ca/gov/content/industry/forestry/supporting-innovation/wood-first-initiative>

Structural material currently accounts for 77% of the global advanced material market and is forecast to be valued at US\$1.37T by 2024⁸⁰.

Novel construction materials are being developed for nearly every building component; highly advanced materials include self-healing concrete, strand rod (carbon fibre) in place of steel cables used for seismic upgrades, hollow bricks with air circulation for in-wall heating and cooling, and GHG-absorbing cement⁸¹.

Brock Commons at UBC is employing various engineered wood technologies and is the tallest building with a wooden structure in the world⁸²

⁸⁰ https://www.researchandmarkets.com/research/43p42r/global_advanced

⁸¹ <https://geniebelt.com/blog/10-innovative-construction-materials>

⁸² <https://www.archdaily.com/879625/inside-vancouvers-brock-commons-the-worlds-tallest-timber-structured-building>

Renewable Power Supply & Storage

Explosive Growth in Renewable Energy Technologies

Clean Energy technology is seeing consistent annual increases accounting for 70% of net additions in 2017, up from 63% in 2016⁸³.

Energy companies traditionally focused on oil and gas are making unprecedented investments in renewables. Shell plans for annual investments of CAD\$1B in renewable energy by 2020, and Statoil plans to invest up to CAD\$16B in renewables by 2030⁸⁴.

China's investments in renewable energy eclipse the rest of the world, with 40% of the global clean energy investment in 2017, representing a value of US\$132B⁸⁵.

Federal policy and funding drivers for renewables include:

- Mission Innovation increasing up to \$775M by 2020⁸⁶
- Low Carbon Economy Fund – \$4.1B to participating provinces and \$500M in project funding⁸⁷
- Green Municipal Fund through FCM worth \$625M⁸⁸
- NRCan Clean Energy Innovation Program – \$49M over three years to 2019⁸⁹

Electrification

From individual sensors to entire cities, the shift toward electrification for communities and industry is a significant part of the low-carbon transition.

We are seeing an increase in individual home energy storage, linked to solar PV supply and EV charging for example.⁹⁰

⁸³ http://www.ren21.net/gsr-2018/chapters/chapter_01/chapter_01/

⁸⁴ <http://cleanenergycanada.org/report/energy-disrupted-tracking-the-energy-revolution-2018/>

⁸⁵ <https://data.bloomberglp.com/bnef/sites/14/2018/01/BNEF-Clean-Energy-Investment-Investment-Trends-2017.pdf>

⁸⁶ <https://www.nrcan.gc.ca/energy/resources/mission-innovation/18612>

⁸⁷ <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework/climate-change-plan.html>

⁸⁸ <https://fcm.ca/en/programs/green-municipal-fund>

⁸⁹ <https://www.nrcan.gc.ca/energy/funding/icg/18876>

⁹⁰ <https://www.pv-tech.org/guest-blog/the-future-of-combining-ev-with-pv>

Distributed Energy Systems & Grid Infrastructure

Utility and grid operators are seeing new business models emerging, and disruptive energy technologies are expected to reach key milestones in the next decade⁹¹. Much of this is enabled by energy storage and shift to smart grid technologies that allow better demand and supply of energy.

Smart grid technology specifically is receiving significant investment and has the potential to reduce the projected 2050 demand by up to 24% in parts of the world⁹². The global distributed generation market is also expected to grow annually by 15.5% reaching USD\$483B by 2024.

Energy Storage Revolution

The costs of batteries have declined as much as 65% in the past five years, and the global battery market is expected to hit US\$250 Billion by 2040⁹³.

Digitization of Energy

Digitization can have significant impacts on energy grids and enables technical cascades like Blockchain and distributed generation⁹⁴. Digitization of the energy market is forecast to hit US\$45B by 2025⁹⁵.

The International Energy Agency (IEA) claims digitization is fundamental for transforming electrical utility sectors⁹⁶, and the company ABB suggests digitization of power and water utilities can yield operational efficiency gains of 10% (versus 1-2% without digitization)⁹⁷.

⁹¹ <https://www.pwc.com/ca/en/industries/power-utilities/publications/gaining-momentum-energy-transformation.html>

⁹² https://www.researchandmarkets.com/research/cwqb9b/global_smart

⁹³ <https://about.bnef.com/new-energy-outlook/>

⁹⁴ <https://about.bnef.com/blog/digitalization-energy-systems/>

⁹⁵ <https://about.bnef.com/blog/market-digitalization-energy-sector-grow-64bn-2025/>

⁹⁶ <https://www.iea.org/digital/>

⁹⁷ <http://www.abb.com/cawp/seitp202/88bdc1e521d136b2c125819c00264e3c.aspx>

Knowledge & Innovation

Artificial Intelligence

2017 saw US\$15.2B invested in AI start-ups, a 141% increase over 2016. Of that 48% came from China and 38% from the USA⁹⁸.

In the smart workspaces field, 62% of organizations expect to have AI-powered virtual assistants in the next two years⁹⁹. More than 40% of enterprises will seek to combine AI with robotic process automation (RPA) representing a market valued at US\$1.7B in 2019 and US\$2.9B by 2021.

The market for AI for autonomous vehicles is anticipated to reach \$US10.7B by 2024¹⁰⁰, and the cognitive computing market is expected to reach US\$49.4B by 2025¹⁰¹.

Immersive Experiences

The fastest-growing segment in virtual reality (VR) is healthcare, followed by gaming, media, and communications. The global market for VR is projected to be US\$33B by 2022, representing a growth of 55% annually¹⁰². VR applications in the manufacturing sector are anticipated to increase by 98.9% from 2017 to 2021¹⁰³

Augmented reality (AR) is a relatively new branch of VR used to enhance natural environments and offer perceptually enriched experiences. The VR/AR combined market is forecast to reach US\$94.4B by 2023¹⁰⁴, with the AR share growing at 73%. AR for mobile devices is expected to drive growth faster than the VR market, with AR glasses and headsets set to ship 22.8M units by 2020¹⁰⁵

Digital Platforms

Emerging blockchain use cases include smart contracts, IoT integration, and content streaming load easing¹⁰⁶. Outcomes from the World Economic Forum suggested 10% of global GDP will be stored on

⁹⁸ <https://www.geospatialworld.net/blogs/13-artificial-intelligence-trends-2018/>

⁹⁹ <https://www.dimensiondata.com/zh-hant/insights/technology-trends/digital-workplace-trends-2018>

¹⁰⁰ <https://igniteoutsourcing.com/automotive/artificial-intelligence-in-automotive-industry/>

¹⁰¹ <https://www.grandviewresearch.com/press-release/global-cognitive-computing-market>

¹⁰² <https://www.marketwatch.com/press-release/virtual-reality-market-size-is-projected-to-be-around-us-33-billion-by-2022-2018-08-30>

¹⁰³ https://www.researchandmarkets.com/research/22fw9s/future_of_global

¹⁰⁴ https://www.researchandmarkets.com/research/6w5hnb/global_augmented

¹⁰⁵ <https://www.mordorintelligence.com/industry-reports/augmented-reality-market>

¹⁰⁶ <https://globenewswire.com/news-release/2018/12/18/1668415/0/en/Global-FinTech-Blockchain-Market-Will-Reach-USD-8-311-Million-By-2024-Zion-Market-Research.html>

blockchain by 2027¹⁰⁷. The FinTech-Blockchain market is expected to grow to US\$8.3B by 2024, from US\$207M in 2017¹⁰⁸.

The Internet of Things (IoT) is expected to see business investment reach US\$832B by 2020, and consumer spending reach US\$236B by 2020, resulting in a cumulative total of US\$6T spent on IoT by 2020¹⁰⁹

The cloud computing market is projected to reach US\$206B in 2019, a 17% increase over US\$175B in 2018¹¹⁰. The fastest growing segment within this market is Infrastructure as a Service (IaaS), expected to reach US\$39.5B by 2019.

The big data market was estimated at US\$23.5B in 2015 and forecasted to reach US\$118.5B by 2022¹¹¹

Biotechnology & Advanced Materials

The biotechnology market size was valued at over US\$330B in 2015 and is expected to double to US\$775B by 2024¹¹². Key growth areas are anticipated to be DNA sequencing, recombinant technology, fermentation, tissue engineering, and nanobiotechnology.

Advanced materials include ceramics, glasses, polymers, composites, metals and alloys, and applications include medical devices, automotive, aerospace, electrical/electronics, industrial, and power. The advanced materials market is anticipated to reach US\$102B by 2024¹¹³, and is dominated by 3M which holds a 70% share.

Nano-materials have applications in paints and coatings, adhesives and sealants, electronics, consumer goods, and personal care products. The nano-materials market expected to hit US\$55B by 2022, a 20% annual growth from \$14.7B in 2015¹¹⁴.

¹⁰⁷ <https://www.cio.com/article/3294225/blockchain/5-top-blockchain-trends-of-2018.html>

¹⁰⁸ <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/blockchain-beyond-the-hype-what-is-the-strategic-business-value>

¹⁰⁹ <https://www.pwc.com/gx/en/industries/tmt/publications/ai-and-iot.html>

¹¹⁰ <https://www.gartner.com/en/newsroom/press-releases/2018-09-12-gartner-forecasts-worldwide-public-cloud-revenue-to-grow-17-percent-in-2019>

¹¹¹ <https://www.marketwatch.com/press-release/big-data-market-2018-global-analysis-industry-demand-trends-size-opportunities-forecast-2023-2018-08-31>

¹¹² <https://www.gminsights.com/industry-analysis/biotechnology-market>

¹¹³ <https://www.transparencymarketresearch.com/pressrelease/advanced-materials-market.htm>

¹¹⁴ <https://www.alliedmarketresearch.com/nano-materials-market>

Additive Manufacturing

The additive manufacturing (AM) market is anticipated to reach US\$20.5B by 2020, with the highest growth expected in tooling components and metal castings.¹¹⁵

Desktop 3D printers sold approximately 278K units in 2015, and by the end of 2018, a total of 529K units are expect to sell. Sales for specialized 3D printers for metal additive manufacturing increased form 983 units in 2016 to 1,768 units in 2017¹¹⁶.

4D Printing is still an emerging technology that allows the components to transform into another shape when exposed to heat, humidity, or any other environmental stimuli. This market is expected to grow by US\$162M per year to 2022, with the main applications in aerospace and defence, healthcare, automotive, construction, clothing, and utilities¹¹⁷.

¹¹⁵ <https://www.statista.com/statistics/284863/additive-manufacturing-projected-global-market-size/>

¹¹⁶ <https://www.forbes.com/sites/tjmccue/2018/06/04/wohlers-report-2018-3d-printer-industry-rises-21-percent-to-over-7-billion/>

¹¹⁷ <https://www.marketresearchfuture.com/reports/4d-printing-market-2692>

Clean Economy in the Fraser Valley

Appendix C: Climate & Cleantech Policy Drivers

Summary of Policy & Program Drivers

Federal Policies and Programs

Paris Agreement	Global Climate Policy to limit temperature rise
Mission Innovation	\$775m in federal clean energy investment
Pan-Canadian Framework	30% reduction of GHG emissions from 2005 levels
Low Carbon Economy Fund	Federal funding to support the Pan-Canadian Framework
Innovation Superclusters Initiative	Digital Technology Supercluster in B.C.
Investing in Canada Infrastructure	\$4b in B.C. infrastructure over 10 years
Mid-Century, Low Emissions Development Strategy	Living document to inform the conversation about how Canada can achieve a long-term, low-carbon economy.
Green Municipal Fund	\$625m FCM program for sustainable community development
Clean Energy Innovation Program	\$49m to support clean energy innovation
Clean Tech Working Group Strategy	Report on options to transition to a low-carbon economy

Provincial Policies and Programs

CleanBC Climate Plan	Provincial climate plan to reduce GHGs by 18.9 Mt by 2030
CleanBC Communities Fund	\$63m green infrastructure fund
BC Energy Step Code	Code for high-efficiency buildings
BC Tech Fund	\$100m for early-stage funding to emerging tech companies
Smart Communities Pilot Project	Grants to help small communities use data and connected tech
Small Business Venture Capital Program	Credit to resident investors who invest in BC cleantech companies
Innovate BC	Several programs to support cleantech growth
Rural Dividend Fund	\$25m/year for projects in communities under 25,000 population
Clean Growth Program for Industry	Fund for large industrial emitters to make operations cleaner
Carbon Neutral Government	Streamlined procurement of clean technologies for public sector
Innovative Clean Energy (ICE) Fund	Fund to support pre-commercial clean energy projects and tech
Regional Adaptation Enhancement Program	BC Agriculture & Food Climate Action Initiative - Fraser Valley Adaptation Strategies

Local Government Policies and Programs

Fraser Valley Regional Growth Strategy	Overarching planning framework for coordinating local and provincial government activities
Solid Waste Management Plan	Management plan for municipal solid waste in the FVRD

Federal Policy & Program Priorities

- **The Paris Agreement:** The Paris Agreement is critical to shaping global climate policy and investment decisions moving forward. Nearly every country in the world has agreed for the first time to take on national commitments to address climate change and reduce GHG emissions. This new Agreement will strengthen the effort to limit the global average temperature rise to well below 2°C and pursue efforts to limit the increase to 1.5°C. The preverbal ‘devil is in the details’ and implications will ultimately be driven by how national governments implement the reductions. The agreement also sent a strong signal to governments and markets on the urgency to implement tools and strategies founded in cleantech aimed at reducing carbon emissions across governments, cities, civil society, the private sector, and financial institutions.¹
- **Mission Innovation:** On the margins of the COP21 Conference, a global commitment to accelerate clean technology investment was also made between the world’s largest economies. *Mission Innovation* will see over 20 countries (including the US, China, India, and much of the European Union) double the amount of public funds invested in clean energy research and development investment over the next five years. The investments are intended to be innovation-focused, seeking to develop transformational clean energy technologies that can be scaled to varying economic and energy market conditions globally. For Canada, the commitment means doubling its 2014-2015 funding of \$387 million for clean energy and clean technology research and development to \$775 million by 2020.²
- **The March 2016 Vancouver Declaration to a Pan-Canadian Framework for Climate Change and Clean Growth:** this agreement signed in Vancouver in 2016 commits First Ministers to work together on the development of a Pan-Canadian Framework on Clean Growth and Climate Change. The overarching goal of the detailed Framework will be to define a path forward to achieve Canada’s 2030 Paris Commitment of a 30% reduction of GHG emissions from 2005 levels. The process to date has been shaped around four key areas, aligned with the FPT working groups formed earlier in 2018. They are:³
 1. Clean Technology, Innovation, and Jobs
 2. Carbon Pricing Mechanisms
 3. Specific Mitigation Opportunities
 4. Adaptation and Climate Resilience
- **Low Carbon Economy Fund:** An important piece of the Pan-Canadian Framework, the \$2 billion Low Carbon Economy Fund is an important part of the Pan-Canadian Framework on Clean Growth and Climate Change (the Framework). The Fund supports the Framework by leveraging investments in projects that will generate clean growth, reduce greenhouse gas emissions, and help meet or exceed Canada's Paris Agreement commitments. The fund is split into two parts, the Low Carbon Economy Leadership Fund which provides \$4.1 billion to provinces and

¹ <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

² <http://mission-innovation.net/our-members/canada/>

³ https://itk.ca/wp-content/uploads/2016/04/Vancouver_Declaration_clean_Growth_Climate_Change.pdf

territories that have adopted the Framework, and the Low Carbon Economy Challenge which has over \$500 million available to fund projects that reduce emissions and generate clean growth in support of the Framework.⁴

- **The 2018 Federal Budget:** Recipients of up to \$950 million in funding through the Innovation Superclusters Initiative were announced, five clusters representing a cross-section of Canadian industries / regions (buildings are not represented):⁵
 - Digital Technology Supercluster – to use bigger, better datasets and cutting-edge applications of augmented reality, cloud computing and machine learning to improve service delivery in the natural resources, precision health and manufacturing sectors. This Supercluster was officially launched in Vancouver on November 27, 2018.
 - Ocean Supercluster – discovering how to use digital technologies to help develop Canada’s off-shore industries.
 - AI-Powered Supply Chain Supercluster – using AI to improve business processes in retail, manufacturing and infrastructure sectors.
 - Advanced Manufacturing Supercluster – to build up next-generation manufacturing capabilities, incorporating technologies like advanced robotics and 3D printing.
 - Protein Innovations Supercluster – to increase Canada’s share of the growing global market for plant-based proteins, primarily by increasing the processing capacity for canola.

Priorities as they pertain to budget quantities going to cleantech, reducing GHG emissions, reducing GHG emissions in buildings:

- To be confirmed: \$1 billion over five years to support the proposed new impact assessment system and Canadian Energy Regulator; increase scientific capacity in federal departments and agencies; implement the changes required to protect water, fish and navigation; and increase Indigenous and public participation.
- **The Low Carbon Leadership Fund** – provided to make buildings more energy efficient, to help industries reduce emissions, and help forestry and agriculture sectors increase stored carbon in forests and soils. The first round of funding agreements was announced in December 2017:⁶
 - BC: \$162 million

⁴ <https://www.canada.ca/en/environment-climate-change/services/climate-change/low-carbon-economy-fund.html>

⁵ <https://www.budget.gc.ca/2018/docs/plan/toc-tdm-en.html>

⁶ https://www.canada.ca/en/environment-climate-change/news/2017/12/low_carbon_economyleadershipfund.html

- AB: Almost \$150 million *This funding may be withdrawn as Alberta withdrew from the federal climate agreement*
 - ON: \$420 million (specifically to support renovating buildings, retrofitting houses, among other projects – *This funding is no longer going to be provided as Ontario withdrew from the federal climate agreement*)
 - QC: Over \$260 (including funding for businesses to retrofit their buildings)
 - NB: \$51 million (specifically to help improve energy efficiency of homes and businesses)
 - NS: \$56 million
- Extends incentives for businesses to invest in clean energy generation / promote the use of energy efficient equipment through tax support, now for property acquired before 2025 (represents an investment of \$123 million over 2017-18 and 2022-23).
 - \$109 million over five years to the Canada Revenue Agency and ECCC to implement, administer and enforce the federal carbon pollution pricing system.
 - Continued infrastructure deployment: Last year’s budget announced the allocated investment to electric vehicles (EVs) and alternative transportation fuel infrastructure starting in 2018-2019 of \$30M / year for 4 years, totalizing \$120M, in line with EMC’s priorities to pursue the deployment of DCFC in strategic areas, as investment in charging infrastructure is essential for increasing the adoption of EVs. A Zero Emission Vehicle Strategy for Canada has yet to be announced.
- **Investing in Canada Infrastructure Program:** The Liberal government committed to spending \$120 billion on infrastructure over the next 10 years. This quantity is an amalgamation of the spending that was already promised under the previous Conservative administration and the Liberal election promise of putting \$60 billion towards infrastructure in 10 years. As part of a bilateral agreement with the Province, The Canadian government will invest \$3.917 billion in B.C. infrastructure over 10 years in four key areas:⁷
 1. Community, Culture and Recreation Infrastructure
 2. Rural and Northern Communities Infrastructure
 3. Green Infrastructure (includes the CleanBC Communities Fund)
 4. Public Transit
 - **Mid-Century, Low Emissions Development Strategy:** The Strategy heavily references a variety of emissions modelling studies such as the Deep Decarbonization Pathways Project⁴⁴ (DDPP) and provides illustrative scenarios of the potential for emissions improvements from large industrial emitters, transportation, the built environment, electricity generation and transmission, waste, agriculture, and forestry. The mid-century strategy will help inform the pan-Canadian framework, as well as Canada’s infrastructure agenda. It also helps to reaffirm Canada’s commitment to investing in innovation and clean technologies. The strategy itself does

⁷ <https://www2.gov.bc.ca/gov/content/transportation/funding-engagement-permits/funding-grants/investing-in-canada-infrastructure-program>

not outline any specific policies, but identifies potential abatement opportunities, emerging key technologies, and areas where emissions reductions will be more challenging and will require a policy focus. Some of the key focus areas are:⁸

1. Electricity
 2. Industry
 3. Clean technology
 4. Infrastructure
- **Smart City Challenge:** Led by Infrastructure Canada, the pan-Canadian competition set one prize of \$50 million open to all communities; two prizes of up to \$10 million for communities of 500,00 people and under and one prize of \$5 million open to all communities with populations under 30,000 people. While the competition is now closed, the winners will be announced in Spring of 2019. There are 3 finalists in B.C. including Surrey and Vancouver (joint entry), Greater Victoria, and Richmond.⁹
 - **Green Municipal Fund:** The Green Municipal Fund is a \$625-million program that provides funding and knowledge services to support sustainable community development through the Federation of Canadian Municipalities. The funding focus areas are: sustainable neighbourhood and brownfields action plans; energy efficiency and recovery; transportation and fuel efficiency; water quality and conservation; waste management and diversion; and brownfields. The funding can be used for plans, feasibility studies, pilot projects, and capital projects.¹⁰
 - **Innovation, Science and Economic Development Portfolio:** targeted at creating made-in-Canada innovation clusters, overlaps with FVRD's regional growth pillars.¹¹ Seventeen federal departments and agencies make up the Innovation, Science and Economic Development Portfolio. Together, these organizations are uniquely positioned to further the government's goal of building a knowledge-based economy in all regions of Canada and to advance the government's jobs and growth agenda. Innovation, Science and Economic Development Canada works in partnership with the members of the Innovation, Science and Economic Development Portfolio to leverage resources and exploit synergies in a few specific areas:
 1. Innovation through Science and Technology—helping firms and not-for-profit institutions more rapidly turn ideas into new products and services.
 2. Trade and Investment—encouraging more firms in more sectors to export to more markets, and helping Canadian firms attract a larger share of foreign direct investment.
 3. Growth of Small and Medium-sized Enterprises—providing access to capital, information and services.
 4. Economic Growth of Canadian Communities—fostering new approaches to community economic development, based on community strengths and information infrastructures.
 - **NRCAN Clean Energy Innovation Program:** The Energy Innovation Program received \$49 million over 3 years from April 1, 2016 to March 31, 2019 to support clean energy innovation. Accelerating clean technology research and development is a key component of the

⁸ https://unfccc.int/files/focus/long-term_strategies/application/pdf/canadas_mid-century_long-term_strategy.pdf

⁹ See: <https://www.infrastructure.gc.ca/cities-villes/index-eng.html>

¹⁰ <https://fcm.ca/en/programs/green-municipal-fund>

¹¹ https://www.ic.gc.ca/eic/site/icgc.nsf/eng/h_00022.html

Government of Canada's approach to promoting sustainable economic growth and to supporting Canada's transition towards a low-carbon economy. Clean Energy Innovation key priority areas are: renewable, smart grid and storage systems; reducing diesel use by industrial operators in northern and remote communities; methane and VOC emission reduction; reducing greenhouse gas emissions in the building sector; carbon capture, use and storage; improving industrial efficiency.¹²

- **Clean Technology in Canada's Natural Resources Sectors Discussion Paper:** Natural Resources Canada, in partnership with the Minister of Fisheries and Oceans, the Canadian Coast Guard, and the Minister of Agriculture and Agri-Food has signalled they will redefine their clean technology strategy – particularly as it relates to Canada's commitments under Mission Innovation.¹³
- **Clean Tech Working Group Strategy:** The Pan-Canadian Climate Change and Clean Growth Framework Working Group on Clean Technology, Innovation and Jobs released their final report in September 2016. The report focused on four areas:¹⁴
 1. Building and strengthening early-stage clean technology innovation and research, development and demonstration;
 2. Accelerating clean technology commercialization and growing Canada's commercial capacity in clean technology;
 3. Fostering greater clean technology adoption within Canada; and
 4. Strengthening and sustaining collaboration in support of clean technology and clean growth and creating metrics for success.

Programs and priorities that are in progress / important to be aware of:

- **Infrastructure 'Triple Bottom Line' Screening**
- **Federal Impact Assessment Act** – will impact the development resource extraction projects
- **Building Code Updates** and Incentives
- Provincial alignment with national carbon price
- **Federal Clean Fuel Standard:** the federal government is working to consult with key stakeholders on the development of clean fuel regulations and to enact the standard in 2023¹⁵

¹² <https://www.nrcan.gc.ca/energy/funding/icg/18876>

¹³ http://publications.gc.ca/collections/collection_2016/rncan-nrcan/M134-40-2016-eng.pdf

¹⁴ <https://www.canada.ca/content/dam/eccc/migration/cc/content/6/4/7/64778dd5-e2d9-4930-be59-d6db7db5cbc0/working-20group-20on-20clean-20technology-20innovation-20and-20jobs-20final-20report-20engl....pdf>

¹⁵ <https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-standard/timelines-approach-next-steps.html>

Provincial Policies and Programs

- **CleanBC Climate Plan:** On December 5th, 2018, the Government of B.C. released its CleanBC climate plan. CleanBC includes initiatives in four focus areas which are all relevant to the Fraser Valley: transportation, buildings, industry, and waste. Across these focus areas of the plan there are goals around increasing the requirements for low carbon fuel standards, increasing the supply of renewable natural gas for industry, expanding the electric vehicle charging network, and helping communities implement organic waste diversion and landfill gas capture.¹⁶
- **CleanBC Communities Fund:** This fund is part of the federal-provincial Investing in Canada Infrastructure Program and supports cost-sharing of infrastructure projects focusing on the management of renewable energy, access to clean-energy transportation, improved energy efficiency of buildings and the generation of clean energy.¹⁷
- **BC Energy Step Code:** This performance-based tool will provide local governments and builders with more tools and opportunities to accelerate energy efficiency and reduce GHG emissions in the built environment. The code will require better building envelopes, higher performing windows, high efficiency mechanical systems that reduce energy consumption through heating and cooling and bring B.C. towards the goal of being net-zero ready by 2032. It will create the opportunity for businesses to shift into knowledge around installation and performance of high efficiency products and potentially bring manufacturing of high-performance building products to areas like the Fraser Valley.¹⁸
- **BC Retrofit Initiative:** The Province is investing \$1.1 billion over the next decade to make social housing more energy efficient, less polluting, safer and cost efficient. The \$400 million retrofit component of the initiative will focus on increasing the use of cleaner energy in 51,000 units of publicly funded and owned social housing.¹⁹

MINISTRY OF JOBS, TRADE AND TECHNOLOGY (JTT)

- **BC Tech Fund:** A \$100 million venture capital fund launched by the Government of British Columbia in 2016. The BC Tech Fund has been established to invest in emerging technology companies in BC across multiple sectors, including Information and Communications Technology (ICT), Digital Media, Clean Tech and Life Science/Healthcare. The BC Tech Fund mandate includes investments in BC-based venture capital funds and BC companies. The BC Tech Fund is focused primarily on investments at the Series A stage and is being managed by Kensington Capital Partners on behalf of the province.²⁰

¹⁶ <https://cleanbc.gov.bc.ca/>

¹⁷ <https://www2.gov.bc.ca/gov/content/transportation/funding-engagement-permits/funding-grants/investing-in-canada-infrastructure-program/green-infrastructure/cleanbc-communities-fund>

¹⁸ <https://energystepcode.ca/>

¹⁹ <https://news.gov.bc.ca/releases/2018PREM0084-002249>

²⁰ <http://www.kcpl.ca/bc-tech-fund/>

- **BC Knowledge Development Fund (KDF):** The KDF contributes to fund equipment and facilities in post-secondary institutions for BC scientists and their students to conduct research. Recent revision of the KDF criteria will contribute to advancing BC’s knowledge regarding its environment, including reducing greenhouse gas, protecting the environment and creating innovative clean technologies. Since its inception in 1998, the KDF has committed over \$750 million for over 1300 projects.²¹
- **Smart Communities Pilot Project:** This project was developed to help local governments use data and connected technology to improve services and address community challenges. The one-year pilot project is open to B.C. municipalities and First Nations communities with populations under 30,000. Grants of up to \$40,000 will be provided to as many as four communities. The 2018 call closed in July 2018. The Pilot aligns with the government’s mandate to ensure the benefits of technology are felt throughout the province.²²
- **British Columbia’s Small Business Venture Capital program:** This program provides a 30% credit to BC resident investors who invest into eligible BC companies or managed funds. The Cleantech Venture Capital portion of the program supports the government’s commitment to stimulate investment in the clean technology industry. Businesses must be substantially engaged in the manufacture and processing, or research and development for commercial exploitation, of technologies that do one of the following: increase energy efficiency and conservation; reduce greenhouse gas emissions; reduce the environmental impact of energy production, generation, storage, transmission, delivery, provision or conversion.²³
- **BC Provincial Nominee Program Tech Pilot:** The B.C. technology sector is a major driver of economic growth in the province. As part of the overall Provincial Nominee Program (PNP), the B.C. PNP Tech Pilot works to ensure that the technology sector can attract and retain top talent for sector sustainability and growth. Eligible occupations under the B.C. PNP Tech Pilot include many types of engineers, technicians, programmers, and other occupations that could be leveraged by clean technology companies if the demand for these skills outweighs the domestic availability.²⁴
- **BC Cleantech Scale-Up Program:** B.C. is investing more than \$711,000 over the next three years in the Alacrity Foundation of B.C.’s Cleantech Scale-Up program. The program guides growing companies in generating new international business opportunities and promotes investment in B.C. clean tech companies. B.C.’s support for Alacrity’s program matches federal funding from Western Economic Diversification Canada, along with funding contributions from Export Development Canada and Alacrity.²⁵ (*Announced April 2018*)

MINISTRY OF JOBS, TRADE AND TECHNOLOGY (THROUGH INNOVATE BC)

The following programs are funded by JTT via annual funding to its Crown Corporation, Innovate BC.

²¹ <https://www2.gov.bc.ca/gov/content/governments/about-the-bc-government/technology-innovation/bckd>

²² <https://www2.gov.bc.ca/gov/content/governments/about-the-bc-government/technology-innovation/smart-communities>

²³ <https://www2.gov.bc.ca/gov/content/employment-business/investment-capital/venture-capital-programs/budget-descriptions>

²⁴ <https://www.welcomebc.ca/Immigrate-to-B-C/B-C-Provincial-Nominee-Program/BC-PNP-Tech-Pilot>

²⁵ <https://news.gov.bc.ca/releases/2018JTT0018-000677>

- **Venture Acceleration Program** (Innovate BC): The Venture Acceleration Program (VAP) is a paid structured venture growth program designed to guide, coach and grow ambitious early-stage technology entrepreneurs and effectively grow their technology ventures. The VAP helps entrepreneurs accelerate the process of defining a proven business model based on a set methodology and set of best practices for growing technology companies.

The VAP is delivered by a team of Entrepreneurs in Residence and supported by a province-wide BC Acceleration Network of partners and entrepreneurs. The VAP is funded by JTT via annual funding to its Crown corporation, Innovate BC.²⁶

- Included in the BC Acceleration Network is the **Foresight Clean Tech Accelerator**. Established in 2013, Foresight is Western Canada’s first clean technology accelerator that fosters the growth of small and medium size businesses. Foresight nurtures start-up success by providing an ecosystem of mentorship, like-minded entrepreneurs, and industry specific guidance. To get companies to commercialization, Foresight has a program with the Business Development Bank of Canada that provides \$250,000 in financing to promising early stage companies provided it is matched by at least the same in private investment.²⁷
- **New Ventures Competition** (Innovate BC): Innovate BC is the lead partner of the New Ventures Competition, which promotes the growth of early-stage technology companies by providing mentorship, business seminars, networking events, and recognition. It attracts entrepreneurs from a wide range of tech industries including cleantech, ICT, software, bioenergy, agritech, and life sciences.²⁸
- **Ignite Program** (Innovate BC): Ignite provides funding to accelerate the commercialization of new technologies and innovations in the natural resources and applied sciences sectors in BC. The program provides awards of up to \$300,000 to consortia that are conducting research projects that address a significant demonstrated problem faced by industry and will commercialize a proposed innovation within a 3-year timeframe.²⁹

MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT (FLNR)

- **Clean-tech Innovation Strategy for the Forest Sector:** Forest Product Innovation is FLNR’s partner in delivering an annual clean-tech innovation program which funds approximately 20 projects per year. FLNR invests approximately \$3.5M annually which is leveraged with investment from Natural Resources Canada and in some cases industry to a total of \$5-6 million annually to support research and development projects in forest sector, including clean tech projects.³⁰

²⁶ <https://innovatebc.ca/what-we-offer/connect-with-experts/venture-acceleration-program/>

²⁷ <https://foresightcac.com/>

²⁸ <http://www.newventuresbc.com/the-competition/>

²⁹ <https://innovatebc.ca/what-we-offer/get-funding/ignite/>

³⁰ https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/competitive-forest-industry/bc_innovation_strategy_2017-01-18.pdf

- Rural Dividend Fund:** The BC Rural Dividend Fund is providing \$25 million a year to assist rural communities with a population of 25,000 or less to reinvigorate and diversify their local economies. It was developed to recognize both the contribution rural communities have made to B.C.'s economy, and the unique challenges they face to diversify beyond natural resources. The program is focused on supporting worthy projects that help rural communities navigate changes impacting their economies, such as attracting and retaining youth, using innovation to drive economic growth, and developing new and effective partnerships to support shared prosperity. Since 2016/17, BC Rural Dividend Fund has provided over \$2.7 million towards 22 cleantech projects across the province.³¹ See: [Link](#)

MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY

- Clean Growth Strategy:** The provincial government released a long-term clean growth strategy (CleanBC), which was released on December 5th, 2018 (referenced above). Three intentions papers were released in Summer 2018 focusing on transportation, buildings, and industry. More engagement is planned for 2019 and 2020.³²
- Clean Growth Program for Industry:** Announced in Budget 2018, the Clean Growth Program for Industry program partially addresses the competitive impacts of increasing the carbon tax with new incentives and a new fund to offset the cost of making operations cleaner. The Clean Growth Program for Industry directs a portion of B.C.'s carbon tax paid by industry into incentives that encourage them to transition to cleaner operations and reduce emissions. It is designed for regulated large industrial operations, such as: pulp and paper mills, natural gas operations and refineries, and large mines that emit over 10,000 tonnes of GHG emissions per year.³³
- Carbon Neutral Government:** British Columbia is streamlining the procurement of priority clean technologies for municipalities and other public sector organizations through their Carbon Neutral Government program. In addition, the Ministry of Citizens' Services has created a procurement concierge service to connect commercial-ready technology suppliers to government buyers.^{34 35}

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES

- Innovative Clean Energy Fund (ICE Fund):** The ICE Fund is a Special Account, funded through a levy on certain energy sales, designed to support the Province's energy, economic, environmental and greenhouse gas reduction priorities, and to advance B.C.'s clean energy sector. Benefits associated with the completed ICE Fund projects include a reduction in

³¹ <https://www2.gov.bc.ca/gov/content/employment-business/economic-development/support-organizations-community-partners/rural-economic-development/rural-dividend>

³² <https://cleanbc.gov.bc.ca/>

³³ <https://engage.gov.bc.ca/app/uploads/sites/391/2018/07/MoE-IntentionsPaper-Industry.pdf>

³⁴ <https://www2.gov.bc.ca/gov/content/environment/climate-change/public-sector/carbon-neutral>

³⁵ <https://www2.gov.bc.ca/gov/content/environment/climate-change/local-governments>

greenhouse gas emissions of over 135,000 tonnes and completed projects have created approximately 262 ongoing jobs.

In March 2017, the ICE Fund has launched a joint call for proposal with Sustainable Development Technology Canada (SDTC). The \$40 million partnership between the Ministry and the SD Tech Fund is to support the development of pre-commercial clean energy projects and technologies. The parties will conduct a joint call over a three-year continuous intake period to seek out clean energy projects and technologies that will mitigate or avoid provincial GHG emissions, including prototype deployment, field testing and commercial-scale demonstration projects in B.C. The call for expression of interest opened in April 2017.³⁶

- **CEV Advanced Research & Commercialization (ARC):** The ARC Program is to support the development of BC companies operating in the Clean Energy Vehicle (CEV/ zero emission vehicle) sector, and to encourage international investment in the CEV sector in BC. It is the intention of the ARC Program to provide reliable and targeted support to build on existing strengths or eliminate barriers for companies in the sector. The program is expected to issue two funding calls of \$675,000 over the next three fiscal years.³⁷
- **Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirement) Act:** Introduced in 2008, Part 2 of the Act establishes renewable fuel content requirements for gasoline and diesel sold in British Columbia: fuel suppliers must ensure that they have a minimum renewable fuel content of five percent (5%) for gasoline and four percent (4%) for diesel, on a provincial annual average basis; and fuel suppliers have the flexibility to vary their blend percentages and can choose where in the province they supply renewable fuel blends, as long as they meet the provincial annual average requirement for renewable fuel content.

Part 3 of the Act establishes low carbon fuel requirements for fuels sold in British Columbia requiring fuel suppliers to progressively decrease the average carbon intensity of their fuels to achieve a 10% reduction in 2020 relative to 2010. Fuel suppliers choose their own approach for compliance with Part 3 requirements by either supplying more low carbon fuels, acquiring credits through a Part 3 Agreement, or trading credits with other suppliers.³⁸

- **Clean Vehicle Program:** Introduced in 2011, the CEV program has committed more than \$71 million to incentivize the sales of battery electric and hydrogen fuel cell vehicles and investment in charging and hydrogen fueling infrastructure. The main areas under the CEV Program are: [CEVforBC vehicle point-of-sale incentives](#), [Charging infrastructure investments](#), [Hydrogen fuelling infrastructure investments](#), Fleet adoption support & incentives, research, training & economic development, [Emotive public outreach & awareness](#).

³⁶ <https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/innovative-clean-energy-solutions/innovative-clean-energy-ice-fund>

³⁷ <https://arcbc.ca/about/>

³⁸ <https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/renewable-low-carbon-fuels>

- **B.C. ZEV Legislation** (to be introduced spring 2019): This legislation will set targets of 10% ZEV sales by 2025, 30% by 2030, and 100% by 2040, while government will take additional steps to make ZEVs more affordable. a three-point plan to kick-start and fuel the rollout of the ZEV standard: 1) Expanding the size of the province’s electric vehicle direct-current fast-charger (DCFC) network to 151 sites, with 71 already completed or underway and, leveraging federal and private-sector dollars, another 80 in the works; 2) Increasing the provincial incentive program, administered by the New Car Dealers Association of BC, by \$20 million this year to encourage more British Columbians to buy clean energy cars now. This will bring the incentive program up to \$57 million in total; 3) Reviewing the incentive program with an eye to expanding it over time, so buying a ZEV becomes a more affordable option for middle- and lower-income British Columbians.³⁹

MINISTRY OF AGRICULTURE

- **AgriTech Innovation Challenge:** On November 14, 2016, the BC Ministry of Agriculture and Innovate BC hosted the AgriTech Innovation Challenge event, bringing together farmers, industry, innovators, investors, and government. At the event, participants learned about select agrifood sector challenges, in the thematic areas of: improving berry competitiveness, pest management and loss reduction, greenhouse efficiency, nutrient recovery and management. Post-event innovators were given the opportunity to submit proposals for how their solutions mitigate these challenges, and to be considered for funding and other opportunities. This challenge process was made possible through federal and provincial Growing Forward 2 funding.⁴⁰
- **Canadian Agricultural Partnership (CAP) – Innovation Program (BC):** Innovation is one of five CAP Designated Programs Areas. The Innovation Program (BC) is designed to accelerate the pace of innovation along the innovation continuum (research, pilot, and commercialization) to enhance the competitiveness, sustainability, productivity and resilience of the sector, and meets commitments under the Science, Research, and Innovation priority area by investing in projects that may include but are not limited to:
 - Investments in applied science for major sector commodities;
 - Improved support for minor sector commodities and emerging/transformational areas including agri-tech;
 - Enhanced efforts in clean growth, environment and climate change;
 - Accelerating the growth of the sector, particularly in the agrifood and value-added food processing sectors; and,
 - Strengthening knowledge transfer and adoption.

³⁹ <https://news.gov.bc.ca/releases/2018PREM0082-002226>

⁴⁰ <https://agritechinnovation.ca/>

Under the Innovation Program, \$25.8 million in funding is available over five years. The Innovation Program does not specifically support cleantech companies, however, it is anticipated that a number of cleantech companies or projects will be supported by the Program.⁴¹

- **Canada-BC Agri-Innovation Program:** The Canada-BC Agri-Innovation Program allows industry, academia, value-added food processors, retailers and others to access funding for projects involving late-stage research, pilots and demonstrations, as well as the commercialization and adoption of innovative products, technologies and practices for the agriculture, food or agri-products sector. Priority for funding will be given to activities identified to advance innovation and competitiveness in B.C.'s agriculture, food or agri-products sectors, and include:
 - Advancement in plant, animal and food science
 - Energy and waste management
 - New product development and commercialization
 - Improvements in soil, water and air quality
 - Climate change adaptation

Under the Canada-BC Agri-Innovation Program, \$14 million in funding (CAP) is available over five years. The Canada-BC Agri-Innovation Program does not specifically support cleantech companies, however, it is anticipated that a number of cleantech companies or projects will be supported by the Program.⁴²

- **Regional Adaptation and Enhancement Program – BC Agriculture and Climate Change: Fraser Valley Adaptation Strategies (2015).** The plan includes 12 strategies and 28 actions for agriculture to adapt to five priority impact areas: 1) Warmer and drier summer conditions; 2) Increasing precipitation and extreme precipitation events; 3) Changing freshet flood risk; 4) Changes to pests and pollinators; and 5) Greater frequency and intensity of extreme heat events. Over a three-year period six regional projects (and two farm adaptation innovator projects) were undertaken to address the highest priorities identified in the Fraser Valley Adaptation Strategies plan. The regional projects were supported with \$300,365 of seed funding provided through Growing Forward 2 and \$55,634 from contributing partners. The Farm Adaptation Innovator Projects (FAIP) were supported with \$281,476 of Growing Forward 2 funding and \$80,600 in funding from other partners.

MINISTRY OF FINANCE

- **B.C. Scientific Research & Experimental Development Tax Credit Program (SR&ED):** The SR&ED Tax Credit Program is designed to encourage research and development in British Columbia that will lead to new, improved, or technologically advanced products or processes. This tax credit complements the federal SR&ED tax credit. Industry feedback indicates that this is the most important program supporting B.C.'s clean technology sector.⁴³

⁴¹ <http://www.agr.gc.ca/eng/about-us/key-departmental-initiatives/canadian-agricultural-partnership/>

⁴² <http://iafbc.ca/funding-opportunities/innovation/>

⁴³ <https://www2.gov.bc.ca/gov/content/taxes/income-taxes/corporate/credits/scientific-research-development>

MINISTRY OF ADVANCED EDUCATION, SKILLS AND TRAINING

- **Simon Fraser University’s Sustainable Energy Engineering Program:** AEST is providing funding in support of a new SFU Surrey sustainable engineering program that will host an additional 320 undergraduate spaces and 120 graduate spaces by 2021-22, expected to result in 140 additional graduates per year by 2023.

The \$126 million five-storey, 15,000-square-metre Sustainable Energy Engineering Building at Simon Fraser University’s Surrey campus will allow the university to expand its research in the energy, hydrogen and electricity sectors, in addition to supporting SFU’s sustainable-energy engineering degrees. Total provincial start-up funding this year is \$4.4 million and is expected to increase to \$42 million.⁴⁴

⁴⁴ <https://news.gov.bc.ca/releases/2018AEST0008-000046>

Regional Policy & Program Priorities Driving Cleantech

Municipal Policies are set out in municipal Official Community Plans and other policies, links to each plan are provided below and shape the region's planning priorities and opportunities:

1. [Abbotsford Official Community Plan](#)
2. [Chilliwack Official Community Plan](#)
3. [Harrison Hot Springs Official Community Plan](#)
4. [Kent Official Community Plan](#)
5. [Mission Official Community Plan](#)
6. [Hope Official Community Plan](#)

Fraser Valley Regional Growth Strategy: The strategy promotes coordination across the six municipalities in the regional district and guides the vision through 8 key pillars: Collaboration across jurisdictions; economic strength and resiliency through employment and education that grows the region's strengths; living well to promote a high quality of life regardless of age, income or ability; community building to create compact, complete, affordable neighbourhoods across urban and rural settings; ecosystem health to protect water, air, biodiversity; transportation that enables safe and efficient systems that provides variety and reduces impact on air quality; infrastructure and services to provide efficient, sustainable, and cost effective services, and lastly energy and climate change aimed at increasingly energy efficiency, lower costs and reduction of GHG emissions to reduce the region's impact on climate change. Air quality is of particular focus/importance within the RGS.

Solid Waste Management Plan: Looking out to 2026, the Solid Waste Management Plan outlines three significant components, zero waste, mixed waste materials recovery and extended producer responsibility. The biggest challenges the region faces when it comes to waste management is the rate of waste each person produces each year; product designed and composition that do not promote sustainable use or responsible disposal; waste migration; global market conditions that make it difficult for small recycling facilities to survive; proper removal of organics from waste streams; illegal dumping; and the **rejection of incineration as a tool in the zero waste strategy**. The plan commits the FVRD to divert 65% of its waste by 2018; 80% by 2020; and 90% by 2025 through 3 main goals: 1) Reduce waste generation; 2) Maximize diversion and materials recovery; 3) Manage residual waste responsibly.



Clean Economy in the Fraser Valley

Appendix D: Stakeholder Focus Group Summary

Date / Time: January 30, 2019 / 12:30 PM to 4:00 PM

Location: Coast Chilliwack Hotel (Sardis / Hemlock Room)

Address: 45920 First Avenue, Chilliwack, BC V2P 7K1

Objectives

The purpose of this study is to gain a better understanding of the Fraser Valley's existing strengths and gaps as it relates to the clean economy. The Regional Growth Strategy (RGS) includes policies supporting economic strength and resiliency. With provincial and federal governments focusing on the clean economy it is important to ensure that the RGS reflects the region's economic opportunities.

The goal of this Focus Group was to share preliminary findings from Delphi's research on Fraser Valley's clean economy and dive deeper on the opportunities in terms of how the Fraser Valley Regional District (FVRD) can best support local governments and businesses, grow key components of the value chain, and support economic development agencies across the region with their efforts to attract investment and talent.

Please note: The definition adopted by this study for 'clean economy' includes the following sectors: sustainable resource and ecosystem management (including agriculture); green and sustainable transportation solutions; green buildings and industrial energy efficiency; renewable power supply and storage; and knowledge and innovation.

Expected Outcomes for the Focus Group

1. An understanding of the Fraser Valley's existing strengths and weaknesses / gaps as it relates to growing its clean economy.
2. An understanding of the size and possible scope of opportunities and challenges / risks as it relates to growing Fraser Valley's clean economy.
3. Information to support the FVRD's Regional Growth Strategy (RGS) update and other RGS policies and programs, including a "reference guide" for local governments.

Agenda

Start	Item	Lead
12:30	Assemble/Lunch	
13:00	Welcome & Introductions: Setting the stage for a productive and collaborative workshop <ul style="list-style-type: none"> • Introductions • Project objectives and proposed outcomes • Project overview – key activities 	Delphi & FVRD
13:15	Session 1: Clean Economy in the Fraser Valley: Highlights from Delphi’s research to date <ul style="list-style-type: none"> • Highlights from the sector profiles • Strengths and weaknesses 	Delphi Presentation
13:45	Breakout 1: Facilitated Discussion on the Fraser Valley’s Clean Economy <ul style="list-style-type: none"> • Review of sub-sector profiles: First impressions? Surprises? Gaps? • Review of value chain strengths and weaknesses: First impressions? Surprises? Gaps? 	Facilitated Breakout Discussions
14:30	Break	
14:40	Session 2: Seizing the Clean Economy Opportunities for Fraser Valley <ul style="list-style-type: none"> • Global megatrends and other factors for consideration • Key areas of focus (specific sectors, segments, technologies, value chain expertise, etc.) • Identifying opportunities and risks 	Delphi Presentation
15:00	Breakout 2: Identifying Roles for Growing the Clean Economy Opportunities <ul style="list-style-type: none"> • Explore strategic opportunity areas in line with trends and policy drivers; key challenges, risks and gaps; potential partnerships; infrastructure investments; R&D and innovation needs; etc. • Discuss “Reference Guide” structure and value for local stakeholders 	Facilitated Breakout Discussions
15:45	Report Back & Next Steps	Delphi & FVRD
16:00	Adjourn	

List of Participating Organizations

1. Fraser Valley Regional District
2. Catalyst Agri-Innovations Society
3. District of Kent
4. UFV Digital Innovation Hub
5. City of Chilliwack
6. BC Min of Agriculture
7. Sto:lo Community Futures
8. Chilliwack Economic Partners Corporation (CEPCO)
9. XLRator
10. Redux Nutrition
11. Delphi Group
12. Fortis BC
13. BLDRS Collective Inc.
14. BC Hydro
15. Evolved Consulting

Key Takeaways

The following key takeaways emerged from participant's feedback at each table (detailed notes from each table are below).

General

- There is strong alignment between the region's strengths and assets and the provincial government's CleanBC policy;
- Pockets of clean economy innovation exist across the region and can be mobilized through greater collaboration, cooperation and competition across the region.
- There is a need to gather more data/statistics to better understand what type of jobs people are commuting to and which types of future jobs align with the region's clean economy strengths.
- There is a valuable opportunity to improve and increase communication with First Nation communities to build relationships and partnerships around land use and skills development.

Sustainable Resource Management

- Agriculture and manufacturing are the backbone of the region's economy and is the low hanging fruit that should be focused on for further economic development.
- Developing an agriculture data portal that is open to government, industry and universities can be a key tool in making satellite and GIS data (among others) available to key stakeholders to inform their decision making (i.e. understand where the opportunities and pain points exist across agricultural land).
- Look to the higher value end of the supply chain and make the Fraser Valley a hub of locally sourced, sustainably harvested/processed foods.

Green Buildings

- The BC Energy Step Code could provide more region-wide green building industry growth.

Green and Sustainable Transportation

- The Fraser Valley is well-positioned to serve larger markets including Metro Vancouver and the Cascadia Innovation Corridor;
 - Long term goal could be to establish a centre of excellence via UFV at Abbotsford International Airport.
- Reverse logistics and Smart Mobility solutions could be paired with new development of residential and industrial areas. Because of the limited supply of land, it will be important to redevelop existing land to meet future needs, rather than just build out (e.g. transit-oriented residential development, and clusters of industrial users with smaller footprints).

Renewable Power Supply

- The grid is not currently equipped to handle the anticipated growth in electric vehicle charging infrastructure. This could be a driver for more small-scale RE-generation and storage solutions.

Knowledge and Innovation

- There is an opportunity to build vertically instead of horizontally via technology / the knowledge-based economy and fill the gap in the region's skilled technical workforce;
- It will be important to leverage and attract local expertise to educate and implement new technologies, policies, and projects (e.g. home energy assessments). The government could be more active in linking new policies and incentives to local experts and suppliers.
- There is a need to ensure that information provided to local governments and business around clean economy development is accessible in laymen's terms to ensure the opportunities and resources resonate with key stakeholders.
- UFV is better able to respond to demand for certain skillsets (i.e. data scientists) by receiving explicit demand from the region to UFV, which will help mobilize funds and develop programs i.e. School of Engineering.
- Create a forum with UFV, XLRator and municipalities to strategize around high-tech skilled workers and which skills need targeted training/development.

Breakout Tables

Table 1 Notes

Session 1: Clean Economy in the Fraser Valley – Strengths and Weaknesses

Initial Reactions

Sustainable Resource Management

- Fraser Valley Biogas creating RNG from 20+ farms. The number of farming operations in close proximity is both a current strength and opportunity for further collaboration.
- It is valuable to have a diversity of different energy projects in the portfolio. Most technology can be scaled up as necessary.

Green Buildings

- Relatively affordable housing compared to MV.
- BC Energy Step Code direction from City of Abbotsford.
- Metric Modular building company in Agassiz.
- Population growth/shift from Metro Vancouver as a way to increase knowledge economy and workforce capacity.

Green Transportation

- The process for acquiring grant funding for, and implementation of EV charging infrastructure by municipalities, Stratas, etc.

Renewable Energy

- Some current difficulties with the privately-managed geothermal utility. The residents hooked up to the system are not necessarily supportive because they do not experience the benefits.

Knowledge and Innovation

- There is importance in having local expertise available to educate the implementation of new technologies, policies, and projects (e.g. home energy assessments). The government could do a better job linking new policies and incentives to local experts and suppliers. Alberta government was pointed to as an example of this.
- The table highlighted a gap that exists for a hub of CleanBC-related information for grants, regulations, GHG calculators, and translating it into lay terms.
- Success of knowledge sharing, and quick transition related to asbestos regulation amendments, could serve as a model for future knowledge sharing.

Session 2: Seizing the Clean Economy Opportunities for Fraser Valley

Opportunities by Sector

Sustainable Resource Management

- Five-step-plan for a Fraser Valley Organics Conversion Initiative, including a certified benefits corporation, community-scale digesters.
- Re: cross-border waste and wastewater pollution threats - there is an opportunity to be proactive in finding alternatives to prevent future liability related to air, land, and water pollution crossing the U.S. border.
- New recycling bylaw and feasibility study for a material separation facility. This could result in more circular economy and renewable energy opportunities.
- There is an opportunity from nearby jurisdictions having soil deficiencies that complement the nutrient abundances in the FV (e.g. low phosphorus soils in Cowichan Valley).
- Increased knowledge, insight, and asset management benefits from new reporting requirements in the *Code of Practice for Agricultural Environmental Management*.¹

Green Buildings

- Opportunities for high performance building in new developments involving local suppliers of green building materials.
- More municipalities adopting the BC Energy Step Code could provide more region-wide green building industry growth.

Green Transportation

- Abbotsford International Airport (YXX) facilitates direct connections without having to transit through Metro Vancouver. This applies to both people and goods.
- Potential for hydrogen-based aviation research at YXX. Neighborhood-scale hydrogen could serve as both a source of electricity and a transportation fuel.
- Reverse logistics and Smart Mobility solutions could be paired with new development of residential and industrial areas. Because of the limited supply of land, it will be important to redevelop existing land to meet future needs, rather than just build out. (e.g. transit-oriented residential development, and clusters of industrial users with smaller footprints).

Renewable Energy

- The provincial target for RNG (10-15%) will be a driver of increased innovation and production. Current mix is 0.5%.
- The grid is not currently equipped to handle the anticipated growth in electric vehicle charging infrastructure. This could be a driver for more small-scale RE-generation and storage solutions.

Knowledge and Innovation

- Bringing together knowledge from Canada's new Superclusters - especially the MV Digital Supercluster and the Prairie Protein Supercluster. The EMILI project (Enterprise Machine Intelligence and Learning

¹ <https://www2.gov.bc.ca/gov/content/environment/waste-management/industrial-waste/agriculture>

Initiative) was highlighted: <http://emilicanada.com/vision/>,
<https://www.ic.gc.ca/eic/site/093.nsf/eng/00012.html>

- Advancing Cleantech past the initial R&D investment through to commercial viability. The table thought that Canada does a good job at funding initial R&D but needs to put more investment into commercialization of new technologies.
- Clusters of existing knowledge could be working together more to develop new value-added products for local and export markets.
- Importance of working with/marketing to nearby jurisdictions, especially the West Coast and Cascadia Innovation Corridor.
- Opportunity to re-invigorate under-utilized facilities at UFV and Agassiz. The table thought the current process and priority for research at these facilities was outdated and not enabling innovation.
- Many of the above opportunities could be leveraged by a comprehensive agriculture research and business incubator facility.

Table 2 Notes

Session 1: Clean Economy in the Fraser Valley – Strengths and Weaknesses

Initial Reactions

- Situational awareness is strong.
- Need to address more clearly what the problem is or what is the solution we are working towards?
 - There is an economic opportunity to serve the clean economy and this study/workshop is working to bring more clarity on what that opportunity looks like and which strengths should be focused on.
- Lack of jobs and workforce:
 - There aren't enough jobs to meet the influx of people/works to the Fraser Valley.
 - There is also a current lack of workforce to fill the jobs that do exist.
 - In creating more jobs, the desire is to create more jobs that are based in the clean economy subsectors. The question is which jobs will be needed in the future?
- Data gaps
 - Need more data/statistics to inform decisions and strategies (i.e. more data on who is travelling/commuting where and for which jobs)
- Land
 - Lack of industrial land is a well-known challenge that will demand more creative and strategic land use planning.
- Skilled Workforce
 - There is a gap in the skilled technical workforce that would be needed to develop the region's knowledge/tech economy.
 - Lack of communication between First Nation communities in the Fraser Valley and the municipalities is resulting in missed opportunities around the availability of land
 - There is approx. 3,000 hectares of land owned by First Nations communities that could be used to develop projects and partnerships.
 - There needs to be more collective planning between municipalities

- By striking a balance across being cooperative, collaborative, and competitive, municipalities raise the bar (i.e. attracting businesses like Molson Coors) which can drive or attract more business to relocate to the Fraser Valley.

Strengths

Sustainable Resource Management

- Agriculture is the backbone of the local economy and is the low hanging fruit.
 - It will grow, but it needs to be done sustainably, with as little environmental impact as possible, and the way to achieve this by applying clean tech.
- The region / municipalities need to leverage skills that exist in agriculture and at UFV
- Developing an agriculture data portal open to government, industry and universities can will be a key tool in making satellite and GIS data (among others) available to key stakeholders and inform their decision making (i.e. understand where the opportunities and pain points exist across agricultural land)
- There are valuable skills that exist and can be developed among First Nation communities and can also promote partnerships where First Nations communities can provide land and project partners can bring in training and skills development around new technologies or projects.
- Look to the higher value end o the supply chain and make the Fraser Valley a foodie hub.
 - Note: UFV is limited on what they can study/address food wise, i.e. not allowed to do dairy

Renewable Power Supply

- 20% of power in Canada is produced by First Nations across solar, hydro, geothermal; this means that there is a lot of capacity for production within local First Nation communities but there needs more communication and willingness to collaborate.

Session 2: Seizing the Clean Economy Opportunities for Fraser Valley

Gaps / Challenges / Risks (in line with policy and macro trends)

- Overarching challenge is that government moves slowly and cannot react as quickly as economy and technology does; however, they do have a regulatory responsibility that needs to be acknowledged (i.e. the buck stops with them)
- There is a lack of knowledge/education/literacy around clean economy in the region that needs to be addressed by government.

Innovation and Knowledge

- Lack of Wi-Fi coverage across the region, particularly rural areas and connectivity from the street to homes/businesses, also known as the last mile.
 - The gap around the last mile is rooted in high costs for companies to make the connection and the lack of skilled workforce to install the necessary infrastructure.
 - This is a large gap that will prevent the Fraser Valley, and specifically small businesses, from aligning with many of the key trends across each subsector.
- There is a lack of data scientists in the Fraser Valley (Canada wide as well)
- Risk: the demand for reliable electricity from the grid.
 - The Okanagan is looked to a prime location for data centres because there is a lot of land and a stable electrical grid that can meet the demand.

- In gathering and sharing data, there is a barrier in how much companies / organizations want to share and make open to industry, government, etc.
 - This will need to be addressed in developing tools such as agriculture data portal.

Green Transportation

- The airport has a huge need for tech
 - Bring a centre of excellence via UFV to the airport.
- There is a gap in EV infrastructure, particularly charging stations (both public and residential)
- The capacity to efficiently move goods and people is not there in the region

Opportunities by Sector

- CleanBC is a huge opportunity for business and community growth.

Innovation and Knowledge

- There is an opportunity to collect, organize, manage and analyze the data that is need around land, jobs, skills, etc.
 - This is an area for the region to develop skills and jobs focused in this area (i.e. data scientist)
 - UFV will respond to FVRD/municipalities asking for more data scientists
 - Explicit demand from the region to UFV Will help mobilize funds and develop programs i.e. School of Engineering to create a supply of data scientists and other skillsets that align with the collection, movement and analysis of data.
- In improving Wi-fi coverage, there is advantage that the region is a river region and therefore is flat which makes for better / easier coverage
- Long term opportunity or goal would be to create a partnership between Google, Telus and UFV to develop the infrastructure, skills development and worker supply create a tech hub in the Fraser Valley.
- Call to action: create a forum with UFV, XLRator and municipalities to strategize around high-tech skilled workers and which skills need targeted training/development.
- Developing these programs will require access to capital
 - This will demand creativity around new financing and investment structures to mobilize plans. This will be a key opportunity to develop in line with Clean BC.
- Key opportunity: FVRD as a tech hub based on its key location, quality of life, natural surroundings and affordability. It could be “Silicon Valley done right.” Use case studies such as Toronto and San Jose that have developed strong tech hubs and replicate what they did well and improve on what they didn’t do well.

Sustainable Resource Management

- The low hanging fruit is agriculture and manufacturing
 - The key will be to better understand what will attract talent, retain it and grow it.

Reference Guide

- City of Vancouver Green Economy Advantage report provides a good example for content
- Have a priority list of gaps and investment strategy
- List out conditions required to attract investment / capital / skills

- Look at Ministry of Finance white papers (Dominic Barton) as resources in developing reference guide2
- List out comparative advantages

Table 3 Notes

Session 1: Clean Economy in the Fraser Valley – Strengths and Weaknesses

Initial Reactions

- STEM not surprising, there are academic challenges surrounding this
- Chicken vs. eggs? Where to focus? i.e. coding vs engineering and innovation
- Stronger connection between post secondary and industry needs
 - There is a need for industry demand and co-op opportunities, or mentorship program or else brain drain becomes an issue

Sustainable Resource Management

- Agriculture's characterization needs more detail in the profiles – much more than just biogas
 - Labour and robotics – focus on higher productivity / acre
 - Mix of imported and local innovation taking place
 - Local adoption of innovation by agriculture sector is quite high.
 - Agriculture way ahead on tech over manufacturing
 - Some technology being controlled by mobile devices for example
 - Climate change adaptation is at the forefront.
 - Water use efficiencies / infrastructure
 - Pressure on aquifers
 - Improving performance
 - Going vertical
 - Intensification focus
 - Increased productivity
 - Use of hydroponics and aeroponics
 - Greenhouse production
 - However, still need space / land for field crops
- Ag/Urban Interface
 - Close proximity has value/benefits e.g. greenhouses
 - Urban amenities (power, water, labour)
 - Diverse population is key
- Advanced manufacturing (less footprint)
 - Build higher
- How can government help?
 - Re-zonings
 - Encourage thinking outside the box
 - Need to be nimble

² See: <https://ppforum.ca/publications/inclusive-innovation-technology-urban-rural-divide/>

- *Hard when one doesn't own; based on supply, demand and business case.
- Not many brownfields – maybe Mission (formal industrial sites)
- Grid / distribution > resiliency
 - CleanBC new models
- UFV
 - Fuel processing > hydrogen
 - Carbon extraction to biofuels
- Micro reactors, solar PV (residential) and win

Transportation

- Regional connectivity within the region is growing
- 50-year planning (e.g., rail and alternatives)
- Passage movement to hubs; connectors off main roads
 - Ride share – rural component
 - “Last mile connections”
- Access to ports can be a challenge
 - Fraser River as a channel to move goods and people
 - Ferries vs. bridge
- Farmers – need to transport workers
 - Roads can be risky for farm equipment (traffic flow / management)

Infrastructure

- Lack of fibre in more rural communities
- Greyhound gap for shipping goods

Session 2: Seizing the Clean Economy Opportunities for Fraser Valley

Opportunities by Sector

Sustainable Resource Management

- Agriculture Innovation
- Adoption of robotics...factors include:
 - Cost
 - Awareness
 - Profitability to reinvest
 - Must consider long-term planning
 - 15 to 20-year capital re-investment/modernization
 - Dairy – supply management, robotics
 - Greenhouse – Dutch technology/design; structural tech; lighting; nutrients; water
 - Forage crops – more irrigation use; working with agronomists; opportunity to adopt precision agriculture to manage nutrients, water and pests
 - Berry crops – less sophistication
- Opportunity:
 - Food processing

- Precision agriculture: maintaining, innovating, software development, monitoring health and nutrients.
- Risks:
 - Rapid tech evolution
- Forestry Innovation - Wood Products
 - Denbow is doing wood waste recycling and biochar; doing their own R&D.
 - Structurecraft
- Waste Management
 - Collaboration is key for this sector
 - Handling of waste products
 - Contaminants
 - Nutrient separation
 - Water use innovation for industry (including agriculture e.g. berries and vegetables)

Clean Energy

- Solar PV (residential roof top) – particular interest with First Nations
- Wind (potential in the canyon?)
- Storage
- Efficiency upgrades across the system
 - Cooling
 - Shift to heat pumps
- Geothermal (e.g. Pacific Ag Research)
 - High costs associated with this technology
- First Nation leaders have capacity in construction and development of projects:
 - Are there any off grid communities in FVRD? BC Hydro will check but don't think so.

Green Buildings

- Opportunities in windows, materials, prefab
 - Westeck is a local window manufacturer that specializes in steel window production
- Manufacturing potential exists but land constraints for facilities and logistics / distribution
- Access to workforce and markets
- First Nation lands have opportunities as partners
- UFV to facilitate R&D and connections with industry
- Potential for data centres (land, power, fibre, etc.) – BC Hydro interested in this.

Policy Drivers

- Industrial zoning – needs to be flexible
 - Mixed use zoning
- Infill (urban areas) opportunities?

Reference Guide

- Data and profiles detailing existing capacities
- Case studies
- Policies / Drivers
- Trends

- The tech shift will be interesting to follow
- Growth Opportunities in the long term
- Skills / Training (potential here for a Phase 2 to do a deeper dive on the strategy)
 - Entrepreneurs
 - K-12
 - Post-secondary
 - Retraining