

## CARBON GOVERNANCE PROJECT

## BRITISH COLUMBIA: INNOVATION, CAPITAL AND CARBON

British Columbia (BC) has some of the most aggressive greenhouse gas (GHG) reduction targets in the world. The 2007 Greenhouse Gas Reduction Targets Act (GGRTA) establishes a commitment to reduce provincial emissions 33% below 2007 levels by 2020, and 80% below by 2050.

The province also has a unique natural endowment of plentiful fossil fuel and mineral deposits (coal, natural gas, copper), combined with an abundance of renewable energy fuels, in particular biomass and hydro-electricity, which represents 88% of the energy generation capacity. Electricity generation in British Columbia is essentially carbon free, so most of the legislated reductions must come from changes to transportation, industrial processes (including fossil fuel production and cement manufacturing) and building heating.

Cleantech companies in BC are developing components for innovative natural gas and electric transport technology, third-generation biofuels, biomass and biogas heating and better management of the electricity grid network, including storage solutions and demand-side management. eral government, and from private investors inside and outside the province, and the opportunity to export their technologies markets across the globe. In order to realize these opportunities, it is essential that we understand how capital, innovation, and the structures that govern them, can come together to create the conditions that allow scale up of low carbon transformation, providing opportunities for real green growth.

To examine these transformative conditions, in 2010 ISIS, Sauder School of Business at the University of British Columbia, developed the Carbon Governance Project (CGP). Through empirical research in British Columbia, and a series of workshops in collaboration with the University of Oxford and the University of California, Berkeley, the CGP seeks to understand the pathways to a low carbon future by examining the relationship between capital, innovation and climate policy.

Each institution will host a workshop in its leading climate policy jurisdiction, bringing together groups of key strategic thinkers and executives.

These innovators seek capital from the provincial and fed-



The workshops will provide insight into:

- How business and the capital markets are responding to low carbon opportunities,
- How regions are capitalizing on expertise and importing/ exporting best practice,
- How the corporation is innovating (or not) in light of the climate change problem, and
- What role other stakeholders can play in enabling the growth of a low carbon economy.

Key questions related to the project and BC:

- How do we create a culture of innovation to reach the low carbon economy?
- How do we build on existing policy to enable capital to make the transformation?

This document provides an overview of the BC economy and the economic conditions within which a low carbon economy is beginning to emerge.



THE CGP SEEKS TO UNDERSTAND THE PATHWAYS TO A LOW CARBON FUTURE BY EXAMINING THE RELATIONSHIP BETWEEN CAPITAL, INNOVATION AND CLIMATE POLICY.

## CONTEXT ECONOMY OF BRITISH COLUMBIA

Despite covering an area over twice the size of California, British Columbia's population is only around 4 million, over half of whom live in the south-west corner of the mainland, in Metro Vancouver. A quarter of those, or 500 000, live in the City of Vancouver itself. However, the population of the Metro Vancouver region is forecast to grow by 50% in the next thirty years, with most growth occuring in the municipalities of Richmond and Surrey.

Company	Status	Revenue (\$CDN B in 2009)	
Telus Corp.	Public	\$9.6	
Teck Resources	Public	\$7.6	
Jim Pattison Group	Private	\$7.I	
Best Buy Canada	Private	\$5.7	
H. Y. Louie Co.	Private	\$4.5	
B.C. Hydro	Crown	\$4.2	
Insurance Corp of B.C.	Crown	\$3.7	
Westcoast Energy	Public	\$3.4	
Goldcorp	Public	\$3.1	
BC Liquor Distribution	Crown	\$2.7	

Source: BC Business

British Columbia is a small open economy and its provincial government has a policy of being open for business, addressing climate change and developing and adopting green technology.

Key industries in British Columbia are mining, forest products (i.e. wood and paper) and fisheries. Tourism, shipping and real estate are also important, with the residential real estate sector remaining conspicuously buoyant in Vancouver despite the turmoil south of the border.

The largest companies in British Columbia by revenue (2009) are: Telus, a telecommunications firm; Teck Resources, a mining company; Jim Pattison Group, a media-to-auto-leasing conglomerate, Best Buy, an electronics retailer; and HY Louie, owner-operator of the Marketplace IGA retail chain in BC.

# PopulationAreaGDPSelected key industries62 million243k km²\$2.2 trFinancial services, high-<br/>tech engineering,

\$1.8 tr

\$0.19

tr

pharmaceuticals

ICT, Clean Tech, Business Services.

Creative Industries

Mining, forest products, fisheries,

shipping, construction

In terms of employees, British Columbians mostly work in wholesale and retail trade (supplying building materials, food and automotive products), with the next most common employers being the provincial healthcare system, and the construction industry<sup>1</sup>.

However, the fastest growing industries in the last two decades are very different, and point to a lower-carbon, more service-focused economy. The number of jobs in business services has quadrupled since 1990, with the IT, movie-making, waste management and scientific services sectors also more than doubling.

#### Total employment in 2008: 2,314,300



#### Percentage of total employment



#### Cumulative change in employment, 1990-2008



## Percent of BC workforce employed in goods sector, 2008

UK

CA

BC

37 million

million

4.5

423k km<sup>2</sup>

945k km<sup>2</sup>



## Percent of BC workforce employed in service sector, 2008



3





#### ELECTRICITY

The provincially owned crown corporation BC Hydro is the monopoly electricity supplier in British Columbia responsible for owning and operating the generation, transmission, distribution, and supply of electricity. 86% of its generation comes from 30 "heritage" hydroelectric dams, with the remainder from private producers for their own use, or generated by Independent Power Producers (mostly run-of-river hydroelectric and wind generators) and sold under contract to BC Hydro.

Given these generation sources, grid electricity in British Columbia is essentially carbon-free (some cross-border arbitrage trade keeps it from 100%). It is also one of the cheapest jurisdictions in Canada and North America as a whole, at around 7c per kWh marginal rate for the residential sector.

There are around 40 remote communities in BC not connected to the main grid, who rely on more expensive and carbon-emitting diesel generators.

	Approximate Rate	Carbon	Restriction
UK electricity rate	25c/kWh	High	
California rate	15c/kWh	Medium	
BC electricity rate	7c/kWh	Very low	Monopoly
Standing Offer	10c/kWh	Zero	15MW, rate varies by region
Remote Communities	25c/kWh	High	40 communities only

Source: Manitoba Hydro, Survey of Canadian Electricity Bills

#### HEATING

Building heating is approximately 65% supplied by natural gas in British Columbia, with 25% from electricity heaters and the remainder from wood and heating oil<sup>2</sup>. After transport, natural gas heating is the second largest source of household greenhouse gas emissions in the province<sup>3</sup>.

#### Per Household GHG Emissions



#### BC Greenhouse Gas Emissions - 2008 Total: 68, 719 kilotonnes CO2e



<sup>&</sup>lt;sup>2</sup>Statistics Canada 2007 Survey of Energy Use. Table 3.1 Main heating system <sup>3</sup>British Columbia Provincial Greenhouse Gas Inventory Report 2008.



## CARBON

Due to the relatively high level of clean electricity energy supplied by hydropower in British Columbia, the biggest sources of GHG emissions are in the areas related to transportation, industrial combustion, and the built environment (see previous section). Greenhouse gas emissions in British Columbia grew from 55,678 kt CO2e in 1990 to 68,719 kt CO2e in 2008, the last year for which data are available<sup>4</sup>. Although greenhouse gas emissions from British Columbia have risen in last two decades, growth has occurred at a slower rate than the population has grown, so that emissions per capita have fallen.

#### LARGEST POINT SOURCE EMITTERS

While the largest collective source of greenhouse gas emissions in BC is the transportation sector, the largest single point emitters in the province are two natural gas processing plants owned and operated by Spectra Energy, two cement plants, and a 180MW natural electricity generator that also supplies steam to an adjacent paper mill<sup>5</sup>.

#### CARBON PRICING

Almost all carbon emissions in BC are priced at \$20 per tonne rising to \$30 over the next two years. This makes the province unique in Canada and a rarity in North America in providing a clear incentive to invest in low carbon technologies. Public sector organizations face an additional carbon cost of \$25, which is transferred to the Pacific Carbon Trust to support the carbon neutral government policy.

Top Point Source GHG Emitters in British Columbia	Tonnes CO <sub>2</sub> e in 2008
Pine River Gas Plant (Spectra Energy)	1249961
Fort Nelson Gas Plant (Spectra Energy)	1221555
Delta Cement Plant (Lehigh Heidelberg)	963195
Richmond Cement Plant (Lafarge)	871273
Island Cogeneration No. 2 Inc	778354
Other point sources	7376049
Total Point source GHG emissions	11497192

The three main mechanisms for carbon pricing are a carbon tax on the combustion of fossil fuels, the carbon neutral provincial and municipal government mandates, and an upcoming cap and trade system for large emitters (and emissions not covered under the carbon tax).

#### Table of BC Carbon Tax rates

Fuel type	Rate July 1 08	Rate July 1 09	Rate July 1 10	Rate July 1 11	Rate July 1 12
Aviation fuel	2.46¢/L	3.69¢/L	4.92¢/L	6.15¢/L	7.38¢/L
gasoline	2.34¢/L	3.51¢/L	4.68¢/L	5.85¢/L	7.02¢/L
Heavy fuel oil	3.15¢/L	4.73¢/L	6.30¢/L	7.88¢/L	9.46¢/L
Jet fuel	2.61¢/L	3.92¢/L	5.22¢/L	6.53¢/L	7.62¢/L
Diesel	2.69¢/L	4.04¢/L	5.38¢/L	6.73¢/L	8.07¢/L
Natural gas	1.90¢cm <sup>3</sup>	2.85¢cm3	3.80¢cm <sup>3</sup>	4.75¢cm <sup>3</sup>	5.70¢cm <sup>3</sup>
propane	1.54¢/L	2.31¢/L	3.08¢/L	3.85¢/L	4.62¢/L
Coal (HH)	20.77\$/t	31.16\$/t	41.54\$/t	51.93\$/t	62.31\$/t
Coal (LH)	17.77\$/t	26.66\$/t	35.54\$/t	44.43\$/t	53.31\$/t
Shredded tires	23.91\$/t	35.87\$/t	47.82\$/t	59.78\$/t	71.73\$/t
peat	10.22\$/t	15.33\$/t	20.44\$/t	25.55\$/t	30.66\$/t

Source: Presentation by <u>BC Ministry of Finance</u>

<sup>4</sup>BC Ministry of Environment Greenhouse Gas Inventory

<sup>5</sup>Environment Canada: Facility GHG Emissions by Province/Territory (2009)

<sup>6</sup>Macleans.ca <u>Did Gordon Campbell win because of his carbon tax?</u>

#### CARBON TAX

BC's carbon tax on combustion of fossil fuels currently stands at \$20 per tonne. This will increase to \$25 per tonne this July, and to \$30 July 1st, 2012. This last price will add around 7c to a litre of gasoline (currently around 130c per litre total). The tax is designed to be revenue neutral, with the proceeds returned through corporate tax cuts and personal income tax cuts (to the lowest two tax brackets). Although there were some social equity concerns initially, the tax was ultimately uncontroversial on introduction, with the party that introduced the measure being re-elected afterwards<sup>6</sup>.

There has been no official report on the impact of the carbon tax on business decision-making. However Dr. Nancy Olewiler,



Economics Professor of Director SFU's Public Policy Program, has suggest that<sup>7</sup> that corporate and personal tax cuts are already over \$200 million greater than the \$1.8bn revenue from the carbon tax, a small discrepancy that could either lead to tax increases (to the carbon tax, or elsewhere) or public service cuts.

#### CARBON-NEUTRAL GOVERNMENT

In 2007, the BC Government passed the Greenhouse Gas Reduction Targets Act, which legally required all public-sector organizations, including core government (ministry) operations, school districts, health authorities, post-secondary institutions and Crown agencies to be carbon-neutral by 2010<sup>8</sup>. Furthermore all local government municipalities have committed to carbon-neutrality by the end of this year<sup>9</sup>.

In practical terms "carbon neutral" means that organisations must either reduce their greenhouse gas emissions, or pay \$25 per tonne of emissions to the Pacific Carbon Trust (PCT), a crown corporation that invests funds in carbon-reducing projects in BC. To date, the PCT has directed over \$1m funds to deliver 45 000 tonnes of "made-in-BC" emission reductions.

As public sector organizations will also pay the carbon tax their effective carbon price will be \$55 / tonne in 2012. This price signal has motivated many PSO's to begin to invest in projects that will significantly reduce emissions. UBC currently has up to \$100m of clean energy projects under review.

#### **CAP AND TRADE**

For the past five years the BC Climate Action Secretariat, part of the BC Ministry of Environment, has been designing a carbon cap and trade system for BC, in collaboration with local industry. The system is also being designed in partnership with other North American jurisdictions, including California, so that carbon allowances can be traded between the provinces and states. The framework for this international partnership is called the Western Climate Initiative (WCI). The opening price of carbon in this market is expected to be below \$15 per tonne <sup>10</sup>, but it will be more comprehensive than BC's existing carbon tax (for example it will include "process" emissions from cement manufacturing) and is forecast to rise steadily from there.

WCI partners have been focusing on the impact of carbon pricing on energy-intensive, trade-exposed ("EITE") industries, which may be particularly vulnerable to competition and leakage<sup>11</sup>. Free distribution of allowances to EITE industries has been identified as one approach to promote competitiveness and minimize leakage, but no formal announcements have yet been made.



Western Climate Initiative: participating states and provinces

<sup>&</sup>lt;sup>7</sup> Vancouver Observer: <u>Dr Oleweiler at lunchtime dialogue presented by Carbontalks</u>

<sup>&</sup>lt;sup>8</sup>Carbon Neutral Government

<sup>&</sup>lt;sup>9</sup>B.C. communities commit to carbon neutrality by 2012

<sup>&</sup>lt;sup>10</sup> Bloomberg: <u>Barclays, NRG Make First California Cap-and-Trade Deal</u>

Linklaters: WCI Market Design



#### INDUSTRY VIEWS OF BC CARBON POLICY

Research with BC's top emitters<sup>12</sup>, carried out in summer 2010, revealed that BC's climate policy does pose challenges to existing emitters in the province. Interviewees stressed that innovation for low carbon transition is possible in response to carbon pricing, but not without other supporting mechanisms.

Large emitters were also very concerned about competitiveness issues, in particular that BC is developing at a faster pace than trading partners south of the border. It was suggested that free allowances and subsidies for technology investment could counter this.

Nevertheless the focus on carbon is interpreted positively by industry as a focus on energy efficiency and investment in new technology. Nudging forward the carbon price has given executives incentives to think about efficiency and the implementation of shifting the industrial technology base.

Furthermore, some companies in industries such as forestry, have been able to re-brand and sell 'climate friendly products' into the global market place. Because BC's low carbon policy is ahead of others, it can create a competitive advantage for some companies. Interestingly, the research found a broad preference for the administrative simplicity of a fixed carbon tax among British Columbian firms, while larger multinational firms preferred a floating carbon price set by trading allowances.

Finally several firms cited Alberta's direct link between the carbon tax and the technology investment fund. Despite the well-publicised "revenue neutral" nature of BC's carbon tax, no interviewees mentioned using the corporate capital freed-up by this reduced corporate tax burden for technology investment.

#### OTHER SUPPORTING POLICIES

The Renewable and Low Carbon Fuel Requirements Act (2008) requires that all gasoline sold in British Columbia have 5% renewable content, and mandates 10% reduction in carbon intensity of fuel by 2020<sup>13</sup>.

Since 2011, the BC Building Code requires all new single-family and row houses to be at least EnerGuide 80 (where '100' signifies buildings that require no utility energy) which is the most stringent in Canada. (Ontario is set to mandate EnerGuide 80 from next year.)

In partnership with BC Hydro and FortisBC, the province has offered an energy efficiency incentive program called Livesmart<sup>14</sup>, with over \$7,000 in rebates for household improvements and equipment.

British Columbia's Clean Energy Act was passed in June 2010, and requires provincial greenhouse gas emission to be 80% below 1997 levels by 2020, and 66% of new provincial electricity demand to be supplied by conservation measures (i.e. new generation capacity may only be built to satisfy one third of predicted load growth).

<sup>&</sup>lt;sup>12</sup> Bumpus, (2011) in review

<sup>&</sup>lt;sup>13</sup>BC Ministry of Energy and Mines: <u>Renewable and Low Carbon Fuel Requirements</u>

<sup>&</sup>lt;sup>14</sup>LiveSmart BC: Efficiency Incentive Program



## INNOVATION

British Columbia is a hotbed of clean technology innovation. According to the Globe Foundation, the green economy makes up over 10% of British Columbia's GDP and spans sectors from green buildings, to alternative energy and smart grid technology.

In the clean energy sector, the province is home to smaller fast-growing IPfocused companies. The Ministry for Economic Development lists 89 Advanced Energy companies with a workforce of over 3000<sup>15</sup>. A 2009 study of BC's clean energy companies found that just over one third had a product on the market, while the remainder were at demonstration stage or earlier.

#### Product Development Stage of BC's Clean Energy Community, June 2009



Source: Guhr & Schaeffer

Another survey by Deloitte carried out in 2008, indicated that while 40% of BC's cleantech companies had revenue below \$100,000, 90% forecast revenue growth to over \$2m in 2010.

#### Cleantech sales level and implied growth trend



Source: Deloitte

#### Direct GDP contributions by sector to BC's green economy in 2008 (\$millions)



#### The sectors and sub-sectors of BC's green economy

#### **Clean & Alternative Energy**

- Renewable Energy
- Bioenergy
- Hydrogen & Fuel Cells

#### **Energy Management & Efficiency**

- Energy Management & Power Electronics
- Energy Saving Lighting & HVAC
- Advanced Batteries, Energy Storage & Charging Systems
- Engines, Power Saving Automotive Equipment & Hybrid Technology

#### **Green Building**

- Architecture, Community Design & Green Infrastructure
- Construction & Building Materials
- Sustainable Development, Property Management & Real Estate

#### **Environmental Protection**

- · Pollution Mitigation, Control & Remediation
- Waste Management, Reduction & Recycling
- Water Conservation & Technologies
- Carbon Capture, Storage & Sequestration · Environmental Consulting

#### **Carbon Finance & Investment**

- Carbon Finance & Offsets - Investment & Venture Capital

#### Knowledge

- Education & Training
- Research & Development
- Information & Communication Technology . Legal & Accounting
- ٠
- Public Administration & Support Organizations

Source: Globe Foundation

<sup>&</sup>lt;sup>15</sup> BC Ministry for Economic Development: Advanced Energy Sector



Cleantech companies reported to Deloitte that the chief drivers of sales were government procurement and regulation. "Promotion of adoption of cleantech by government", "trends in local or regional attitudes against pollution", "provincial/federal regulations" were cited as the top three drivers, ranking above "corporate cleantech spending" and privatisation of utilities.

#### THE KNOWLEDGE ECONOMY

There are four research-intensive universities in the Canadian province of British Columbia: University of British Columbia, Simon Fraser University, University of Victoria, and University of Northern British Columbia. In addition, the British Columbia Institute of Technology works closely with BC Hydro on smart grid innovation.



CAMPUS AS A LIVING LAB INVOLVES STUDENTS AND FACULTY DEVELOPING AND APPLYING THEIR SUSTAINABILITY RESEARCH IN COLLABO-RATION WITH UNIVERSITY STAFF AND CAN ALSO INVOLVE INDUSTRIAL OR COMMUNITY PARTNERS WORKING WITH ACADEMIC AND OPERATIONAL STAFF.

#### UBC as a "living lab"

The University of British Columbia has its own operational infrastructure that runs the equivalent of a small city. The campuses therefore provide a powerful opportunity to explore, test and demonstrate sustainability solutions. They can be "living laboratories" in which students, faculty and staff work together to discover, learn and take action to guide the campus toward sustainability.

According to UBC, the Campus as a Living Laboratory "combines campus operations and administration (e.g. energy and water management, landscaping, buildings and infrastructure, planning) with the education, research and outreach mandates of the university. Campus as a Living Lab involves students and faculty developing and applying their sustainability research in collaboration with university staff and can also involve industrial or community partners working with academic and operational staff".

#### Centre for Interactive Research on Sustainability (CIRS)

The Centre for Interactive Research on Sustainability (CIRS) at UBC is dedicated to research, collaboration and outreach that lead to workable solutions for the challenges of urban sustainability. Physically, CIRS will be based in a new building, opening in spring 2011, which will be the most innovative and high performance building in North America. The building will be used to demonstrate leading-edge research in day-to-day use, and develop sustainable design practices, products, systems and policies.

#### UBC Clean Energy Research Centre (CERC)

The UBC Clean Energy Research Centre (CERC) is Canada's only interdisciplinary facility dedicated to improving existing energy technologies and developing new sustainable energy sources. Members of the centre are working on everything from renewable energies to clean burning engines, fuel cell systems and advanced hydrogen production methods.

#### UBC Sustainability Initiative (USI)

The UBC Sustainability Initiative (USI) main office coordinates sustainability efforts across teaching and learning, research and campus operations. The office relies on partnerships and collaboration within and outside the UBC campus, and across all disciplines, to fulfill its mission.

#### SFU Vancouver Greentech Exchange

The Vancouver Greentech Exchange (VGE) launched in March of 2009 by Simon Fraser University as a monthly networking and learning event featuring presentations from leaders in the green technology field, pitches from cleantech entrepreneurs and networking with



entrepreneurs, professionals, investors, government representatives and more. In April, Greentech Exchange partnered with Kachan & Co., Deloitte and Gowling, to take seven of Vancouver's best clean technology companies to present to investors in California.

#### ELECTRICITY

British Columbia's electricity utility has a mandate to use its transmission and distribution grid assets more efficiently, in order to temper investment in new generation capacity.

#### Smart Grid

The British Columbia Institute of Technology (BCIT) is designing and building a scaled down version of the smart grid - the Intelligent Microgrid. This will enable utility providers, technology providers, and researchers to work together to test and improve architectures, protocols, configurations, and models.

As well as this academic research, BC is a relatively active cluster for demand side management. Tantalus (raised at least \$14m VC capital) manufactures load control hardware, and Enbala (raised at least \$8m VC capital) offers a software service to handle spot trading for major electricity users. SmartCool Systems (\$3m revenue) sells software that more efficiently controls refrigeration and air conditioning compressors, typically reducing electricity use by 10-15%. Legend Power Systems (\$24m revenue) makes electronic hardware for voltage optimisation. In terms of storage one successful local firm is Corvus Energy (\$4m revenue) who manufactures utility-scale lithium-ion batteries.

Finally, the \$73m contract to install smart meters in 1.8m BC residences was awarded by BC Hydro in November 2010 to local firm Corix.

#### ELECTRIC VEHICLES

With the third lowest electricity rate in North America, but one of the highest gasoline prices in the continent (thanks to a combination of geography and specific regional taxes) Metro Vancouver is an obvious early adopter for Electric Vehicles (EV).

Municipal regulations are anticipating considerable uptake, with EV charging equipment space mandatory in 20% of parking spaces in new apartments in the city of Vancouver<sup>16</sup>.

Companies manufacturing electric-drive cars and parts in BC include: Azure Dynamics, which was founded and is still manufacturing in Burnaby (although now headquartered in Michigan) and makes part of Ford's Electric Transit Van; Mercedes-Benz who announced in March that they will build a \$50m fuel-cell plant in Burnaby, Metro Vancouver; Rapid Electric Vehicles (REV) a Vancouver-based company that retrofits SUVs as electric vehicles; E-One Moli Energy who makes Li-Ion batteries; Delta-Q, manufacturers of power management equipment for EVs; and Cadex Electronics which offers a high-power battery testing facility.

#### BIOENERGY

In January 2008, BC launched its Bioenergy Strategy and the BC Bioenergy Network (BCBN). The network was funded with \$25 million and has a mandate to encourage innovation and make BC a world leader in developing bioenergy technologies.

Total Bioenergy Network commitments to date are \$12.5 million, invested in 21 projects with an overall value of \$74.2 million<sup>17</sup>. BCBN support is levered by additional investments of \$61.7 million – a ratio of nearly 6:1 on a project funded basis. Almost half of the funds to date have supported two firms - Nexterra and Lignol - who are also successfully exporting low-carbon innovation from BC (see next section).

16 City of Vancouver By Law 9936

<sup>&</sup>lt;sup>17</sup>BC Bioenergy Network Portfolio



Carbon offset funds enabled the Lafarge cement plant to reduce the amount of coal used in the process of creating cement. Traditionally substantial users of coal, the company was able to reduce the amount they burn by replacing a portion of this fossil fuel with biomass and other materials from construction waste. This shift in fuel reduces annual greenhouse gas emissions relative to the baseline.

Furthermore, owners of anaerobic digestion systems - often farmers - in BC can sell their biogas to Fortis BC, one of two gas suppliers in BC. Under this program, anaerobic digestion system owners can sell either raw biogas or biomethane to Fortis for injection into their distribution system. While the price paid for the raw biogas and biomethane will vary between projects, the maximum price is \$15/GJ for biomethane, and less (due to the cost of upgrading) for raw biogas<sup>18</sup>.

BC Agriculture Council (BCAC) and its subsidiary BC Agriculture and Research Corporation (ARDCorp) are developing the Renewable Agri-energy Initiative (RAI) to help strengthen the competitiveness of the BC agricultural sector. It is hoped ARDCorp-RAI will help combat rising energy prices, provide rural employment, and improve organic waste management<sup>19</sup>.

#### NON-CLEANTECH SMALL AND MEDIUM ENTERPRISES

In British Columbia, the small business sector is a key driver of economic growth, and a vital source of innovation. 98% of businesses in British Columbia employ fewer than 50 people, and are classified for tax purposes as small businesses. According to BC Stats<sup>20</sup>, they number 395,900 in the province and generate 32% of the province's GDP, higher than the Canadian average of 28%.

Small businesses in BC currently pay 2.5% of profit as income tax on earnings over \$500,000. The tax rate was lowered from 4.5% when the carbon tax was introduced, and will be reduced to zero in 2012. The carbon tax will likely become the largest tax BC small businesses pay, providing a strong incentive to emit as few greenhouse gases as possible, and increasing the need for support mechanisms to assist them in a transition to low carbon processes.

#### Climate Smart BC

Climate Smart is a for-profit subsidiary of non-profit Ecotrust Canada which provides greenhouse gas accounting and consulting services to companies with fewer than 500 employees. Climate Smart has also exported its training services to Oregon. Businesses that have completed Climate Smart programme may use the Climate Smart logo on their marketing, in a similar fashion to the UK's Carbon Trust Standard or the CARB's Cool California Small Business.



#### CASE STUDIES

Mountain Equipment Coop (1,500 employees nationwide) targeted scope two emissions, transporting goods from distribution centres to stores by train as opposed to truck where possible. Emissions fell 30% and costs reduced, although delivery time rose.

Translink operates the public transit system in the Greater Vancouver area. Since 2006, 75 of their 1,300 buses have run on compressed natural gas, lowering local particulate emissions and potentially lowering greenhouse gas emissions by up to 20%. This was Cummins Westport's first large commercial order in British Columbia<sup>21</sup>.

#### EXPORTING INNOVATION

Business in British Columbia is not just innovating to cut its own carbon emissions at home. The cleantech sector is also benefiting from the province's long history as an exporter bringing low-carbon technologies to the world.

<sup>&</sup>lt;sup>18</sup>Anaerobic Digestion Initiative Advisory Committee of BC

<sup>19</sup> Renewable Agri-energy Initiative

<sup>&</sup>lt;sup>20</sup> BC Small Business Profile

<sup>&</sup>lt;sup>21</sup> Press Release: <u>Cummins Westport Engines to Power Up to 95 New TransLink Buses in Vancouver</u>



#### Wood Pellets

BC is the center of wood-pellet production in North America, with 90% of production exported including over 500,000 tonnes to Europe<sup>22</sup>. One large example is Vancouver's Pacific BioEnergy Corp. which has formed a partnership with French energy giant GDF SUEZ, who will support a \$24-million capacity expansion of Pacific BioEnergy's wood pellet production plant in Prince George. The two companies have formed a joint venture to own and operate the Prince George plant, the expansion of which is expected to be completed in the autumn of 2010, doubling production capacity to 350,000 tons per year. Under the terms of the joint venture, GDF SUEZ has also agreed to purchase 2.5 million tons of wood pellets for use as feedstocks at its generating facilities in Belgium over the next 10 years, displacing two million tons of coal as a result.

#### Westport

Westport Innovations<sup>23</sup> is a leading developer of automotive engines and fuel systems that use natural gas, biomethane, and hydrogen. As such, the company and its joint ventures have sold over 25,000 engines in 25 countries, helping municipal and commercial fleets of buses and trucks transition from diesel to natural gas. The 200-employee, Vancouver-based company was founded in 1995 following a spin-off from a UBC research project. Strong partnerships with companies like Cummins, PACCAR, Volvo, and Weichai Power have allowed Westport to develop a wide market base, with over \$121 million in revenues in 2009.

#### Nexterra

Vancouver-based, Nexterra Systems Corp. is a leading developer and supplier of biomass gasification solutions which enable industrial and in-

stitutional customers to generate renewable heat and power from low cost biomass fuels. Founded in 2003, and now with a staff of 55, Nexterra's sales to date include projects at the University of South Carolina, Dockside Green, the US Department of Energy's Oak Ridge National Lab, Kruger Products, and Tolko Industries. To expand their product deployment, Nexterra has established strategic relationships with several key parties including GE Energy, Johnson Controls Inc., and Andritz Separation.

#### Ballard

Ballard Power's innovative product development in clean energy hydrogen fuel cell products has earned the 340 employee, Burnabybased company a reputation as a clean technology leader<sup>24</sup>. Ballard currently owns approximately 400 patents and has licenses to another 1,800. Ballard's clean energy solutions bring compelling value propositions to end users' in markets such as material handling, backup and supplemental power, distributed generation, and heavy duty applications. In January 2010, Ballard signed a two-year fuel cell stack supply agreement, valued at \$1.5 million Cdn, with Wuhan Intepower Co. Ltd, a Hubei-based systems integrator of cell station back-up power equipment.

#### Endurance

Endurance Wind Power Inc. manufactures advanced induction based wind turbines for distributed wind power applications. The company designs, builds and sells 5kw, 35kw and 50kw turbines in BC, with over 90% of its sales outside Canada. Founded in 2007, the company has raised \$4.7m in three equity rounds under the Venture Capital Program and has grown from two employees to 55 in three years. The company used early angel and VC investments to attract management and technical talent, and to target the global power market.

"A KEY DRIVER IN OUR DECISION-MAKING IS THE KNOWLEDGE THAT THE PRICE OF CAR-BON WILL BE INCREASING IN THE FUTURE.WE WANT TO BE WELL-POSITIONED TO COMPETE IN A CARBON-CONSTRAINED WORLD"

-Esther Speck, Director of Sustainability, Mountain Equipment Co-op



<sup>&</sup>lt;sup>22</sup> UBC Engineering <u>Research Spotlights</u>

<sup>&</sup>lt;sup>23</sup>Westport Innovations <u>corporate website</u>

<sup>&</sup>lt;sup>24</sup> Ballard Power <u>corporate website</u>



#### Lignol

Lignol is currently developing proprietary biorefinery technology to convert lignocellulosic biomass into fuel ethanol, lignin-based products and other biochemicals. In addition to receiving backing from Canadian provincial and federal agencies, the company also received \$30 million from the US Department of Energy to build an \$88-million cellulosic ethanol plant in Colorado<sup>25</sup>.

#### Carmanah

Based in Victoria, Carmanah Technologies<sup>26</sup> is a leader in solar LED lighting innovation and performance and in industrial solar roof-top grid-tie solutions in Canada. Established in 1996, Carmanah has thousands of clients worldwide —resulting in over US \$30 million in revenues in 2009—and a global staff of more than 100. Notable clients include the Canadian Coast Guard, NATO, Lockheed–Martin, the US Military, airfields and waterways around the world, and a number of cities in California.

#### NRC Institute for Fuel Cell Innovation

The National Research Council of Canada's Institute for Fuel Cell Innovation<sup>27</sup> (NRC-IFCI) is located in BC, on the UBC campus. As the premier applied research organization dedicated to supporting Canada's fuel cell and hydrogen industry, the institute supports BC's Hydrogen fuel cell cluster, the largest concentration of expertise of its kind in the world.

## CAPITAL

Access to investment capital is vital for innovative, fast growing companies. Deloitte's 2007 survey of BC cleantech companies identified "raising new growth capital" as the most significant challenge facing respondents, and specifically in clean energy Guhr & Schaeffer identified "equity, debt and fundraising" as the most significant need of BC's Clean Energy Community.

Innovative low-carbon technology companies do not bemoan a lack of investors however: only 17% said they could not find private equity firms in Canada that were interested in cleantech investing. Instead the key challenge, reported by 52% of respondents to the Deloitte survey, was a lack of investors at early stages of technology development. Private equity firms appear to be focused only on later stage deals, with a shorter horizon until exit.

KPMG's inaugural Cleantech Report for British Columbia surveyed a representative sample of 35 of 226 pure-play clean energy companies in the province. The survey found that 25% of investment since inception had come from within the province of BC, although in the last year that had dropped to below 20% with the United States rising to the most important source of capital.

#### PRIVATE VENTURE CAPITAL

British Columbia is home to several private Venture Capital firms with a mandate to invest wholly or in part in "green" companies. Together these investors allocate almost \$2bn in equity capital.

#### **GOVERNMENT VENTURE CAPITAL**

BC and Canada as a whole are fortunate to have dedicated government funds that specifically target stages of the corporate funding cycle underserved by private venture firms. In particular the so-called "valley of death" between applied research and full commercialisation is the focus of SDTC and ICE funds.

#### Sustainable Development Technology Canada (SDTC)

SDTC is a not-for-profit foundation that allocates government funds to support the development and demonstration of clean technologies. Beyond simply providing funding, SDTC staff work closely with stakeholders and partners to build the capacity of Canadian

<sup>&</sup>lt;sup>25</sup>Lignol <u>corporate website</u>

<sup>&</sup>lt;sup>26</sup> Carmanah <u>corporate website</u>

<sup>&</sup>lt;sup>27</sup> NRC Institute for Fuel Cell Innovation



clean-technology entrepreneurs, helping them form strategic relationships, formalize their business plans, and build a critical mass of sustainable development capability in Canada.

The \$550M SD Tech Fund is aimed at supporting the late-stage development and pre-commercial demonstration of clean technology solutions: products and processes that contribute to clean air, clean water and clean land, that address climate change and improve the productivity and the global competitiveness of the Canadian industry.

#### ICE fund

4%

The Innovative Clean Energy (ICE) Fund was created in 2007 to support "pre-commercial" energy technology (or commercial technologies not currently used in BC). The fund will also help to showcase technologies that solve problems in BC and other jurisdictions that have international market potential.

Since 2008, over \$60 million of spending has been approved for 41 projects in over 37 communities across BC. These projects represent a total value of over \$234 million and showcase a variety of clean energy technologies including solar, wind, tidal, geothermal, ocean wave and bioenergy.





- Cannot find cleantech focused private equity in Canada
- Private equity firms are not interested in or do not understand cleantech

Source: Deloitte

#### Needs of BC's Clean Energy Community, June 2009





Source: KPMG inaugural CleanTech Report 2010 for British Columbia in partnership with BC CleanTech CEO Alliance (not yet published) presented at UK Trade and Investment Clean Technology Mission, February 14,2011-04-27

Source: Schaeffer & Guhr



#### BC Renaissance Capital Fund

The Renaissance Capital Fund (BCRCF) is a government owned fund-offunds, that invests in venture capital funds in order to attract successful venture capital managers to British Columbia, and help develop the province's innovative technology companies.

To date, the BCRCF has committed capital to seven venture capital fund managers based in the United States and Canada that have approximately \$2 billion in capital under management for investment.

#### GOVERNMENT VENTURE CAPITAL VS. PRIVATE VENTURE CAPITAL

A 2008 paper by three professors from Sauder School of Business found that firms financed by government-sponsored venture capitalists underperformed on a variety of criteria. The investigators assembled a near-comprehensive data set of Canadian venture-capital backed enterprises, and found government-sponsored firms underperformed on value-creation - as measured by size of IPO or M&A activity - and innovation - as measured by patents.

The authors note that this correlation could either arise from a selection effect (private venture capitalists have a higher quality threshold for investment than government venture capitalists) or from a treatment effect (government venture capitalists crowd out private investment and furthermore provide less effective mentoring and other value-added skills).

#### Biggest investment fund management firms in BC

Company name	Assets (\$m in 2010)
Growthworks Capital	\$1000
Chrysalix Energy Venture Capital	\$300
Ventures West Capital	\$241
Yaletown Venture Partners	\$150
BC Renaissance Capital Fund	\$90
Lions Capital Corp	\$64
Pangaea Ventures Fund	\$32
Greenscape Capital Group	\$6m
Green Angel Energy	\$2.6m

Source: Business in Vancouver, January 2011

#### TAX INCENTIVES

#### Venture Capital Program

The venture capital program (VCP) in the province of British Columbia provides a 30% tax credit to investors making eligible investments. Between 2001 to 2008, tax credits of \$256M were leveraged over nine times into at least \$2.3B of equity investments, according to a report prepared for the Ministry of Small Business, Technology and Economic Development in June 2010 by Thomas Hellmann, Sauder School of Business, University of British Columbia and Paul Schure.

Each \$1 of BC tax credits translated into \$1.98 of BC taxes; the 91 VC-backed companies surveyed created an average of 2.5 jobs per year in BC (compared with a control sample of 150,780 BC firms that created fewer than 0.5 jobs per year on average).

Revenues contain a strong export component. Our data suggest that 47.35% of all revenues are generated outside BC. In addition, the survey shows that the percentage of sales outside BC is particularly high in the cleantech sector, reflecting the fact that energy is relatively cheap to produce in BC. An interesting case in point is Endurance Wind Power Inc. which sells over 90% of its wind turbine products outside Canada.

#### IFC BC

A company registered in the International Business Activity (IBA) program can receive up to a full refund of provincial tax on income earned on qualifying export activities, incurring only the federal corporate income tax rate of 16.5% in 2011, reducing to 15% in 2012. Since 2010 Clean Technology companies are eligible to register for the IBA program.



#### Corporate taxes cut with carbon tax

The British Columbia Carbon Tax Act was introduced alongside personal and corporate tax cuts, with the intention that the tax would be revenue neutral (as recommended since at least Pearce 1991). Small business corporate income tax rate reduced from 4.5% to 3.5% effective July 1, 2008, reduced to 2.5% effective December 1, 2008 and reduced to zero by April 1, 2012. General corporate income tax rate reduced from 12% to 11% effective July 1, 2008, reduced to 10.5% effective July 1, 2010 and reduced to 10% effective January 1, 2011.

#### SOURCES OF REVENUE

The KPMG Cleantech Report found that one third of revenues to BC cleantech firms came from sales to the US, and a further third from sales to Europe. Only 10% of clean energy companies' revenue came from within BC and an even smaller percentage were exporting to Asia.

Utility-scale renewable electricity developers must receive power purchase agreements from BC Hydro in order to sell their electricity. On August 3, 2010, the final project was selected for an award of an Electricity Purchase Agreement (EPA) bringing the total number of projects selected under the Clean Power Call to 27. In terms of installed capacity, the projects are approximately half wind power and half run-of river hydroelectric.

#### Pacific Gateway

The small proportion of cleantech exports to Asia stands in contrast to the overall picture of the BC economy, for which China is the number one destination. The share of BC's exports shipped to China has increased seven-fold in the last decade, from just over 2% in 2001 to 14% in 2010. If Hong Kong is included, China actually surpassed Japan to become the second largest destination for goods produced in BC. These existing trade connections to Asia's large growing economies clearly offer a great opportunity for BC's low-carbon innovators.

## CONCLUSIONS

Global investment in clean energy has continued to grow at an unprecedented pace in the last five years. This has been driven not only by billions of dollars of stimulus funds made available by most major developed economies in response to the recession, but by the recognition that high non-renewable energy prices make numerous renewable energy solutions competitive. Carbon pricing in Europe under its emissions trading scheme is driving demand for alternative energy which results in companies like Vattenfall looking as far afield as British Columbia for biomass supply to meet European obligations.

China's role as an investor, particularly in wind and solar production, is unprecedented. Targets in China include 15% renewables in primary energy generation by 2020, 35-40% reductions in energy intensity compared to 2005 by 2015 and 40-45% reduction in carbon intensity compared to 2005 by 2020. Government policy in the form of a five-year plan and large-scale investment has shifted the centre of gravity for wind and solar production away from European countries like Germany and Denmark through over \$50bn of investment in 2010 alone. This level of investment by a single country is hard to match and shows the role that targeted government investment in energy infrastructure can play in encouraging clean energy production. As the graph on the next page shows, private equity and venture capital investment into clean energy is relatively small by comparison, although this form of investment is more focused on early stage commercialization and innovation rather than large-scale energy technology deployment. Bloomberg New Energy Finance reports that \$7.8bn of venture capital was invested in 2010 with the solar sector attracting the largest proportion.

In an extensive review of the clean energy spending, Deutsche Bank points out that the Investor Network on Climate Risk, representing 80 institutional investors with over \$8 trillion of assets is motivated to continue to invest in the sector. Surveys of the institutional



BC Hydro Clean Power Call

## Dollar weighted revenues, derived by location (2009 - 2012 average)

#### Product Technology Development Fundamental Applied Market Entry Commercialization and Demonstration Research Research & Market & Market (Pilot to Full Scale) Volume Development Funding Intensity Governments Banks Gan Venture Capital Industry Industry Angel Im

investor community suggest that the primary motivations are portfolio diversification, increasing ethical investment by funds, the desire to invest in new technologies and the opportunity to generate returns from a market that should see strong growth in the future.

In evaluating the role of governments in supporting clean energy development Deutsche Bank argue that investors have three overarching expectations:

• Transparency: policies need to be easily understood and open to all,

BC
Rest of Canada

Export- US

Export - Europe

Export - Asia

Export - Other

- Longevity: policy makers need to establish long term commitments to give investors assurance about the security of their investments, and
- Certainty and consistency: the incentives need to be financeable.

Set against this backdrop, it is clear that a small jurisdiction like British Columbia could never outspend China, Germany or the US in clean energy investment. Experience suggests that a highly targeted strategy that leverages the Province's resource endowments is more likely to succeed. While the dominant base of low cost hydroelectric power production represents a challenge for other forms of renewable energy generation within the province, alternative resources including wind, tidal and biomass are present at significant scale and are accessible at competitive costs both for domestic demand and for export purposes. A suite of aggressive and innovative carbon policies including the carbon tax, carbon neutral government and a low carbon fuel standard create a clear and transparent regulatory structure that both prices carbon and encourages innovation.

Federal and Provincial funding through the SRED, the ICE Fund and SDTC provide a pool of risk capital to support the early stage demonstration of clean technologies and a low taxation business environment creates good conditions for startups and small cap companies.

The province has a highly educated workforce and strong commitments by the higher education sector to engage in clean energy development. UBC has made the University Sustainability Initiative a core priority, with the goal of transforming the campus into a living laboratory for clean technology demonstration.

The provincial government has created a policy platform that creates an opportunity structure for clean technology businesses. Simply placing a price on carbon within the province of up to \$55 per ton creates a strong signal for investments that reduce emissions. But it is clear from a number of studies that there are barriers to the growth of the sector. While there has been a great deal of interest in the role of venture capital in driving growth in the clean technology sector, a number of studies point to the mismatch between the



investment expectations of VC firms and the likely returns from investments in clean energy generation, which by definition, generate utility rates of return.

A study by the Pacific Institute for Climate Solutions (PICS) drew four broad conclusions about the barriers in BC based on interviews with a number of firms:

 The capital intensive nature of cleantech investment results in illiquid assets that are not ideal for VC firms, who look for a relatively short runway to an exit from their investment. This finding is reinforced in studies by Deloitte and by an extensive survey by Guhr and Schaeffer, who found that 'equity, debt and fundraising' represent the biggest challenge for companies in the province, particularly during the early stages in development of a technology company.

### Total Global investment in clean energy in 2010 including all asset classes \$USD B)



Source: Bloomberg New Energy Finance, 2011

- 2. Many clean technology companies are founded by scientists and experts who have strong technical skills but weak management skills. Since 'clean energy' covers a huge array of technologies, it is challenging for investors to maintain expertise in all areas, although it is clear that an investor's ability to bring strong management teams to the table may be as important as their ability to bring capital.
- 3. As evidence from China suggests, the state can play a key role in supporting the clean technology sector through investment and procurement policies. Surveys in BC indicate that growing companies need demonstration scale projects to support their commercialization efforts. BC Hydro's clean energy procurement process is considered too slow and it is not well suited for smaller scale demonstration projects. Other utility companies in BC such as Fortis BC and Corix may be better suited to support this form of investment. While the ICE Fund provides an alternate source of investment, it is considered too small to drive growth in investment (although it should be noted that some ICE fund calls were undersubscribed). Public sector organizations within BC spend hundreds of millions of dollars a year on energy services.
- 4. The domestic market in BC is relatively small, meaning that local clean technology companies must look to export markets for growth. British Columbia does not have a strong platform for supporting growth in key markets. Alberta has a significant staff in Washington DC, while BC does not appear to have a strong presence there or in California or China to support export market development.

This paper provides an overview of the BC economy, which was clearly already in a major transition away from high levels of resource dependence towards a more mixed economy. It is a transition that we have witnessed in other small jurisdictions like Finland. Provincial policy has created a strong foundation for the accelerated growth of the clean energy sector and the purpose of this workshop is to identify the priorities for growth in all sectors over the coming five years.



© ISIS, Sauder School of Business, University of British Columbia 2011

Carbon Governance Project (CGP) Backgrounder Authors: Neil Salmond, Dr. James Tansey, Dr. Adam Bumpus

CGP International Workshop Series: Initiator and International Coordinator: Dr. Adam Bumpus Vancouver Chair: Dr. James Tansey UK Chair: Dr. Chukwumerije Okereke California Chair: Dr. Blas Pérez-Henríquez

**PROJECT PARTNERS**:











VANCOUVER WORKSHOP SPONSOR: Deloitte.