GREEN ECONOMY *WORKING PAPER #1*

VANCOUVER'S GREEN ECONOMY

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VANCOUVER GREEN CAPITAL

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This paper has been produced as part of a series of working papers intended to further discussion on the green economy in Vancouver. Developed in support of VEDC's work in support of the City of Vancouver's Greenest City Action Team, the papers have been produced by consultants and researchers, and do not necessarily reflect the views of the VEDC or its stakeholders. These papers will be used to inform the strategies put forward by the Green Economy working group. Findings will be continuously refined as understanding of the green economy progresses.

cover photos and inside cover:
City of Vancouver

Contents

1. SCOPE

This report will focus on the Green Economy within the City of Vancouver (including the unincorporated lands—UBC) and will investigate a number of questions:

- What are the employment characteristics of the green economy in Vancouver?
- What jobs are reasonably identified as "green jobs" and what does the green job employment spectrum look like: what are the key roles and key sectors?
- What are reasonable estimates of current green jobs, and estimates of magnitudes of growth in key segments?
- In what ways can the City foster the growth of these sectors?


photo: City of Vancouver

2. INTRODUCTION / CONTEXT

Climate Change, rising energy costs, loss of biodiversity and other environmental concerns have caused individuals, businesses and governments to re-examine the way products and services are produced consumed and disposed of. These concerns have had a real effect on all aspects of the economy, from investment by businesses and governments, law and regulations from all levels of government and changes in consumer preferences. New businesses have emerged and existing ones have adapted to capitalize on the opportunities arising from these economic changes. Within Vancouver businesses, new green jobs are emerging and old jobs are being transformed to meet the world's material and energy needs while complying with the growing environmental demands of government, business and consumers.

Vancouver has also identified the importance of green businesses to the area's economy, environment and lifestyle. The green industry could help Vancouver meet some of the challenges that have limited Vancouver's economic development. Traditionally Vancouver has had a lower income than most other large North American cities.[1] Some of this low income can be attributed to the lack of head offices, manufacturing, export-oriented businesses and larger businesses[2]. Many of the sub-sectors of green businesses, like fuel cell technology and alternative energy, have firms which are headquartered in the Lower Mainland and provide opportunities for export-oriented growth.

A diversified green industry in Vancouver could supply a range of employment opportunities for Vancouver's diverse workforce. From high-skilled, high-paying employment in scientific, technical and consulting fields to plentiful trades work in green construction to jobs for those with multiple barriers to employment in the recycling fields, a diversified green industry in Vancouver economy could supply a range of employment opportunities.

The City is well-positioned to capitalize on the green economy opportunities. Vancouver has set the goal of being the world's greenest city by 2020. It is already a centre for innovative green businesses like Westport, Saltworks and Nexterra and is perceived as a centre of fuel-cell technology and green building. It also has the lowest GHG emissions per capita of any large community in North America, showing how, in recent years, economic gain can occur alongside declining emissions. This paper will examine the size of Vancouver's green economy and provide recommendations for how the city can foster further growth.

3. GREEN JOBS

3.1 Challenges for Defining Green Jobs

The first challenge in determining the number of green jobs in Vancouver's economy is developing a definition for "green jobs" Currently no consensus definition exists among the many groups that have tried to define the term. The main points of contention among the definitions are:

Process vs. Output: Some definitions categorize a job as being green if the process that the company uses to develop its product or service has a significantly lower environmental impact than its rivals have. Under their definition, a job can be green regardless of the industry. Other definitions require that the job be within an industry whose core function is to create a product or service designed to minimize, measure, avoid or mitigate negative impacts on the environment.

photo: City of Vancouver

Direct vs. Indirect: Although all definitions include at least some jobs within industries, like wind power, which reduce dependence on fossil fuels and the GHG emissions that they create, some definitions also include the indirect jobs that are created by the business. This would include, for example, the steel workers who create the metal which goes into the wind turbines. Some definitions also include the "downstream" jobs created by employees within green sectors spending their wages.

Job-Centred vs. Business-Centred: Some definitions include only jobs, like that of an environmental scientist, whose output directly contributes to an improved environment. Other definitions include all positions that contribute to the success of a green business, including those, like a janitor or tax accountant, whose work has little to do with the environment.

Inclusion/Exclusion of Social Criteria: Some definitions of green jobs have not only environmental criteria but also social criteria. They state that, in order to be a green job, it needs to provide things like the right to unionize, a "living wage" and opportunities for career advancement. They argue that without these elements, a position cannot be truly considered "sustainable" for employees.

Debate about specific industries: Even when there is agreement about how a green job should be defined, there is disagreement about whether specific industries meet the selection criteria. One example of this is that some definition includes jobs within the nuclear power industry because it produces low GHG emissions, while others exclude those jobs due to the impact of uranium mining and waste storage.

3.2 Working Definition

This report is not intended to develop the final definition for green jobs worldwide, (although such a definition would be of great value to green job studies). It is, instead, meant to look at the variety of jobs within industries and businesses that have a positive green impact (or at least a significantly lower negative impact than their rivals) which are most able to capitalize on the growing governmental, business and consumer desire to minimize and mitigate humans' effect on the environment.

Green jobs in this classification will only include those within businesses and industries, which directly have a positive impact on the environment. It will not include the jobs within their suppliers' businesses or those generated by green employees' personal spending.

Green jobs, within this classification will not be limited to only those that provide a specific wage-level, have the opportunity to unionize or have career-advancement opportunities.

Green jobs will be classified within the following sectors:

Fuel Cell Technology and Green Transportation 500 Vancouver Green Jobs	• Metro Vancouver is seen as a world leader in fuel cell technology for transportation, materials handling and back-up power • Vancouver also has innovative companies developing fuel efficient transportation technologies
Alternative Energy and Power Management 2000 Vancouver Green Jobs	• Vancouver is a hub for a range of alternative energy businesses in hydro electric, bio-fuel, wind and tidal energy. • It also has businesses creating power measurement, management and smart grid technologies to monitor, control and reduce power usage.
Environmental Consulting 1350 Vancouver Green Jobs	• The City of Vancouver has over 45 businesses providing environmental consulting to the mining, forestry and governmental sectors.
Land and Water Remediation 150 Vancouver Green Jobs	• Many businesses specialize in mitigating industry's environmental impact on the Province's land and water resources.
Green Building and Building Technologies 1350 Vancouver Green Jobs	• Green Building constitutes 3-5% of overall building construction in Vancouver • Vancouver has one of the largest number of LEED buildings in North America.
Public Transportation 2300 Vancouver Green Jobs	• Public Transportation companies encourage commuters to use travel options more energy efficient than single occupancy vehicles.
Public Sector and Non-Profits 1200 Vancouver Green Jobs	• Many of Vancouver's educational institutions, non-profit organizations and governments are environmental innovators.
Waste Management and Recycling 1400 Vancouver Green Jobs	• Vancouver has businesses recycling materials from asphalt to metals to electronics.

On top of these sectors, other jobs within traditional sectors are included as green:

Green Businesses in Traditional Sectors 250 Vancouver Green Jobs	• Many Vancouver companies have found game-changing products and processes to create significantly green practices than their rivals.
Green Departments in Traditional Businesses 80 Vancouver Green Jobs	• Businesses of all types have developed departments devoted to measuring, reducing and ameliorating the environmental impact of their companies.

Green jobs tend to fall within a spectrum. Determining whether a sector is green is not an either/or question as every business has a range of positive and negative effects at all points of the supply chain. Because of the somewhat arbitrary line that must be made upon the spectrum dividing the green and non-green jobs, it is inevitable that some sectors with "green aspects" will be excluded from the green job definition. Some notable exclusions in this survey are:

- Bicycle stores and repair shops
- "Retail recycling"—consignment, thrift and used-product stores that sell re-used material. (However businesses that sell recycled construction material will be included.)
- Urban Agriculture

3.3 Outlook

There is a very strong outlook for many sub-sectors of Vancouver's Green Economy. Macroeconomic factors like impending cap and trade systems and overall environmental concern will create greater demand for environmental products and services. Vancouver is well – positioned to meet this demand. Its fuel cell cluster is a world leader. Provincial and municipal legislation and policies will create greater demand for alternative energy, green building and public transportation. The consulting and remediation sub-sectors will be cyclical, largely dependent on the strength of the forestry and mining sectors that employ many of their employees. Green employment in traditional industries and business will continue to steadily grow as more companies identify the benefits of lessening their environmental impact.

3.4 Methodology for counting Green jobs within a sector

Within certain industries, whose core function is to repair, avoid, measure or lessen a negative impact on the environment, all jobs within the industry will be considered to be "green jobs", including those of employees like administrative staff whose daily work has little direct effect on the environment. These jobs have been designated "green" because their work directly supports the green mandate of the business. This inclusion of support staff in the overall industry is consistent with the manner in which jobs within the construction or mining sectors are counted. Some businesses like BC Hydro have opted to outsource core business functions like HR and administration to outside organizations. Because these are core business functions, these outsourced jobs will be included as green jobs.

This technique of including all employees of businesses within green industries will be used for the following industries: Waste Management and Recycling; Alternative Energy; Fuel Cell Technology; Land and Water Remediation and the environmental non-profit sector.

In other industries, like construction and consulting, where many companies often do both "traditional" and "green" work, and many

photo: City of Vancouver

employees will have both environmental and non – environmental projects during a given day of work, the number of green jobs will be determined by calculating the rough percentage of the sector's revenue from green projects and multiplying that percentage by the overall number of jobs within the sector.

Green jobs within the government and traditional businesses will be calculated by counting those employees within the relevant green or sustainability departments.

3.4 Methodology for Determining Green Businesses

In order to catalogue green businesses, a number of databases were used. These include:

- BC Technology Directory
- Canadian Company Capabilities
  - Subsector: Wind Energy
  - Subsector: Environmental Solutions
- Federal Clean Energy Technology Sector
- Green Technology in Vancouver: Demonstrated Strengths and Industry Challenges, (VEDC, 2009)
- Charity Village (For environmental non-profits)
- Internet searches of green Vancouver companies

Employees were counted from these businesses through either reviewing company websites, using the Hoovers.com database or contacting the company directly. A list of companies and their number of employees will be released as a companion appendix.

Within industries like construction, where there are a large number of small companies and relatively few employees are dedicated to green projects, job numbers were secured by Census data (2006) about construction jobs in Metro Vancouver. It was assumed that the proportion of City of Vancouver construction jobs to Metro Vancouver construction jobs would be the same as the proportion of City of Vancouver jobs to Metro Vancouver jobs (34%)[3]. This technique was used instead of only counting those residing in Vancouver who worked construction jobs because only counting residents would likely give an inaccurately low estimate of jobs in the city. The City of Vancouver contains a disproportionate share of the region's jobs with a net inflow of 57,000 workers from the rest of the region into the City of Vancouver each day.[4]

4. GREEN ECONOMY SUB-SECTORS

4.1 Hydrogen, Fuel-Cells and Green Transportation

Approximately 490 Vancouver Green jobs in Hydrogen, Fuel Cells and Green Transportation

Overview: Businesses within the Hydrogen and Fuel Cell sub-sector provide technology to use hydrogen or other fuel to provide power in the transportation, materials handling, backup power or other usages. Since this technology is used in many other sectors including green building and alternative energy, and because there is significant governmental and education involvement through the National Research Council (NRC) and UBC, there is a great deal of overlap with other sectors. Also included within this sector are businesses devoted to providing greener forms of transportation, like Westport.

Key Players: Vancouver is generally perceived as a world leader in fuel cell technologies; a bibliometric study by Science Metrix found that the city produced the greatest amount of fuel-cell research in the world in 2008.[5] Three of the top fuel cell companies by market capitalization—Ballard Power Systems, Plug Power and Heliocentris—are either based in Greater Vancouver or have a branch located there[6].

Aside from this, the National Research Council has located a Fuel Cell Technology Cluster and has an office-laboratory near UBC's Point Grey campus. Daimler, Linde Gas, Air Liquide and Ford have also invested heavily within the sector, creating demonstration projects within the City.

Within the green transportation sector the major player is Westport, which produces high-performance, fuel efficient internal combustion motors and fuel systems for alternative fuels. To add to this there are a number of smaller firms that produce, market or distribute electric vehicles for short-range commuting.

Jobs: The NRC has estimated that there are 1400 jobs within this sector in the Metro Vancouver area[7]. However, many of the larger players like Ballard, Plug Power and Powertech Labs have major parts of their operations (and jobs) located outside of the City of Vancouver. Based on surveys of employers in the region, a closer estimate of City of Vancouver jobs would be 490.

Many of the jobs within the sector are high-skilled well-paying jobs within research and development, recruiting engineers, scientists and technicians. Vancouver's world-class institutions at UBC, SFU and BCIT are able to provide qualified staff for these positions. These research and development jobs are particularly valuable in Vancouver, which has a corporate rate of

Key Vancouver Hydrogen, Fuel-Cells and Green Transportation Companies

Company	Technology	Location	Jobs
Westport Innovations	Fuel-efficient Internal Combustion Engines and Fuel Cell technology	Vancouver	200
NRC's Institute for Fuel Cell Innovation	Conducts research and provides office and testing facilities for Lower Mainland Fuel Cell companies	Vancouver (UBC Point Grey)	220
Dpoint	Fuel Cell Humidifiers and HVAC systems	Vancouver	20

(Source: Website surveys and Interviews with Companies)

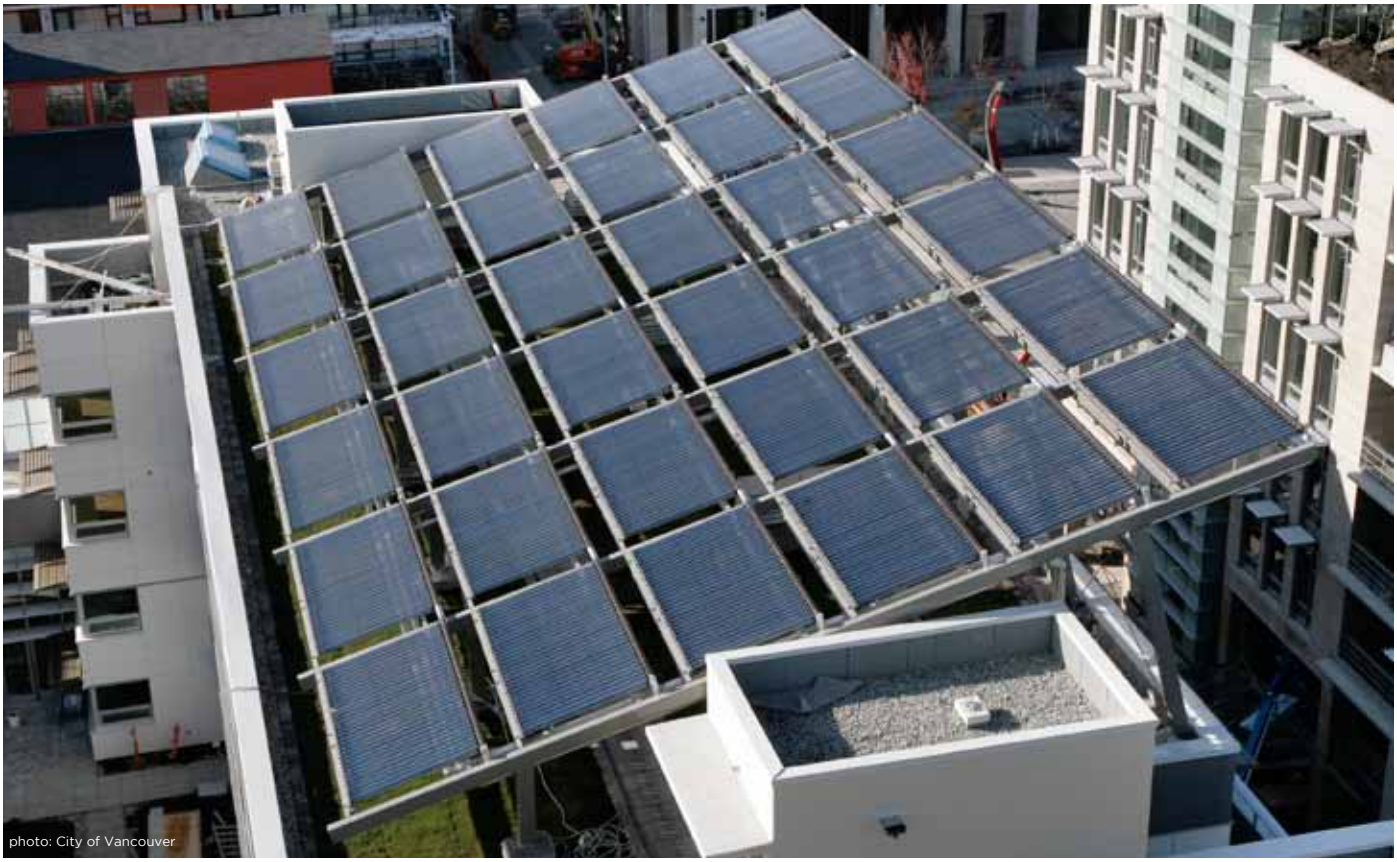
photo: City of Vancouver

research and development that is a fraction of the rate for companies in Ontario, Quebec and south of the border.[8] Although UBC has the 5th largest R&D budget among Canadian universities, only 1 of the top 20 Canadian companies in R&D—Telus has a major office in Metro Vancouver.[9]

Because the fuel cell cluster is moving beyond research and development into commercialization of their products, jobs within the sector have increasingly included jobs in marketing, business management and administration. There are no immediate plans to start large-scale manufacturing within Vancouver, largely due to the lack of available industrial space. Even firms like Westport, who manufacture within the Lower Mainland, have chosen Annacis Island for their manufacturing location.

Jobs created within this sector will not displace other work within the city, as there is relatively little investment in traditional engine systems in Vancouver.

Outlook: Although there are some concerns about hydrogen's ability to be a major player in the short-term transportation market[10], significant growth is still anticipated in sectors like materials handling and back-up power, expanding the global industry to $325 billion by 2018[11]. This projected growth has already increased the amount of competition for Vancouver within the sector, as other cities are attracting and retaining fuel cell companies.

The Fuel Cell cluster's future in Vancouver will be affected by a number of factors:

- *Demonstration Projects:* Initiatives like Whistler's Hydrogen Buses provides valuable exposure to Vancouver companies' technology
- *Carbon Pricing*—With carbon taxes or Cap and Trade fuel-cell products will become more competitive against fossil-fuel technologies
- *Continued Government investment*—Vancouver's strong position in the market is largely due to early private and public funding.[12] Its continuation is necessary for Vancouver's R&D based industry.

4.2 Alternative Energy and Power Management

Approximately 2000 Vancouver Green jobs in Alternative Energy and Power Management

Overview: This sector includes non-fossil-fuel energy sources including hydro, bio-fuel, wind, tidal, solar and wave energy. It also includes companies developing power measurement, management conversion and other "smart-grid" technology which allows greater information and control over energy usage.

British Columbia is blessed with an abundance of hydro energy which is a major contributing factor to Vancouver having the lowest carbon emissions per capita in North America[13]. In addition, there is an enormous amount of potential micro-hydro, wind, tidal, solar and wave energy available in the province.

Key Players: By far, the largest player in the City is BC Hydro, which supplies electricity for 1.8 million household and commercial customers around the province[14]. In April 2010, legislation merged BC Hydro with the BC Transmission Corporation, raising their staffing levels. As a crown corporation, BC Hydro has a mandate to follow BC's Energy plan, which requires the province to be energy self-sufficient by 2016 with all new generating stations having zero net greenhouse gasses.[15] In order to meet these requirements BC Hydro has issued "Clean Power Calls" for long-term power contracts with independent renewable power producers like Plutonic Power Systems (hydro and wind), Naikun Wind Energy Group (wind) and Nexterra (biomass).

The largest businesses within energy management, measurement and "smart grid" technologies are Pulse Energy, Energy Aware and Rainforest Automation.

Jobs: There are approximately 2000 jobs within the City of Vancouver in Alternative Energy and Power Management. BC Hydro employs 1680. (This includes those administrative and human resources jobs that they have outsourced to Accenture.) These jobs include management, technicians, engineers and trades people along with the Accenture Administrative staff. They also have a significant marketing department which works to reduce energy consumption within the province. Because 25% of BC Hydro's workforce is within five years of being eligible for retirement[16], they will likely be a source of hiring in the coming years[17]. BC Hydro has developed a range of apprenticeship programs in order to address the challenges of developing a young workforce.

Key Vancouver Alternative Energy and Power Management Companies

Company	Technology	Location	Jobs
BC Hydro	Provider of electricity and transmission lines for British Columbians	Vancouver	1680
Plutonic Power	Clean energy	Vancouver	50
Nexterra	Biofuel energy	Vancouver	40

(Source: Website surveys and Interviews with Companies)

Aside from BC Hydro, many of the other firms within the sector are earlier in their business life-cycle and so have a higher percentage of staff in business development and R&D. Several firms have sought to be "agile" by outsourcing administrative, legal and human resources to outside companies[18]. (Outsourced jobs from these smaller firms are not factored into the total.)Power Management companies also have a higher need for programmers to develop and/or adapt software for power management systems.

Because BC plans to become energy self-sufficient, jobs created within this sector will not likely displace other jobs within the city. They will mostly replace jobs in the fossil fuel sector which, for the most part, are located outside of the province.

Outlook: Despite valid critiques of over-optimistic alternative energy growth projections[19], there are a number of reasons to predict continued growth of the alternative energy sector. The price of competing energy sources, like coal and natural gas fossil fuels, is projected to increase 10% annually over the next few years[20]. Concerns about climate change have motivated governments to create regulations that have favoured the alternative energy industry, like BC's carbon tax, BC's mandate for BC Hydro to purchase 10 MW of clean energy and the cap and trade system that President Obama advocates. The Power Management sub-sector will likely benefit from Vancouver's upcoming renovations regulations requiring investments in energy improvement with any sizeable renovation project. BC also benefits from tremendous renewable fuel supplies in its forests, bolstering the bioenergy sector.

The sector has disadvantages as well. Vancouver has some of the lowest energy prices in North America, due to large Hydro projects whose capital costs have already been amortized, making it difficult for other alternative energies to compete. Also, because energies like wind, run of river and solar are relatively new technologies and early in the learning curve, it is difficult for them to compete against more mature technologies like coal or natural gas[21]. To add to this challenge, currently BC does not have the feed-in tariffs for alternative energy producers that Ontario has. This creates an uncertain revenue stream for energy producers and may inhibit investment in the sector.

4.3 Environmental Consulting

Approximately 1350 Vancouver Green jobs in Environmental Consulting

Overview: Environmental consulting companies and departments provide a range of services for businesses, governments and industries in the province and around the world. These include sustainability reporting, GHG assurance and certification, process improvement and ISO certification. Much of the work of Vancouver consulting companies caters towards the forestry and mining sectors which make up a large portion of the province's economy.

There is significant interplay between environmental consulting and the other green and traditional sectors. For most consulting companies, their environmental work is just one aspect of their work which can include engineering, remediation and managerial consulting. Because of the multi-disciplinary aspect of consulting work, it is difficult to distinguish between the different aspects of the job. (companies were asked to identify how many employees they felt were involved in environmental consultancy). To add to this complexity, many fuel cell and alternative energy companies limit their payrolls by outsourcing to consulting companies[21]. Because of this, a discretionary decision is made whether to classify a specific company and their employees as either environmental consulting or another sector of the green economy.

Major Players: Most businesses within this sector are SMEs with only a few businesses with over 100 employees. Two of the larger companies focusing in environmental consulting in Vancouver are Hemmera Resource Consulting and Franz Environmental. There also are very large environmental departments at Ausenco Sandwell, AMEC and SNC Lavalin.

Jobs: There are approximately 1350 green jobs in consulting in the City of Vancouver. These jobs largely are held by engineers, scientists, business experts and technicians which make up 80% of the work. A further 20% of the jobs are within support and administrative department[23]. There are also external lab staff, who are indirectly employed by the sector. (The majority of this lab work, though, is located in Burnaby and Richmond at firms like Exova and Maxxam.) Although based in Vancouver, many of those who hold these positions spend significant amounts of their time travelling to the companies and projects (in BC and globally) for whom they are consulting.

Outlook: Across North America the demand for environmental services like consulting has been increasing at a rate of 2.6% – slightly faster than the growth rate of the economy as a whole[24]. Because consulting companies provide the majority of their work for local businesses, their revenue correlates closely with the success of those businesses. Since many of these companies are mining and forestry companies, they are greatly affected by business cycles, commodity prices and interest rates. The general perspective is that in the coming few years BC's mining industry will do well[25]. It is forecasted that the forestry industry will face lower output due to the Mountain Pine Beetle Devastation but higher prices due to greater demand and limited supply[26]. Both are seen as recovery leaders in the BC economy.

Key Vancouver Environmental Consulting Companies

Company	Technology	Location	Green Jobs
Hemmera Resource Consulting	Environmental Consulting	Vancouver	100
AMEC	Engineering and Environmental Consulting	Vancouver	200
Franz Environmental	Environmental Consulting	Vancouver	80

(Source: Website surveys and Interviews with Companies)

Governmental regulations on business also contribute to the size of this sector, as companies need external assistance in measuring and reporting on environmental impact. If a Cap and Trade system takes effect, (and the Western Climate Initiative is scheduled to start in 2011), this could lead to an increase in consulting work in carbon accounting. One study has stated that climate change consulting will be one of the fastest growing sub-sectors of the environmental industry[27].

Including government regulations as a driver in the consulting industry's growth is not to suggest that the government can foster industry simply by indiscriminately adding regulations—regulations need to be selected only if they will produce a demonstrable public gain that exceeds the added cost that they incur on business. These regulations can also act as a barrier for BC companies. Currently, because regulations are different in different provincial and national jurisdictions, it is difficult for BC companies to gain contracts elsewhere. The largest BC-based consulting office, Hemmera, only has 5% of its work in other provinces and 0% internationally[28].

4.4 Land and Water Remediation

Approximately 140 Vancouver Green jobs in Land and Water Remediation

Overview: Metro Vancouver has approximately 60 companies specializing in a range of land and water remediation products and services, including wastewater treatment, soil remediation, reforestation and other measures to lessen the environmental impact of businesses and communities. Canada's land and water remediation industry makes up about 50% of the nation's exports in the environmental sector[29].

Major Players: Of Metro Vancouver's many remediation companies only a small number (9) are located directly within the city. This trend could be due to the fact that much of their work is performed in the field rather than within company headquarters and so there is less demand for central office headquarters. The companies that do exist in Vancouver tend to be smaller, having 50 or fewer employees, and export-oriented, like Paradigm Environmental Technologies and Bioteq.

Jobs: Jobs within this sector are largely scientific and technical with approximately 20% of staff working in administrative and support roles. Much of the work is performed outside of the city boundaries as employees visit contaminated sites. Some Vancouver-based reforestation companies, like Apex Reforestation, have a large number of employees. However, all of these jobs are located outside of the city, at tree planting sites. Local institutions like BCIT provide much of the labour force for this sub-sector from their Chemical and Environmental Technology program.

Key Vancouver Land and Water Remediation Companies

Company	Technology	Location	Green Jobs
AH Lundberg	Remediation product manufacturing	Vancouver	20
Bioteq	Technology that removes heavy metals from waste water	Vancouver	50
Paradigm Environmental Technologies	Creates "micro-sludge" to reduce waste disposal and create bio-gas	Vancouver	11

(Source: Website surveys and Interviews with Companies)


Stanley Park

Outlook: The outlook for the remediation sector is strong. Growth is projected in the mining and forestry industries and in governmental regulations, which will affect the growth of the remediation industry, There are also a large and growing number of identified contaminated sites in BC. According to Hemmera, there are 7,000 potential contaminated sites in BC with an average of 44 new sites being added each month. The current clean-up rate of 16 per month is unable to keep up with the new site identifications[30]. Internationally, the number of contaminated sites is far higher. In China alone, it is estimated that there is over 100,000 square km of contaminated agricultural land[31]. This creates a massive market for Vancouver's remediation technology exports.

BC remediation companies' expansion into other provinces and countries is hampered, though, by regulations and standards that are different in each jurisdiction. Without intimate knowledge of other areas' regulations, it is difficult for them to win contracts.

4.5 Public Sector: Government, Education and Non-Profits

Approximately 1200 Vancouver Green jobs in the Public and Non-Profit Sectors

Overview: This category of Green jobs has three distinct sub-sectors: government, non-profit and educational Institutions.

Non-profits: There are approximately 30 environmental non-profits within the City of Vancouver. They focus on areas as diverse as protecting specific eco-systems, wildlife care, climate change research and reduction of individuals' environmental impact. With few exceptions, these organizations provide little direct environmental intervention, but instead provide education and advocacy to spur the action of citizens, governments and businesses.

Government: Governmental departments at the municipal, regional, provincial and federal levels work to monitor, protect and improve the environment. There is some overlap with other fields like waste management, which, at a municipal level is handled by the City and with alternative energy, where there is some connection with district power at the Southeast False Creek site.

Education Institutions: Included within this sub-sector are post-secondary educational institutions and their centres and institutions that provide education about the environment and the techniques and tools for environmental

Key Vancouver Non-Profit Companies

Company	Focus	Location	Green Jobs
David Suzuki Foundation	Environmental conservation through education, advocacy and policy work	Vancouver	50
Forest Ethics	Promoting environmentally friendly forestry practices	Vancouver	21
Stanley Park Ecology Centre	Youth-focused environmental education programs	Vancouver	19

(Source: Website surveys and Interviews with Companies)

improvement. Vancouver has some world class universities providing cutting edge environmental research, instruction and institutes both within city limits (UBC) and just outside (SFU). It also has an outstanding technical school (BCIT) which supplies skilled labour for all aspects of the city's green economy.

Main Players:

Non-Profit: Most non-profits within Vancouver are relatively small. The largest are the David Suzuki Foundation which has a national reputation and Greenpeace, a Vancouver-founded organization with an international reputation, that currently only has a branch office located in the City, Vancouver has a disproportionately high number of the Lower Mainland's non-profits[32].

Government: The City of Vancouver has a small sustainability department reporting to the Deputy City Manager, as well as a large planning and licensing department whose work has a strong environmental component. Although its engineering department also has a very large environmental component, many of these positions are noted under the waste management or green building sectors. Metro Vancouver also has a range of sustainability focused initiatives but these are largely located in Burnaby. Many of the Province's departments are located in Victoria.Even their Lower Mainland regional offices of the Environment, Agriculture, Energy and Forestry are located in Surrey, Abbotsford, Victoria and Squamish/Chilliwack respectively[33]. Vancouver has branch offices of federal departments like the Environmental Assessment Agency, Environment Canada and Natural Resources Canada.

Educational Institutions: UBC has several departments and institutes devoted to environmental studies in the fields of ecology, civic planning, engineering and technology. Their institutes include the Clean Energy Research Centre and the Centre for Interactive Biodiversity. BCIT's programs equip students with the technical skills required in environmental fields with departments in Ecological Restoration and Chemical and Environmental engineering. Langara's environmental and ecology departments are smaller in terms of staff, but provide students with co-op opportunities to work within environmental businesses.

Jobs:

The common feature of the jobs in the Public and Non-Profit sector is their social science and policy orientation.

Non-profit: Jobs within this sector tend to focus on community building, administrative work and communications. Wages within the non-profit sector tend to be lower than those in the private sector. One study in the U.S. found that comparable management positions in the non-profit sector had 20% lower salaries than those within the private sector[33]. One explanation for this salary discrepancy is employees' willingness to receive a reduced salary in return for the satisfaction that they receive from working with a mission-based organization[35]. There are approximately 285 green non-profit jobs within Vancouver[36].

Government: The City of Vancouver, with its goal of becoming the world's greenest city by 2020, has a sustainability department focusing on green building and transportation and has a staff of 16. Its planning department Employees tend to have business and

Key Vancouver Government Agencies

Company	Focus	Location	Green Jobs
City of Vancouver	Sustainability Department, portions of the planning department and licensing	Vancouver	65
Canada	Environmental Assessment Agency, Environment Canada and Natural Resources	Vancouver	301

(Source: Website surveys and Interviews with Companies)

Key Vancouver Educational Institutions

Company	Programs	Location	Green Jobs
University of British Columbia	Community Planning, Environmental Studies, Atmospheric Science, Environmental Engineering, Forestry, Environmental Design	Vancouver	380
British Columbia Institute of Technology	Chemical and Environmental Technology and Engineering, Ecological Restoration, Renewable Resources, Sustainable Resource Management, Sustainable Energy Management	Vancouver	89
Langara	Environmental Science and Ecology Programs	Vancouver	30

(Source: Website surveys and Interviews with Companies)

city planning backgrounds. Metro Vancouver, based in Burnaby, provides little work that is based out of a Vancouver office. The Province also provides no environmental jobs in Vancouver. At the federal level, jobs at the Environmental Assessment Agency, Environment Canada, Fisheries and Oceans and Natural Resources Ministries all have offices within Vancouver. These employ approximately 400 people.

Educational: Within UBC, BCIT and Langara, there are approximately 500 green jobs within this sub-sector. About 80% of these jobs, including faculty, instructors, researchers and classroom and lab staff, require high levels of educational and technical experience and are relatively well-paying. These staff are supplemented by approximately 20% administrative and support staff. Some of the work and research is performed by the graduate and post-doctorate students from the educational institution. Included within this sector are post-secondary schools and their institutions focusing on environmental studies, sustainable resource usage, ecology and green urban planning and construction.


photo: City of Vancouver

4.6 Green Building and Building Technologies

Approximately 1350 Vancouver Green jobs in Green Building

Overview: Included within Green Building jobs are positions of those who design, construct and install specifically energy-saving or environmentally friendly products for buildings and homes. Also included are jobs of those who design and construct buildings that are "green" or have significant green elements. The Province is seen as a leader in green building with the most LEED buildings per capita in Canada[37]. Vancouver also has some of the most rigorous environmental standards in its building code in North America[38]. Approximately 3-5% of all construction within the City can be considered green building[39].

Major Players: Although there are a few firms that specialize in green construction and architecture, the large majority of companies do green construction as only an aspect of their work. The industry also tends to have very small businesses. 40% of all BC construction workers are self-employed and, of the establishments that exist, 59% have less than 20 employees[40]. As a result there are very few dominant players.

Among building technology companies, there are a number of small companies, like Improheat and Island Clean Air, which build energy efficient elements for homes.

Aside from these businesses, integrators—large companies that package together multiple technologies and products to provide integrated green building solutions—play a vital role in the green building industry and help facilitate the export of local businesses' technologies. General Electric took on this role with Zenon's products in Victoria's Dockside Green project

Jobs: Jobs within this sector include architects, electricians, construction labourers, plumbers and, in Vancouver, a limited number of manufacturing labour, for companies producing green elements for green construction. Because of the large number of construction firms and the low percentage of green work that they perform, we calculated the number of green construction jobs through Statistics Canada using the methodology described in Section 3.3, determining that there are 1081 green construction jobs and 202 within the architecture and engineering firms. On top of these there are approximately 155 jobs in manufacturing and distributing elements for green building.

Construction jobs within the green sector have some characteristic advantages and disadvantages that are unique to the sub-sector. Construction jobs, unlike manufacturing jobs, cannot be outsourced to other regions, guaranteeing that jobs within the sector will remain within the region. However, the push towards green building is unlikely to provide net increases of construction jobs. Instead, it will lead to conversion of existing construction practices to "green" techniques and materials.

This "green" conversion may prove a challenge for the industry. There is currently a shortage of programs providing professional development for practicing construction workers, project managers and architects with information about green construction techniques and materials. The sole exception is a program run out of the Lighthouse Sustainable Building Centre.

Outlook: Green Building will likely increase in Vancouver in the coming years. The City, in its efforts to be the "Green Capital", has created a number of initiatives and regulations to foster its growth:

Key Vancouver Green Building and Building Companies

Company	Focus	Location	Green Jobs
Busby, Perkins and Will	Green Architecture	Vancouver	80[41]
Improheat	Heating Systems	Vancouver	8
Island Clean Air	Air filtration systems	Vancouver	19

(Source: Website surveys and Interviews with Companies)

Green roof at Millennium Water Development • photo: City of Vancouver

- The City has stated that all new buildings must be GHG-neutral by 2020[42]
- In collaboration with several other energy companies, the city has created a $3500 solar water heating rebate[43]
- The Province has pledged $35 million for energy efficiency retrofits[44]
- There is a proposed by-law stating that all renovations that cost more than $5,000 will require there to be energy efficiency improvements at the same time[45].

On top of the governmental regulations energy prices, consumer preferences and new financing options will make green construction more attractive in the future. BC Hydro and Terasen have both had recent energy price increases and have warned that future significant increases may be imminent[46]. Consumer preference has also been steadily increasing, with energy efficiency upgrades increasing from 4 to 7% of overall renovations[47]. Finally, innovative energy efficiency financing programs have emerged across North America that help overcome barriers to energy efficiency improvements, like split incentives, upfront costs and short ownership time. In Manitoba, energy efficiency financing programs facilitated 8100 retrofits in 2007[48]. As one of the first-movers in green building, Vancouver has the opportunity to export its architectural, engineering and technical skills to other regions, which would boost local job numbers in these building-related professions.

4.7 Public Transportation

Approximately 2300 Vancouver Green Jobs in Public Transportation

Overview: The public transportation sector consists of government-supported and private companies that provide intra- and inter-city travel to encourage commuters and travelers to not use single occupancy vehicles for their travel needs. Encouraging public transportation as a means to reduce GHG emissions has been a focus in Vancouver where 32% of all GHG emissions are from light-duty vehicles[49] Since, in Metro Vancouver, electric trolley buses emit less than 1% of a single occupancy vehicle's GHG, public transportation is vital to the city's plans[50].

Major Players: Translink is the province's largest transportation authority planning and delivering transportation options for drivers, transit-users, cyclists and walkers. Aside from Translink, Vancouver is also served by Greyhound and Gray Line inter-city transport as well as suburban-based Vancouver Airporter and Quick Shuttle.

Jobs: About 2285 work within this sector. These positions are largely skilled positions as drivers, mechanics, administrative and head office staff. Most non-managerial staff working within this sector are unionized.

Outlook: Since the city has the goal of a 33% reduction in emissions from its 2007 level by 2020, it is very likely that the city's public transportation system will continue to grow. The region has facilitated the success of public transit and buses through taxes on gasoline.

Key Vancouver Public Transit Companies

Company	Focus	Location	Green Jobs
Translink	Public Transit as well as facilitation of cyclist and pedestrian options	Vancouver	2,033
MVS Canadian Bus	Public transport for those with disabilities	Vancouver	166
Gray Line Buses	Inter-City Transport	Vancouver	45

(Source: Website surveys and Interviews with Companies)

photo: City of Vancouver

4.8 Recycling and Waste Management

Approximately 1400 Vancouver Green jobs in Recycling and Waste Management

Overview: The Recycling and Waste Management Sector consists of those who collect and/or process recyclable material or other waste to be inputs in the manufacturing or energy sectors. It also includes companies which minimize the environmental impact of the waste from businesses or individuals.

Major Players: Vancouver has a large number of recycling depots which collect a range of recyclable material including cans, bottles, electronic equipment and bicycles. The largest of these depots is United We Can, a social enterprise located on the Downtown Eastside. Encorp also has a large number of depots around the Lower Mainland. In Metro Vancouver, most firms which process recycled or waste material are located in the suburbs, due to the scarcity of affordable industrial land. West Coast Reduction near the Port of Vancouver processes animal waste to create protein feed and biofuel.

Jobs: According to Statistics Canada, 4678 are employed within waste management and remediation within the Province[51]. If Vancouver has a number of these jobs proportional to its overall percentage of Lower Mainland jobs, it would have 783 jobs. Because this number does not include positions in recycling or re-processing, a further 610 jobs would need to be added.

Solar powered trash compactor •photo: City of Vancouver

Work within this sector includes part-time temporary jobs for those with multiple barriers to employment at United We Can. This workplace is designed to provide inclusive employment with a work structure, payment and process designed to be meet the needs of marginalized members of the community. At West Coast Reduction, approximately 25% of employees work in management or as certified trades people. The remaining 75% do manual work which is skilled but not formally certified.

Outlook: Recycling firms have stated that the growth of their industry has grown steadily with increases of population and public awareness on recycling and waste reduction facilities. There have also been spikes when an increased number of products were required to have a deposit for recycling. These firms are also very susceptible to commodity prices, especially that of aluminum, and become more profitable with commodity price increases[52]. According to Aluminum Futures, aluminum prices will increase in value by 5% annually over the next couple of years[53].

Key Vancouver Recycling and Waste Management Companies

Company	Focus	Location	Green Jobs
West Coast Reduction	Rendering of animal waste for fuels and feed	Vancouver	125
United We Can	Recycling Depot for glass, aluminum, bicycles and electronics	Vancouver	150
Encorp	Recycling Depot for aluminum, glass and electronics	Vancouver	250

(Source: Website surveys and Interviews with Companies)


photo: City of Vancouver

4.91 Green Businesses in Traditional Sectors

Approximately 240 Vancouver Green jobs in Green Businesses in Traditional Sectors

Overview: There is a range of businesses within traditional industries which offer or use a product, service or process that is significantly more environmentally friendly than its rivals. These firms can be in the fields of finance (green venture capital), food (organic grocers) or environmentally friendly cleaning products and services. Because of the diversity of the fields in which green businesses can operate, it is very challenging to develop criteria in each field to differentiate green businesses from their rivals in each field. This has included firms which either produce or exclusively use organic, bio-degradable and/or environmentally friendly products or those whose work directly fosters green industries.

Main Players:

Jobs: There are approximately 240 jobs within this sub-sector. Due to the difficulty in establishing whether one firm is significantly more "green" than another, it is very likely that this job number has been under-counted. Because of the diversity of the companies and the sectors in which they work, positions in these firms run the spectrum from finance to manufacturing to marketing and sales.

Outlook: There is mixed evidence about whether there are growing opportunities for green products within traditional industries. One Ipsos-Reid survey found 2/3 of Canadian consumers had purchased at a price-premium an environmental product in the past year[54]. Despite this survey, most studies have found that consumers are reluctant to pay a price premium for higher-cost green products[55]. Furthermore, conveying a company's environmental merits has its risks. Companies who are perceived to be "greenwashing"—making misleading statements about the environmental value of their products—can attract consumer backlash, as in the case of British Petroleum. Because of these factors and the uncertainties that green characteristics will continue to be valued traits for products, the outlook for these products is uncertain.

Key Vancouver Traditional Sector Green Companies

Company	Product	Location	Green Jobs
Chrysalix	Green Venture Capital	Vancouver`	10
Spud	Organic Produce Delivery	Vancouver	58
Made by Humans	Recyclable paper plates	Vancouver	10

(Source: Website surveys and Interviews with Companies)

4.92 Green jobs within traditional businesses

Approximately 80 Vancouver Green jobs within Traditional Businesses

Overview: Many companies have opted to set up green lines of products or sustainability departments in order to access the niche of environmental consumers, reduce input costs or comply with regulations or consumer expectations. Some companies will also have environmental projects as part of their community relations programs. Many large businesses locate their sustainability departments in their corporate head office. As a result of its dearth of head offices, Vancouver has fewer of these sustainability departments. Natural Resources companies tend to have larger sustainability departments in order to address the potential impact their firms can have on the environment.

Jobs: There are significant challenges in counting green jobs in traditional businesses. Environmental sustainability tends to be most effective when it is not within a specific department but is incorporated amongst all employees' job descriptions. Many of the jobs within sustainability departments are primarily involved in administrative work—recording and tracking environmental performance—and in marketing—developing sustainability reports. Some companies, like Teck and Ledcor, have sustainability departments which require specific technical skills. Approximately, 80 people work within green departments at traditional organizations.

Outlook: The main driver for sustainability departments within traditional businesses is consumer demand, which is, as discussed in Section 2.8, uncertain over the coming years. As a result, it is difficult to predict the outlook for these types of green jobs

Major Players

Key Vancouver Companies with Green Jobs

Company	Product	Location	Green Jobs
Teck Resources	Smelts metal from e-recycling products	Vancouver`	14
Ledcor Construction	Incorporates waste management into their construction business	Vancouver	40
VanCity	Green Loans	Vancouver	3

(Source: Website surveys and Interviews with Companies)

4.93 Totals

The total Vancouver green jobs from each of these subsectors is 10,571.

Sub-Sector	Green Jobs	% Vancouver Green Jobs
Alternative Energy and Power Management	2009	19.1%
Fuel Cell Technology and Transportation	496	4.7%
Environmental Consulting	1351	12.8%
Land and Water Remediation	139	1.3%
Green Building and Building Technologies	1359	12.9%
Public Transportation	2284	21.7%
Public Sector and Non-Profits	1199	11.2%
Waste Management and Recycling	1404	13.3%
Green Firms and Departments	315	3.0%
Total	**10531**	**100%**

An internal study conducted by the VEDC, using a different methodology found that there were 34,357 green jobs in Metro Vancouver[56]. Considering that Vancouver has 34% of Metro Vancouver's jobs, this would mean 11,681 jobs, an 11.4% difference between the two tallies. This discrepancy is caused by different methodologies and green job definitions.

4.94 Excluded industries

Used book, clothing and sports equipment help to divert un-wanted products from the landfill. It also helps reduce the consumption of new products. Within Vancouver there are approximately 80 consignment and used product stores[57]. Although many of the charitable organizations (SPCA, World Wildlife Fund) use volunteers to staff their stores, there is still significant employment within the sector for retail employment. Working on an estimation of 10 employees per store, this sector would employ 800 within the City.

Bikes, when used as an alternative to vehicular transportation, help reduce a city's GHG emissions. Within the Lower Mainland there are 60 bike shops or bicycle repair shops[58]. Working on an estimation of 8 employees per store, this would employ 480 employees. It can be extrapolated that at least 120 of these jobs are located in Vancouver. These positions are either retail or bicycle repair or a combination of the two.

The Urban Agriculture sector consists of a number of small (the largest—UBC farm—is 40 acres) organic and non-organic farms in small plots and empty lots across Metro Core Vancouver. Because of their usage of organic techniques and their reduced need to transport goods to faraway markets, they can be considered more "green" than traditional agriculture. Approximately 50 people work within this sector in Vancouver, many of whom are part-time.

5. RECOMMENDATION AND CONCLUSION

Vancouver has a large, robust green economy that is diversified amongst a variety of sub-sectors. Many of these sub-sectors are resistant to international out-sourcing due to local expertise and labour supply (Fuel Cell technology and water remediation) and/or geographic location of vital inputs (recycling, green building and alternative energy). Even with these competitive advantages, Vancouver will need to be pro-active to ensure that it attains its target of creating 20,000 more green jobs by 2020. There are, though, actions Vancouver can take to achieve this.

The City needs to be clear about the job creation it wants to foster in the city. The actions it will need to take to foster high-skill, high-wage positions within the fuel cell technology cluster are different from those needed to foster trade positions in green building or jobs for marginalized groups in recycling or retrofits.

In the same way, each of the different sub-sectors of the green economy has different growth drivers. In order to be effective municipal actions will need to be targeted at specific sub-sectors.

5.1 Leverage Vancouver's Core Technology Strengths to Increase Exports

In many fields, like fuel cell technology, remediation and green building technology, Vancouver is a world-leader. However, because of its small market, local companies have challenges in expanding. Many regions, especially within Asia are increasing their environmental spending enormously[59]. Outreach to these markets through trade missions could develop significant export revenue. Many of Vancouver's firms, though, are too small and "niche-focused" to be able to effectively market themselves internationally. Public support through trade missions, networking opportunities at broader sectors could be particularly helpful to Vancouver's small, innovative firms. On the industry side, developing larger firms into integrators will be an important step. These are larger businesses in engineering consulting, green building design or other fields, that package multiple technologies from smaller companies to develop full solutions to engineering, building or remediation projects, as General Electric did for Zenon in the Dockside Green Project. These integrating relationships can be facilitated through networking events that link larger companies with smaller technology companies with which there may be possibilities of synergies. The City may also wish to consider, as a pre-condition of involvement on trade missions, that larger companies be encouraged to develop integrating partnerships with smaller local companies.

5.2 Bolster the Green Building industry through Financing Programs

Through its progressive environmental building code and solar water heating incentives, Vancouver has done a good job of fostering the green building sector within Vancouver. However, some of the gains in green building may be counteracted by the federal government's recent cutting of the renovation tax credits and the ecoENERGY incentive program, which will likely damper demand for renovations in general and green retrofits in particular. One means to mitigate these cuts would be to explore partnerships with utility companies (that have recently been given high targets for greater energy efficiency among consumers) to develop financing programs for energy efficiency retrofits. If planned well, they can be financially self-sustaining for lenders and also provide net savings for borrowers. Sacramento Municipal Utility District and Manitoba Hydro have both initiated strong financing programs with large uptake, leading

to reduced GHG emissions, saved money for renovators and a vibrant green building industry. Because of a strong financing program, Sonoma County had an increase in the amount of construction activity even during the worst of the economic downturn[60].

5.3 Increase the Visibility and Clarify the Role of Environmental Consultants in the City's Green Spectrum

The region is a hotbed of activity in fields such as environmental assessment and site remediation. But because many of these activities take place outside of the region, these key environmental sectors often go unnoticed. Proper recognition of this sector in marketing the region's green strengths, and in developing long-term plans for the City such as those associated with Vancouver's Greenest City Action Team, would be a positive step. This sector also has a number of challenges related to exporting its services; developing a plan for selling the sector abroad and overcoming regulatory hurdles would facilitate its inclusion in international marketing efforts and trade missions.

5.4 Maintain the Manufacturing sectors through Protection of Industrial Land

Many of the companies that create cutting edge technology opt to manufacture their product outside of the city's limits. This is largely caused by a scarcity of affordable industrial land. Because of the high demand for residential development, there is pressure to allow residential development in industrial land, but this will limit the city's economic growth, particularly in key areas such as South Vancouver. The False Creek Flats is a prime location with access to multi-modal transportation that could be valuable for green industries to expand into, provided the right planning is in place. A report is available on Green Zones in Vancouver, examining many of the variables affecting industrial land, as a complement to this report.

5.5 Foster a Trained Labour Force

Several areas of the green economy, like alternative energy, are faced with significant future labour shortages. Other areas, like green manufacturing, have had their growth inhibited by the scarcity of skilled manufacturing labour. Although the City is not responsible for education, it could play a valuable role in brokering relationships between business and educational institutions to ensure that the schools are helping to meet business needs. Vancouver can also take an advocacy role at a provincial and federal level to increase support for the schools. Further, defining the types of labour needed to achieve City targets and demonstration projects that allow students access to study new technology (such as UBC's Living Laboratory concept) could help.

5.6 Continue to Support the Expansion and Effectiveness of Transit

Transit will be critical to the region's future both in terms of reducing future emissions and in terms of attracting talent. Maintaining and expanding public transit will require continued advocacy to the senior levels of government who control the funding for new investments. In addition to working towards a well-functioning transit system, continuing to plan the region in a way that ensures sufficient riders to fill the TransLink farebox. This will require occasionally difficult choices about density, transit-oriented development and limiting the expansion of office parks in industrial areas.

5.7 Greening Jobs in Non-Green Sectors

Most businesses in the city are not strictly classified as "green", but helping these businesses transition to lower-carbon modes will be important for future development. The City has already encouraged this process by working with local businesses through ClimateSmart to

help them green their business practices. As this process accelerates, some jobs may transition to truly green positions such as sustainability coordinators, while other businesses will begin making the shift to providing products and services that offer a tangible environmental benefit over their competitors. If this process can be sufficiently advanced in Vancouver, the City will be well on its way to achieving its goal of making Vancouver "a mecca of green enterprise". Continued green business consulting services, forums for sharing best practices, and internship programs are tools that could assist with this goal.

6. CONCLUSION

Any definition and count of green jobs will be subject to controversy on how the term is defined and how the jobs are counted. The final tally should be seen as a reliable approximation. What is important, though, is to recognize that the green job count is a tool in tracking the development of employment that has a low impact upon the environment. In recent years, communities around the world have increasingly embraced this goal. As a result of greater public demand for sustainability, new technologies and regulations, green sectors have flourished. As well, a greater number of positions in traditional industries have shifted to also incorporate environmental aims. Optimally, the number of green jobs in Vancouver would closely approach the amount of total employment in the city. As a city that has set itself the goal of becoming the "Greenest City in the World", developing regulations, infrastructure and programs to achieve this goal will need to remain a constant focus.

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