

STATE OF VANCOUVER'S GREEN ECONOMY 2018

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01

The Road to a
Billion Dollar Brand



VANCOUVER
ECONOMIC COMMISSION



WHAT WE DO

The Vancouver Economic Commission works to position Vancouver as a global leader for innovative, creative and sustainable business

The Vancouver Economic Commission (VEC) engages directly with entrepreneurs, investors, SMEs, global enterprises and a wide range of community stakeholders – including elected officials, departments of all levels of government, industry associations and educational institutions. By staying connected, informed and agile, we're able to recognize trends and constraints in Vancouver's green economy.

Vancouver consistently ranks among the greenest cities in the world, driven largely by its innovative policies, environmental ethos, and entrepreneurial culture. Top growth sectors in the green economy over the past eight years have been green buildings, cleantech and materials management.

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WHAT'S INSIDE

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THE ROAD TO A BILLION DOLLAR BRAND

Radical roots, progressive culture, entrepreneurial mindset
catalyze low-carbon economy in Vancouver



There is a lot to celebrate in 2018

Climate change policy has seen tremendous successes – as well as serious adversity in the past year.

When the U.S. departed the U.N. Paris Agreement, states, cities and corporations decided to double down on science-based targets to cut back carbon emissions. In the face of increased intensity of destructive hurricanes and wildfires, 1,200 climate laws have been adopted across the globe compared to just 60 two decades ago.¹ China represented the largest automobile market in 2017, buying more than 24 million vehicles, but they have also become the largest producer of plug-in hybrid electric vehicles in the world and have plans to ban gas powered cars altogether. And despite waning faith in governments' ability to bring about needed carbon reductions, more than 40 national and 25 regional governments have put a price on carbon, representing about 15 percent of global greenhouse gas emissions.²

Canada's **cleantech** sector ranks fourth in the world

The Green Economy presents a big opportunity

The transformation goes far beyond policy. Cities, global companies, financial institutions and investors already recognize that climate change is not only an environmental problem but a business one. Addressing climate change means avoiding risks but also means new opportunities for growth. Larry Fink, the largest investor in the world, directly asked S&P 500 companies to incorporate environmental, social and governance strategies into their investment process if they want his support. The Financial Stability Board's climate change task force, which includes Michael Bloomberg and Mark Carney, recommended that all financial institutions assess and disclose climate risk; the market value of companies agreeing reached \$7.1 trillion.

All of this looks promising for Canada's cleantech sector which ranks fourth in the world. Two Canadian cleantech clusters that share a strong presence in Vancouver are driving this global ranking. The Canadian green buildings sector created \$23.45 billion in GDP and 297,890 jobs in 2014,³ and the hydrogen and fuel cell sector generated \$220 million in revenue and 1,785 jobs in 2015.⁴ In addition, the Province of British Columbia's (B.C.) carbon tax and a requirement for all public operations to be carbon neutral have led to major investments in building upgrades and the creation of a robust carbon offsets market.

In Vancouver, a vibrant green economy employs one in 15 Vancouverites up from one in 20 just four years ago, while 30 percent of businesses deliver products or services that help to restore or preserve the environment. Vancouver's reputation as a clean and green leader drives a brand valued at \$31.5 billion, and the economy grew faster than any other city in Canada from 2010 to 2017. All this while carbon emissions declined by 11 percent, resulting in the carbon intensity of our GDP (tonnes GHGs per dollar of GDP) decreasing by 30 percent.

Vancouver's reputation as a **clean and green leader** drives a brand valued at **\$31.5 B**

Three ingredients: policy, innovation, demand

From the founding of Greenpeace to the concept of the ecological footprint and the advent of the 100-mile diet, Vancouver has long been a source for disruptive innovation in response to climate change. Over the decades, Vancouver has pioneered policies that have made the city stand apart on issues of environment, social cohesion and economic inclusion. Vancouverites chose liveability over car-centric urban planning approaches in the 1960s, and today, it is one of the only North American centres without an inner-city freeway. The city's building code is the greenest of any jurisdiction in the world. And recent citywide plans put Vancouver on a path to be 100 percent powered by renewable energy, produce zero waste, make the majority of trips by foot, bike or transit and be a place where everyone has a home.

Vancouver's most enviable innovations have found a supportive policy environment, but they have also been championed by progressive thinkers with some of the world's most entrepreneurial mindsets. Recognized as one of the world's top startup ecosystems, Vancouver is home to numerous game-changing technologies including General Fusion (world leader in commercial fusion energy) and Carbon Engineering (carbon capture and synthesis of transportation fuel). Disciplines can collide and collaborate in this interconnected ecosystem, allowing for solutions to flourish that transcend existing definitions of industry sectors.

Virtual and augmented reality experts provide holograms and immersive experiences for real estate developers to visualize design blueprints and analyze materials ordering before construction even begins. This allows for fewer wasted materials and more efficient construction practices. A generation of cleantech engineers and technicians are using desalination and other techniques to upend age-old polluting industries like mining, and remove contaminants from tailings and wastewater. Machine learning expertise is aiding in the creation of smart grid solutions where tens or thousands of individual energy sources can be networked together to create virtual power plants.

The ultimate driver for green solutions is demand. Policy can drive demand; all new buildings in Vancouver must be zero emissions by 2030 and B.C. has set out a pathway to net zero ready buildings by 2032. Constructing new buildings to meet these rigorous requirements will drive demand for high performance building technologies including triple-glazed windows, thermal bridging solutions, and all manner of heat pumps. But demand is also driven by a consumer mindset in Vancouver that values environmental protection. Consumers want an emotional connection and sense of shared values with the brands they buy. A third of British Columbians want their next car to be an electric vehicle⁵ and 8.5 percent are vegetarian (4 percent are vegan).⁶ Nearly 10 percent of Vancouver businesses want to become zero waste and more than a third are diverting waste streams that are not even regulated yet. Mountain Equipment Co-op is ranked the most reputable company in Canada due in large part to having social and environmental responsibility at its core. This is the company that proactively decided to stop selling products from Vista Outdoor, a U.S. company that produces guns and ammunition.

Vancouver Community-wide Plans & Strategies

Supportive policy driving innovation



Greenest City Action Plan 2020

Through a set of measurable and attainable targets, Vancouver is on the path to becoming the greenest city in the world



Zero Waste 2040

The plan includes forward looking policies and actions to help Vancouver become a zero waste community



Transportation 2040

Guides transportation and land use decisions, and public investments for the years ahead



Renewable City Strategy 2050

Derive 100% of the energy used in Vancouver from renewable sources and reduce greenhouse gas emissions before 2050

Additional Community-wide Plans

Healthy City

Digital City

Resilient City

There is a long road ahead

Although we are celebrating 2018, there is still a lot more work to be done.

With more than a million people expected to call Vancouver home in the next two decades, the region needs a growth strategy that will provide good jobs, efficient urban infrastructure and a resilient economy. In particular, we need to develop responsive, smart and distributed infrastructure; implement aggressive social and environmental policies; and make wise investments in capital projects, people, and places that will improve the diversity, equity, and sustainability of our economy over the long run.

Energy infrastructure

B.C. recently greenlit the Site C Dam, a renewable energy mega-project, expanding the province's reliance on large-scale hydro projects to power a growing population. This project will have a heavy impact on ecosystems and will suffer from large power losses associated with transmission over long distances.

Locking into this centralized system could preclude more efficient and resilient solutions such as distributed and district-scale generation that provide flexible, modular and more responsive systems, located closer to areas of high energy demand.

The government of Canada has bought Kinder Morgan's Trans Mountain bitumen pipeline for \$4.5 billion to ensure that 890,000 barrels of Alberta bitumen per day can be pumped to Canada's west coast and ultimately shipped to global markets. In light of the rapid global shift away from fossil fuels and toward renewable resources and the circular economy, this pipeline would create just 50 permanent jobs and has the potential to quickly become a 'stranded asset'— a risky investment considering even the World Bank has declared it would no longer fund oil and gas exploration.

In the meantime, critical pieces of infrastructure and policy required for a smart energy or transportation system are still missing in B.C. Unlike most jurisdictions in the world, B.C. has been removing rather than installing smart meters after a roll out program plagued first by health and privacy concerns, then by faulty or substandard meters. Smart meters are one of the first steps in establishing a smart grid.

Come join us

We know that solving these challenges is possible with collaboration. At the Vancouver Economic Commission, we develop relationships with investors to help attract the right kind of patient capital; we help local cleantech companies access global markets to realize their full export potential; and we have been leveraging our own city assets and infrastructure to stimulate the early deployment of locally developed green technology.

In this report we share with you data about our green economy while highlighting the movers and shakers that are bringing about transformation. We welcome you to learn about the Vancouver advantage, and what makes us a unique ecosystem for green business and a green economy. We thank those of you already playing a role in Vancouver's acceleration towards a greener, resilient future and we welcome the rest of you to come work with us in the near future.

Real estate affordability

B.C.'s economy is more dependent on real estate and construction than any other province in the country. Real estate and construction make up nearly 15 percent of B.C.'s economic activity⁷ – that's more than the Province of Alberta depends on fossil fuels. Snow washing, ghost immigrants, shadow flipping and speculation have all contributed to an affordability crisis where housing and even commercial and industrial spaces are becoming inaccessible putting pressure on residents and also startups, innovators and small business. In addition to addressing the rampant corruption and opacity in housing markets fuelling a global affordability crisis, economic development efforts that focus on ensuring Vancouverites are experts at thinking, creating and solving in addition to building will improve the diversity – therefore resilience – of our economy.

Transportation

The last few years have seen huge leaps in clean transportation. Vancouver is hailed as 'ride sharing capital of the world' and the city operates the largest municipal electric vehicle fleet in Canada. Connected, smart cars have the ability to reduce energy consumption through efficient driving and improved performance, and projections suggest that full autonomous vehicles will be on the roads by 2025. Yet B.C. has not allowed autonomous vehicles to be tested on the roads, and ride-hailing services like Uber and Lyft are not yet available locally. While the legal and social implications of these technologies are wide-ranging and complex, we cannot afford to ignore them. Resources need to be dedicated to developing effective, thoughtful policies that both enable innovation and protect the safety and security of citizens.



BY THE NUMBERS...

Vancouver's Green Economy

Green Ecosystem | Page 5

25,000 – number of green jobs in Vancouver in 2016

30% – percentage of Vancouver businesses delivering products/services that restore/preserve the environment

30% - reduction in carbon intensity of GDP in Vancouver since 2010

Green Buildings | Page 9

\$23.45 B – amount of GDP from Canada's green building sector in 2014

43% – reduction in carbon intensity of Vancouver buildings since 2010

Cleantech | Page 13

4 – rank for placement of Canada's cleantech sector in the world

7 – number of B.C. companies named to the Global Cleantech 100 in 2018

\$1.3 B – revenues for Canada's renewable energy technology sector in 2015

Green Mobility | Page 17

33% – percentage of B.C. residents wanting their next car to be an electric vehicle

1 – rank for size of Vancouver's municipal electric vehicle fleet in Canada

\$20,000 – cost of Electra Meccanica's SOLO, a single-seat Battery Electric Vehicle

Materials Management | Page 21

10% – percentage of Vancouver businesses with a goal to be zero waste

33% – percentage of Vancouver businesses diverting waste streams beyond those regulated

Local Food | Page 25

8.5% – percentage of B.C. residents that are vegetarian

4% – percentage of B.C. residents that are vegan

25 – number of breweries in Vancouver

13 – number of urban farms in Vancouver

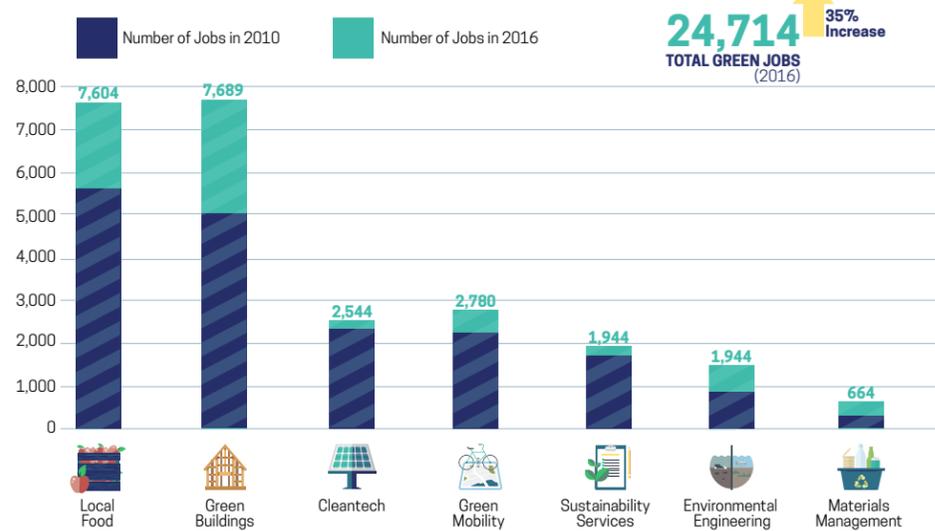
WHY GREEN COMPANIES CHOOSE VANCOUVER

Entrepreneurial spirit, game changing innovation, and world leading policies: all have built Vancouver's global reputation for clean and green leadership

Thirty percent of Vancouver businesses deliver products or services that help to restore or preserve the environment, and one in fifteen Vancouverites works in the green economy. The city has a goal to be 100 percent renewable energy powered before 2050, and the province became a carbon neutral government in 2010. Combined with targeted investments and a strong investment climate, this foundation has helped build Vancouver's \$31.5 billion global brand for clean and green leadership while increasing GDP 26 percent since 2007, and reducing carbon emissions by 11 percent.

Green & Local Food Jobs in Vancouver

Vancouver Economic Commission, 2016



The VEC surveys local businesses every three years (2010, 2013, 2016). Additional data comes from the Statistics Canada Labour Force Survey. Our methodology can be found at www.vancouvereconomic.com/greenjobs2014.

Green jobs have grown 35 percent since 2010, nearly six percent on average per year. The fastest-growing sectors have consistently been **local food** (35 percent between 2010 and 2016, or 5.8 percent on average per year); **green buildings** (53 percent since 2010 or 8.8 percent average per year); and **materials management** (111 percent since 2010 or 18.5 percent average per year).

Of note is that green job growth includes both new and transitional jobs. New jobs come from market expansion and growth, while transitional jobs are existing jobs in traditional sectors that have become green due to changed norms and practices (e.g. construction changes due to greener building codes). On average, 40 percent of growth in green jobs each year may be attributed to new jobs, while 60 percent of growth is due to transitional jobs.



Vancouver's Brand Value: \$31.5 B
Built on Green Leadership
Brand Finance, 2015



3rd Greenest City in the World
Economist Intelligence Unit/Siemens



4th Most Innovative Cleantech Sector
Global Cleantech Innovation Index, 2017



Best Green Building Code in the World
World Green Building Council, 2013



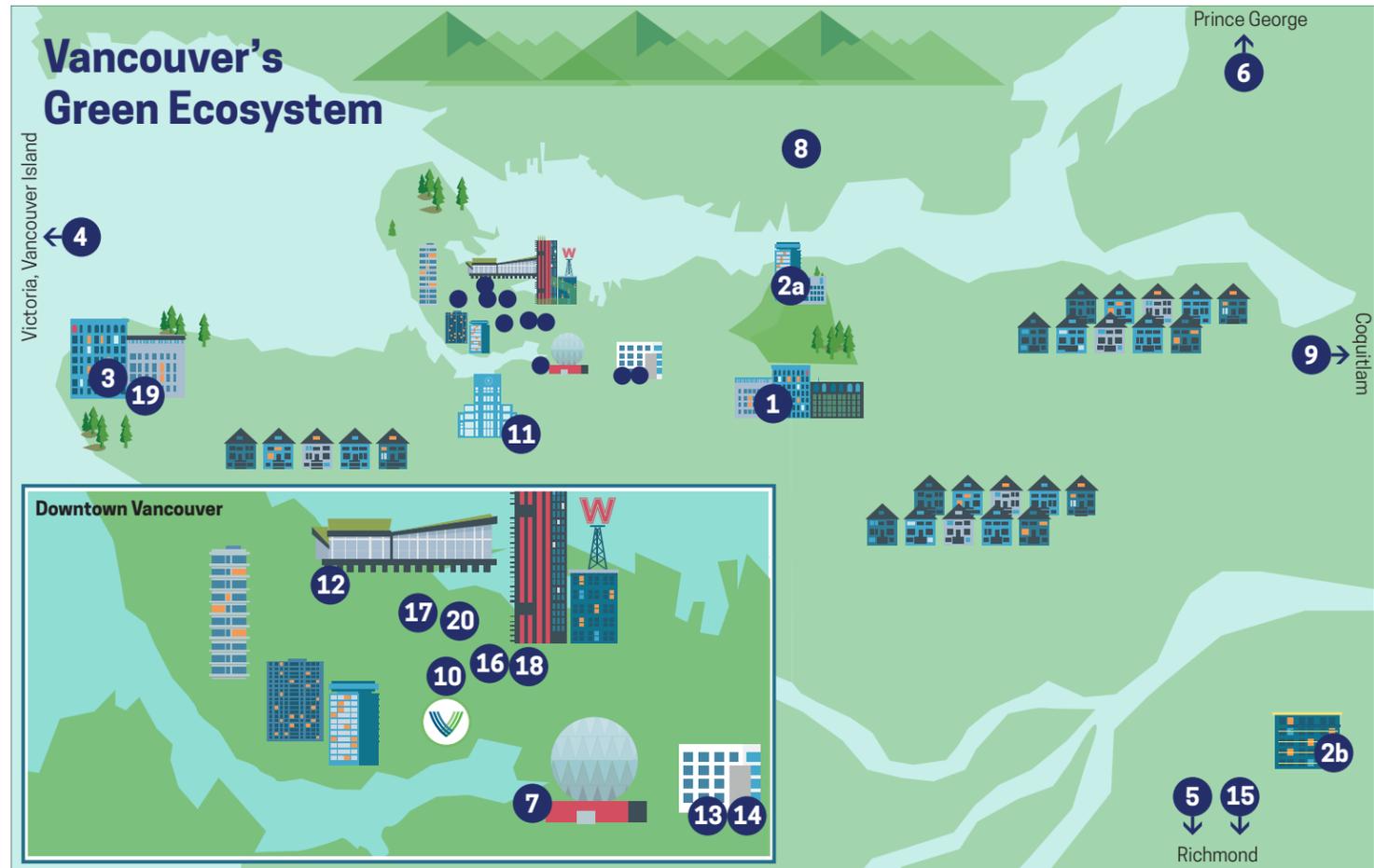
2nd Most Tax Competitive City in the World
KPMG, 2016



Part of the Pacific Tech Time Zone
Seattle, Silicon Valley, San Diego



Canada is the Most Educated Country in the World
OECD, 2018



Legend

Research Centres

- 1 BCIT: Centre for Energy System Applications; School of Construction and the Environment; Green Roof Research Facility; and Building Science Centre of Excellence
- 2a SFU Burnaby: Centre for Sustainable Community Development; and School of Resource and Environmental Management
- 2b SFU Surrey: Sustainable Energy Engineering Program
- 3 UBC: Centre for Interactive Research on Sustainability; Institute for Resources, Environment and Sustainability; and Clean Energy Research Centre
- 4 UVic: Institute for Integrated Energy Systems; and Pacific Regional Institute for Marine Energy Discovery
- 5 Kwantlen Polytechnic University: Institute for Sustainable Food Systems
- 6 UNBC: Wood Innovation and Design Centre
- 7 CityStudio Vancouver
- 8 Capilano University: School of Global Stewardship
- 9 Douglas College: Building Energy and Resource Management Program

Key Organizations

- 10 Vancouver Economic Commission (VEC)
- 11 City of Vancouver (CoV)
- 12 Innovate BC (formerly B.C. Innovation Council)
- 13 BC Technology Industry Association (BC Tech)
- 14 Discovery Foundation Tech Education Program
- 15 Foresight Cleantech Accelerator Centre
- 16 Launch Academy
- 17 SFU Radius Social Innovation Lab and Venture Incubator; Venture Labs; and Coast Capital Savings Venture Prize
- 18 Spring Activator
- 19 UBC: Lean Launchpad Accelerator
- 20 VANTEC Angel Network and National Angel Capital Organization Academy

WHAT IS A GREEN JOB?

GREEN JOB (*noun*) A job with a focus on activities that restore or preserve environmental quality; reduce energy, materials and water consumption; decarbonize the economy; and minimize or altogether avoid the generation of all forms of waste and pollution.

(United Nations)

For many, a green job may be synonymous with highly specialized science and engineering jobs and the invention of new technologies that will stop climate change and pollution. While these types of occupations are certainly crucial to creating a green economy, green jobs are much more varied than that. Green jobs are as diverse as Vancouver's economy itself: people working on designing, building or even deconstructing green buildings; clean technology researchers and sales professionals; recyclers and processors for all manner of valuable materials; and educators and policy makers working in the field of sustainability. Even our banks, mining companies, accounting firms and hair salons employ people that work to make them more innovative and environmentally responsible.

Industry Characteristics vs. Occupational Characteristics

VEC measures Vancouver's green jobs numbers by evaluating the size and health of seven green economic sectors: green buildings; cleantech; green mobility; materials management; sustainability services; environmental engineering; and local food.

This means the nature of the business drives VEC's green jobs figures, rather than the nature of the occupation. For example, green building jobs include specialized occupations such as energy modellers and installers of renewable energy technologies. However, jobs included in the green building sector also include the activities of builders, tradespeople, drafters and architects when they are working on a high-performance or green construction project.

What these roles have in common is that they work towards preserving environmental quality, reducing resource use, decarbonizing the economy, and help to eliminate waste and pollution.

Green jobs are as diverse as Vancouver's economy itself

New Jobs vs. Transitional Jobs

Green jobs encompass both new and transitional jobs. Some jobs are new, created when a sector grows because it is selling more green goods and services. Other jobs are existing ones that have transitioned to greener practices. With more and more industries greening their operations (eco-fashion, sustainable tourism, sustainable film production), the green economy becomes embedded in more sectors.

An average of 40 percent of the growth in green jobs each year can be attributed to new jobs in the green economy, while 60 percent of the growth stems from transitional job growth.



Is my job a GREEN JOB?

I produce a green product or service	
My company produces a green product or service (but I'm the accountant)	
My company produces some green products or services (not all) (depending on % of product or service that is green)	
I incorporate greener practices in my job or decision making	

Green & Local Food Job Growth in Vancouver: New vs. Transitional

Vancouver Economic Commission, 2016



How to find a Green Job

With the broad nature of occupations available in green sectors, there is a green job for virtually every type of background. There are specialized green jobs boards (some are listed to the right), as well as specific post-secondary education programs (listed, by sector, in other sections of this report). If in doubt, make your current job a green job by becoming a green leader at your workplace.

- **City Studio Vancouver**
www.citystudiovancouver.com
 A collaboration where city staff, students, faculty and community work together to design experimental projects that make Vancouver more sustainable
- **Eco Canada Wage Subsidy**
www.eco.ca/wage-subsidy-program
 Employment program for science, technology, engineering, mathematics (STEM) or natural resources environmental jobs
- **MITACS**
www.mitacs.ca
 A variety of research and training programs
- **UBC Greenest City Scholars**
www.sustain.ubc.ca/get-involved/students/greenest-city-scholars
 A collaboration where city staff and UBC graduate students work on sustainability projects
- **United Nations Canada Green Corps**
www.unac.org/unac-projects/canada-green-corps
 Youth employment program focused on climate action

Low-barrier Jobs

Many social enterprises focus on green industries like materials sorting, buildings deconstruction or weatherization, and create jobs for those with barriers to employment. The Binnars' Project, for example, creates low-barrier jobs and generated more than 7,700 hours in economic activity and \$109,200 in earned income for 340+ binnars (2017).

Green social enterprises providing low-barrier green jobs:

- **United We Can:** bottle and can recycling, alley clean-up
- **EMBERS:** green renovations
- **Common Thread:** converts old banners into shopping bags and other products

GREEN JOB BOARDS

ACRE Sustainability Recruitment
www.acre.com

Allen + York Sustainability Recruitment
www.allen-york.com

B.C. Environmental Industry Association
www.bceia.com (click 'Opportunities')

B.C. Technology Jobs
www.bctechnology.com/jobs

Canadian Environmental Network
www.jobs.rcen.ca

Charity Village
www.charityvillage.com

Connecting Environmental Professionals
www.cepvancouver.org

Coro Strandberg's job postings
www.corostrandberg.com

Eco-Canada
www.eco.ca

GoodWork
www.goodwork.ca

GreenBiz Jobs
www.jobs.greenbiz.com

The Green Recruitment Company
www.greenrecruitmentcompany.com

The Idealist
www.idealist.org

Net Impact
www.netimpact.org/jobs

Renewable Energy Jobs
www.renewableenergyjobs.com

U.S. Green Building Council Career Centre
www.careercenter.usgbc.org/home/index.cfm

Work Cabin
www.workcabin.ca



GREEN BUILDINGS

Vancouver's plan for zero emissions **green buildings** is driving demand for new techniques and technologies



VEC Program Spotlight

Green Buildings Research: VEC conducts research and data generation to better understand market dynamics across Vancouver's green economy. Currently, VEC is researching the market transformation potential of various green building and zero emissions building codes in B.C.

Green buildings are the result of a complex value chain, from conception, design and construction through to the installation of technology and ongoing maintenance. Vancouver benefits from a long history of innovation at every stage. This has resulted in pioneering planning paradigms and built forms, from the continuous public waterfront to the podium-tower development model, that have been emulated worldwide and become globally branded as "Vancouverism".

The discovery of a fault in the construction of condos in the 1980s and 1990s, known as the "leaky condo crisis", sparked the development of deep local expertise in building envelope performance. As remedial work on the water infiltration problem tapered off, engineers turned their attention to the next big topic related to building enclosures - energy conservation - and construction of some of the world's most high-performing buildings began.

The end of the crisis dovetailed with a growing emphasis on reducing carbon emissions, and local building codes were revised to include green building standards. By 2013, the World Green Building Council recognized the City of Vancouver as having the "Best Green Building Policy" of any jurisdiction in the world. Today, the City's policies include a Zero Emissions Buildings Plan and Passive House-style standards.

Trends

Windows

In response to a lack of local manufacturers of high performance fenestration, **Cascadia Windows and Doors** was born. They are currently the only manufacturer of fibreglass (and Passive House-certified) windows and doors on the west coast of North America, delivering 85 percent better performance than aluminum alternatives.

The Fenestration Association of B.C. offers \$25,000-40,000 for testing and certifying new window products to either ENERGY STAR or Passive House standards.

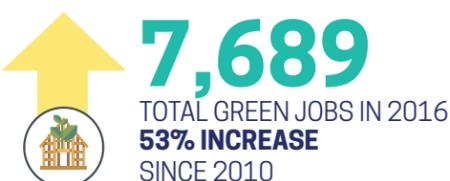
Films or tints can be applied permanently to windows to decrease glare and heat gain, but they compromise natural light and obstruct views. Companies like **View Glass**, **Vario** and **Switch Materials** deliver dynamic, self-tinting glass that can be sensor controlled or respond to occupant location, lighting level or even local weather.

Thermal Breaks

Cascadia's award-winning thermal spacer, called the **Clip**, addresses heat loss through cladding and provides 100 percent more energy efficiency than traditional systems.

Thermal bridges from cast-in-place concrete slabs - balconies, for example - can be retrofitted with **Monoglass** spray-on insulation products. **Schöck** provides structural thermal break solutions for balconies, canopies, slab edges and more.

Vancouver Job Growth: Green Buildings



Heat Pumps & Heat Recovery

Capturing waste thermal energy is essential to achieve zero emissions buildings.

In new Vancouver homes, heat recovery ventilators (HRVs) have been required since 2008, capturing heat from ventilated stale air to preheat cold air as it enters the building. The regulation led to 3,500 HRVs installed in the first five years. Separating ventilation from heating and cooling through Dedicated Outdoor Air Systems (DOAS) is one of the best options to reduce energy use and improve indoor air quality. **TZO** uses artificial intelligence to automate heating, ventilation, and air conditioning services (HVAC). **Core Energy Recovery Solutions** carries products with Passive House certification.

At the neighbourhood scale, Vancouver's Neighbourhood Energy Utility (NEU) has been capturing energy from sewage since 2010 and delivering heat and hot water to 5.2 million square feet of



residential, commercial and institutional floor space. **SHARC's** (formerly International Wastewater Systems) neighbourhood scale sewage heat recovery systems are in operation around the world. In Scotland, the SHARC system intercepts wastewater from a town sewer line and transfers it to Borders College, Galashiels, where it provides 95 percent of campus heat. In Washington D.C., D.C. Water's new US\$60 million headquarters will use the SHARC system for sewage heat recovery to provide all heating and cooling needs for the 150,000 sf building. SHARC's new Piranha product is designed as a heat recovery solution for small buildings.

Contech

Vantech excels in both construction and technology, offering ample opportunity for collaboration at the edges of these disciplines.

Summit AEC offer Building Information Modelling (BIM), software that creates a digital prototype of a building, allowing analysis of materials ordering or site timelines before construction even begins. Virtual and augmented reality (VR/AR) experts such as **LNG Studios**, **Stambol Studios** and **uForis VR** are utilizing holograms and immersive experiences to assist in the multidimensional visualization of design blueprints and generation of realistic 3D previews of finished products.

GEOSim's 3D city-modelling platform allows users to fly or walk around an entire city, enabling analysis of geospatial and sensor data, identifying traffic patterns, building energy use and more. Combined with drone technologies on site, these solutions allow for an integrated design process, precise construction planning and detailed coordination of on-site activities.

Nano-Lit's lighting system uses quantum dots (nanoparticles) to deliver light fixtures suitable for retrofits that shift light temperature from 2400K to 7000K and allow colour purity, efficiency and lowered costs.

Prefabrication & Lean Construction

While prefabricated homes are not yet cost competitive against custom-built homes, automation, off-site modular construction and 3D printing of materials does cut construction time considerably. **Stack Modular**, **Shelter Modular**, **Metric Modular** and **QUBE** cut construction times in half with options for multifamily, commercial and industrial buildings, and provide prototypes for high-rise construction up to 25 storeys.



Deep Dive: Zero Emissions Buildings

The City of Vancouver aims to be 100 percent renewable by 2050, and the City's Zero Emissions Buildings Plan requires all new buildings to have zero operational carbon emissions by 2030. Retrofits must also include energy efficiency improvements.

The Province of B.C. has committed to net-zero energy ready buildings by 2032, and developed its Energy Step Code approach to help municipalities meet this goal. The Federal Government committed to achieving a net-zero energy ready model national building code by 2030.

All of these regulations mark a shift towards passive approaches, such as orientation, massing and solar shading, and strict energy conservation. This also means adoption of performance metrics (rather than just design standards), such as Total Energy Use Intensity (TEUI) and the energy demand for space heating, Thermal Energy Demand Intensity (TEDI). These metrics are used in various combinations in standards such as LEED®, R2000, the Zero Carbon Building Standard and Passive House.

	TEUI kWh/m2/year	TEDI kWh/m2/year	GHGI kg CO2e/m2/year
Passive House	<120	<15	-
City of Vancouver	<100-210*	<15-40*	<3-8
B.C.	<100-170**	<15-70**	-

*depending on type of building
**depending on type of building, climate zone and level of Step Code adopted

The average TEUI for office buildings in B.C. is 335 kWh/m2/year and for multi-unit residential buildings (MURBs) is 215 kWh/m2/yr.⁸ While Vancouver is well equipped with building envelope expertise and high-performance building systems to bridge this gap in TEUI, the TEDI and additional Greenhouse Gas Intensity (GHGI) targets set the bar higher. The GHGI requirements could drive fuel switching, favouring renewable hydroelectricity over natural gas and perhaps drive demand for renewable natural gas.

Policy & Programs

Vancouver Bylaws

New Construction

- The **Zero Emissions Buildings Plan** requires all new buildings to have no carbon emissions by 2030
- The **Green Buildings Policy for Rezonings** requires buildings to meet Passive House requirements (or an alternative such as International Living Building Institute's Net Zero Energy Building)

Retrofits

- Retrofits trigger energy efficiency upgrades proportionate to the nature and scale of the renovation. E.g. home renovation >\$5,000 requires an energy audit

B.C. Provincial Building Code

New Construction

- Net-zero energy ready buildings by 2032
- Energy Step Code (ESC) inspired by Passive House

Technologies for Zero Emissions Buildings

- Triple-glazed/dynamic/tinted windows
- Heat recovery ventilation
- Air-sealing accessories and air-barriers
- Thermal break solutions
- All manner of heat pumps
- High-efficiency HVAC systems
- Metering and smart controls
- Building modeling software
- Battery technology
- Virtual and augmented reality applications

Education & Training

Architectural Institute of B.C. / Engineers & Geoscientists B.C.: professional development courses for designers and engineers

B.C. Housing/Greater Vancouver Home Builders Association: courses to help understand the B.C. Energy Step Code

B.C. Institute of Technology's (BCIT's) School of Construction and the Environment: variety of courses covering green building construction practices

Canada Green Building Council: broad range of programs including LEED® credentials, zero carbon buildings, energy benchmarking and green trades

Emily Carr Centre for Design Innovation and Entrepreneurship (CDIE) at the Wood Innovation and Design Centre (WIDC): training in wood construction and design solutions

Passive House Canada: variety of courses covering Passive House design and construction practices

University of British Columbia: Master of Engineering Leadership in High Performance Buildings

University of Northern British Columbia: Master of Engineering in Integrated Wood Design



UBC's Brock Commons Tallwood Student House—the world's tallest contemporary wooden building at 18 storeys (54 metres/approx 177 feet)—showcases the advantages of building with wood.

Further Reading



Zero Emissions Building Plan

City of Vancouver
2016



Construction Innovation Project: Building B.C.'s Vision

British Columbia
Construction Association
2015



Imagining Construction's Digital Future

McKinsey & Company
2016

WHO TO WATCH

★ **Cascadia Windows and Doors** | www.cascadiawindows.com
North American industry leader in energy-efficient fibreglass windows, doors and cladding support systems

Core Energy Recovery Solutions | www.core.life/en
High performance, hygienic air-to-air heat exchangers suitable for healthcare and Passive House HVAC systems

GeoSim | www.geosimcities.com
Visualizing cities in 3D with high spatial precision, unmatched visual fidelity, and interactive navigation

LNG Studios | www.lngstudios.com
Immersive experiences leveraging 3D renderings, floorplans and animations, VR/AR and drone technology

Metric Modular | www.metricmodular.com
Permanent modular commercial projects, including Canada's first modular multi-unit Passive House building

★ Members of Canada Green Building Council

Monoglass Incorporated | www.monoglass.com
Spray-applied fibreglass insulation with high R-values and thermal performance

Nano-Lit | www.nano-lit.com
Quantum dot technology-enabled, tunable lighting products that reduce energy use, adjust in real-time, and improve well-being

QUBE | www.qubebuildings.com
Digital technology to transform construction decision making and stackable interlocking high-rise building solutions

Schöck | www.schock-na.com
Structural thermal break solutions for new balconies, canopies, slab edges, concrete parapets and steel beams

Seagate Structures | www.seagatestructures.ca
Mass timber construction specialists

SHARC | www.sharcenergy.com
Sewage heat recovery from wastewater for heating, cooling, and hot water for buildings and neighbourhoods

Stack Modular | www.stackmodular.com
Structural steel modular buildings with a 25-storey high-rise prototype

Stambol Studios | www.stambol.com
Immersive experiences through virtual and augmented reality for architecture and real estate

Structurlam | www.structurlam.com
Wood science experts producing the finest cross laminated and mass timber products

Switch Materials | www.switchmaterials.com
Switchable photochromic-electrochromic technology for automotive glass, architectural glass and eyewear

TZOA | www.tzoa.com
Artificial intelligence and sensors to automate HVAC maintenance and air quality analysis

uForis VR | www.uforis.com
Using VR/AR applications, such as physically-based rendering and panoramic videos, that immerse users in a real world location

Vario | www.varioglass.ca
Privacy glass and smart glass for windows and televisions

★ **View Dynamic Glass** | www.viewglass.com
Intelligent windows that take in data from sensors, occupant location and even time of day, to maximize natural light and views while reducing heat and glare



CLEANTECH

Public sector early adoption and corporate strategic investments drive cleantech growth



VEC Program Spotlight

Green and Digital Demonstration Program (GDDP) has allowed numerous cleantech companies to pilot their innovative or sustainable solutions on city-owned assets. Soon, this program will be expanded to the regional level.

Cleantech includes companies that develop technologies for clean energy production, management and storage; water treatment and management; material efficiency and circular economy; advanced materials development; green agritech; clean transportation; and green buildings.

Vancouver is home to many game-changing clean technologies, from **General Fusion** (the development of viable fusion energy) to **Carbon Engineering** (the development of clean fuel out of thin air). The innovation and leadership in this area has significantly contributed to Vancouver's global reputation and \$31.5 billion brand valuation.

Vancouver's cleantech sector emerged in the late 1980s through a combination of entrepreneurial vision and early-stage government and venture funding. Early innovations spawned numerous ventures and created a generation of progressive-thinking engineers and technicians focused on upending age-old industries.

Vancouver's attractive corporate tax regime, targeted incentives and positive policy context (Greenest City Action Plan, Renewable City Action Plan and B.C.'s carbon tax) help to attract new companies and talent to a growing ecosystem.

Trends

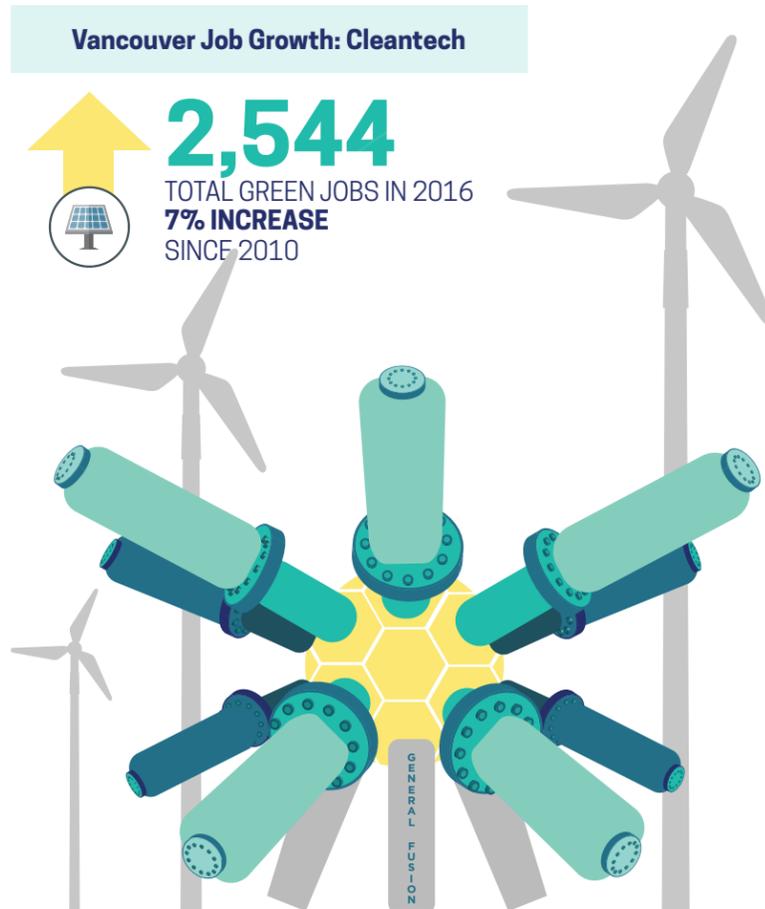
Wastewater

Tailing ponds are inarguably one of the most visual culprits of environmental degradation, and several Vancouver-based innovations are working to turn this sludge into clean water – capturing innocuous solid residue, and extracting nutrients and valuable metals from the fluid.

Saltworks Technologies' industrial desalination technology, which essentially reduces wastewater to salt, has attracted customers from mining company **Teck Resources** to NASA, which is piloting Saltworks' technology for future use on the International Space Station. **MGX Minerals** is also pioneering the extraction of lithium – valued for its use in electric vehicles – from oilfield wastewater.

Others are meeting the increasing demand for clean water, including **Acuva's** UV-LED systems that eliminate pathogens instantly from drinking water. **Axine Water Technologies** offers a solution for toxic wastewater from pharmaceutical and chemical markets, and **lonomr** offers highly durable ion-exchange membranes.

BQE Water has solutions to remove and recover a range of metals, sulphate, cyanide and more recently, selenium, while **Ostara Nutrient Recovery Technologies** – backed by Robert F. Kennedy Jr. – captures nutrients from wastewater in the form of an eco-friendly, phosphorus-based fertilizer.



**CANADA'S
CLEANTECH SECTOR
RANKS 4TH IN THE WORLD**
(Global Cleantech Innovation Index, 2017)



\$1.3 B in revenues
**CANADA RENEWABLE
ENERGY TECHNOLOGIES**
(Statistics Canada, 2015)

Company	Raise (\$CAD)
Mojio Kensington Capital Nov 2017	\$30 M
Jetti Resources DNS Capital & Kleiner Perkins Caufield & Byers Aug 2017	\$22.8 M
Enbala Power Networks ABB Technology Ventures Aug 2017	\$22.1 M
MineSense Technologies Aurus Capital & Caterpillar Ventures Feb 2017	\$19 M
General Fusion Business Development Bank of Canada Sep 2017	\$15.9 M
Inventys Husky Energy Jul 2017	\$10 M
Acuva Undisclosed Dec 2017	\$2.6 M
Elix Wireless Chongqing Zongshen Power Sept 2016	\$6.55 M
DarkVision Evok Innovations & BDC Capital Sept 2016	\$8 M
Axine Water Technologies Asahi Kasei Corporate Venture Capital Aug 2016	\$8 M
Carbon Engineering Undisclosed Nov 2016	\$5.1 M
Illusense Sustainable Development Technologies Canada Sept 2016	\$1.6 M

Changing face of cleantech investment

PitchBook data suggests that venture investments may have peaked. Yet strategic investors are filling the gap, with large corporates delivering more patient capital to cleantech companies. Teck Resources invested in desalination technology from Saltworks to remove contaminants from tailings, reduce runoff and eliminate wastewater at their mining sites. Teck also partnered with **Zincnyx Energy Solutions**, the developer of a zinc-air fuel cell for energy storage at remote sites. **IKEA's GreenTech Investments** became a shareholder in **Terramera Inc.**, which delivers plant-based pesticides for use in agriculture and in targeting bed bugs or dust mites in consumer products.

Distributed, decarbonized and digitized grid

Independent producers already provide 14 percent of BC Hydro's energy supply.⁹ At the building scale, solar PVs and heat pumps mean energy consumers are now "prosumers," contributing to a multi-directional energy system. This multiplication of Distributed Energy Resources (DERs) requires new solutions to manage the complexity of sources, distribution lines and end users.

Powertech Labs helps utilities and manufacturers adapt to this complexity; **Ecotagious** helps homeowners monitor energy use of major appliances; and **Cliir** offers software to optimize renewable assets. **Legend Power Systems** addresses the issue of "overvoltage," matching voltage supplied with demand so that equipment can be operated at a controlled voltage at lower cost.

Tantalus Systems offer Advanced Metering Infrastructure (AMI), sensors and communications networks that allow two-way communications between a utility and its customers. **Awesense's** software helps clients affordably and remotely monitor anomalies and losses on their grid – even with no AMI in place. **Corinex Communications** uses broadband over power lines technology to transmit data about the grid over the power wiring itself, eliminating the need for additional communications infrastructure such as radio towers. **Enbala Power Networks** leverages machine learning to network together tens or even thousands of individual DERs to create 'virtual power plants,' and then optimize the system for cost as well as carbon.

Doing away with power lines and sensors altogether, **ELIX Wireless** has a magnetic coupling technology that allows wireless charging for automobiles. It produces no heat, works in the rain, and can even push aside debris.



35%
INCREASE IN B.C. CLEANTECH
companies, totalling 270+
(KPMG, 2011 - 2017)



\$84 K
AVERAGE SALARY
in Cleantech (24%↑)
(KPMG, 2011 - 2017)

\$6 B
EQUITY RAISED by B.C.
Cleantech Companies (25%↑)
(KPMG, 2011 - 2017)



98%
of Vancouver's
**ELECTRICITY
IS RENEWABLE**

100%
RENEWABLE ENERGY GOAL
by 2050
(City of Vancouver)



47%
OF B.C. FIRST NATIONS are
involved in renewable energy
projects
(First Nations BC Clean
Energy Working Group, 2017)



Deep Dive: Negative Emissions Technologies

Nearly all of the Intergovernmental Panel on Climate Change (IPCC) models for curbing global warming to less than two degrees Celsius assume that we will remove 810 billion tonnes of carbon directly from the air¹⁰.

However, solutions such as carbon sinks – forests or wood buildings used to store carbon – require a lot of land. Carbon capture and sequestration projects, which aim to capture industrial emissions at their source and store them deep underground, are few and far between too.

Carbon Engineering has a novel approach. Their game changing technology – backed by investors like Bill Gates and Murray Edwards – is based on the direct air capture of carbon (up to a million tonnes annually per facility). This is then used to create clean transportation fuels. The energy requirement is significant, but Carbon Engineering's pilot plant in B.C. uses renewable hydroelectric power.

Focusing on capture and sequestration, **Inventys** is developing an adsorbent process that is cheaper, non-toxic, and more efficient than amine solutions, with a plant capacity of 30 tonnes of carbon per day.

The **Carbon Capture and Conversion Institute** helps to accelerate commercially viable technologies to reduce carbon emissions. Along with partner **BC Research**, the institute assists clients to scale and pilot carbon capture solutions.

Policy & Programs

Federal

- **Build In Canada Innovation Program (BICP)**
Public Works and Government Services Canada
- **Green Municipal Fund**
Federation of Canadian Municipalities
- **Going Global Innovation**
Trade Commissioner Service
- **Business Innovation Access Program**
National Research Council Industrial Research Assistance Program (NRC-IRAP)
- **Accelerate Internships**
MITACS Canada National Research Organization
- **Collaborative Research and Development (CRD) Grants**
Natural Sciences and Engineering Research Council of Canada (NSERC)
- **SD Tech Fund**
Sustainable Development Technologies Canada (SDTC)
- **Tax incentives from Scientific Research and Experimental Development (SR&ED) Program**
Canada Revenue Agency (CRA)
- **Western Innovation (WINN) Initiative**
Western Economic Diversification Canada
- **Cleantech loans** from Business Development Bank of Canada (BDC) and Export Development Canada (EDC)
- **Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative; Emerging Renewable Power Program; and Clean Energy for Rural and Remote Communities** Natural Resources Canada

Provincial

- **Innovative Clean Energy (ICE) Fund**
Province of British Columbia

Accelerators & Incubators

Program	Mentorship	Competition	Financing
BC Tech Hypergrowth, Executive-in-Residence programs	✓		
China Canada Cleantech Innovation Centre	✓		✓
Creative Destruction Lab	✓		
Colliers-TechStars PropTech Accelerator	✓		✓
Discovery Foundation Tech Education Program	✓		
Expa Labs	✓		✓
Foresight Cleantech Accelerator Centre	✓		
The Founder Institute	✓		
Futurpreneur Growth Accelerator	✓		✓
Highline BETA	✓		✓
Hollyhock Social Venture Institute	✓		✓
Innovate BC's Venture Acceleration program, New Ventures Competition	✓	✓	
Launch Academy	✓		✓
Ready to Rocket		✓	
Simon Fraser University Radius Social Innovation Lab/Incubator, Venture Labs, Coast Capital Savings Prize	✓	✓	
Spring Activator	✓		
University of British Columbia Lean Launchpad Accelerator	✓		✓
VANTEC Angel Network and National Angel Capital Organization Academy	✓		✓
Vancouver Economic Commission Capital Mentorship and Investment Showcase	✓	✓	✓

Further Reading



Activate an Efficient & Sustainable Future

Schneider Electric
2017



Nanogrids, Microgrids, and Big Data: The Future of the Power Grid

IEEE Spectrum
2017



British Columbia Cleantech 2016 Status Report

KPMG
2017

WHO TO WATCH

★ **Acuva** | www.acuvatech.com

UV-LED system clears water of pathogens instantly for use in RVs, boats and homes

🏆 **Awesense** | www.awesense.com

All smart grid analytics grid modernization platform for electric distribution utilities

🏆★ **Axine Water Technologies** | www.axinewater.com

Treats toxic industrial wastewater from pharmaceuticals, electronics and chemical markets

BQE Water | www.bqewater.com

Treats mining wastewater and hydrometallurgical waste streams

★ **Carbon Engineering** | www.carbonengineering.com

Captures carbon directly from the air which is then used in the synthesis of clean transportation fuels to displace crude oil



Members of the Global Cleantech 100 2018 List

★ **Clir Renewables** | www.clir.eco

Software enables wind & solar renewable energy asset optimization

★ **Ecotagious** | www.ecotagious.com

Software as a Service (SaaS) engagement platform that generates energy insights using smart meter and Internet of Things (IoT) data

🏆 **Enbala Power Networks** | www.enbala.com

Real-time energy-balancing platform for controlling and dispatching multiple energy resources

★ **General Fusion** | www.generalfusion.com

World leader in commercial fusion energy, developing the world's first commercially viable fusion power plant to deliver clean, safe, abundant and on-demand energy

★ **Inventys** | www.inventysinc.com

Post-combustion carbon capture uses adsorbent structures that are cheaper, non-toxic and more efficient than amine solutions



Members of B.C. Cleantech CEO's Alliance

🏆 **Ionomr** | www.ionomr.com

Durable ion-exchange membrane that will not deteriorate over time due to complete alkaline stability and strength

🏆★ **MineSense Technologies** | www.minesense.com

Industrial IoT provides real-time, sensor-based ore data and sorting solutions for large-scale mines

🏆 **Ostara Nutrient Recovery Technologies** | www.ostara.com

Nutrient management solutions to recover phosphorus and nitrogen from wastewater, producing an eco-friendly fertilizer

Portable Electric | www.portable-electric.com

Clean, mobile power stations using plug-and-play modular lithium ion battery packs. For festivals, film sets, job sites, emergencies and more

🏆★ **Saltworks Technologies** | www.saltworkstech.com

Desalination systems that produce freshwater from highly contaminated industrial wastewater. Projects include a plant for NASA with intended future use on the International Space Station

🏆★ **Semios Technologies** | www.semios.com

Pest management system integrates pheromone dispensers with camera-enabled pest traps, all connected wirelessly across fields

Tantalus Systems | www.tantalus.com

Smart grid communications and solutions for advanced metering, demand response, distributed automation and grid optimization

🏆★ **Terramera** | www.terramera.com

Safe, effective and high-performance plant-based alternatives to conventional chemical pesticides and fertilizers for pest control and consumer products



GREEN MOBILITY

The birthplace of fuel cell innovation, Vancouver cultivates cutting edge green transportation solutions for high livability



VEC Program Spotlight

VEC has worked with a number of industrial businesses to develop solutions for greener, more efficient fleets. Recommendations include investment in shared charging and fueling infrastructure, and a vehicle sharing pilot project.

Green mobility is a multifaceted sector encompassing solutions from transportation planning and public transit to vehicle sharing and internet-enabled route-planning platforms; it includes the design, manufacture and maintenance of clean energy vehicles, and the entire ecosystem of connected car technology.

Vancouver chose liveability over car-centric urban planning approaches in the 1960s, instead developing a top-ranked transit system that includes the longest, fully automated light metro in the world. Today, Vancouver is one of the only North American centres without an inner-city freeway, and half of all trips originating in the city are made by walking, cycling or transit. The city's biking network spans 311 km, and Vancouver operates the largest municipal electric vehicle fleet in Canada.

Smart, connected and clean vehicles are seeing increased demand, and are supported by policy and incentives such as the Clean Energy Vehicle incentive program and local bylaws that require new buildings to provide charging infrastructure.

Canadian geophysicist Geoffrey Ballard's early breakthroughs in the 1980s led to global recognition of B.C. as the "birthplace for fuel cell innovation," and Canadian fuel cell companies continue to play a leading role in today's global industry.

Trends

Smart logistics and planning

The transportation network now extends beyond physical roads and transit lines and into a virtual world built on sensors, data and analytics. **Routific** offers a route optimization software for delivery vehicles while **Freightera** finds efficient shipping options and includes a Green Freight Marketplace featuring carriers with emissions reduction programs. **Cowlines** provides individuals with the most efficient options for getting from point A to point B and thanks to multimodal routing, helps reduce your carbon footprint, while **UrbanLogiq** analyzes municipal data to provide insights that can reduce traffic collisions or identify other links between traffic patterns and social phenomena.

Clean aviation & marine travel

Canada became the first country in the world in 2005 to develop a voluntary agreement to address carbon emissions from aviation, and then to conduct the world's first civil jet flight powered by 100 percent biofuel in 2012. A consortium led by Vancouver-based **NORAM Engineering** and the **University of British Columbia** is working to make aviation biofuel from forest residue, which could meet up to 10 percent of B.C.'s annual jet fuel demand.

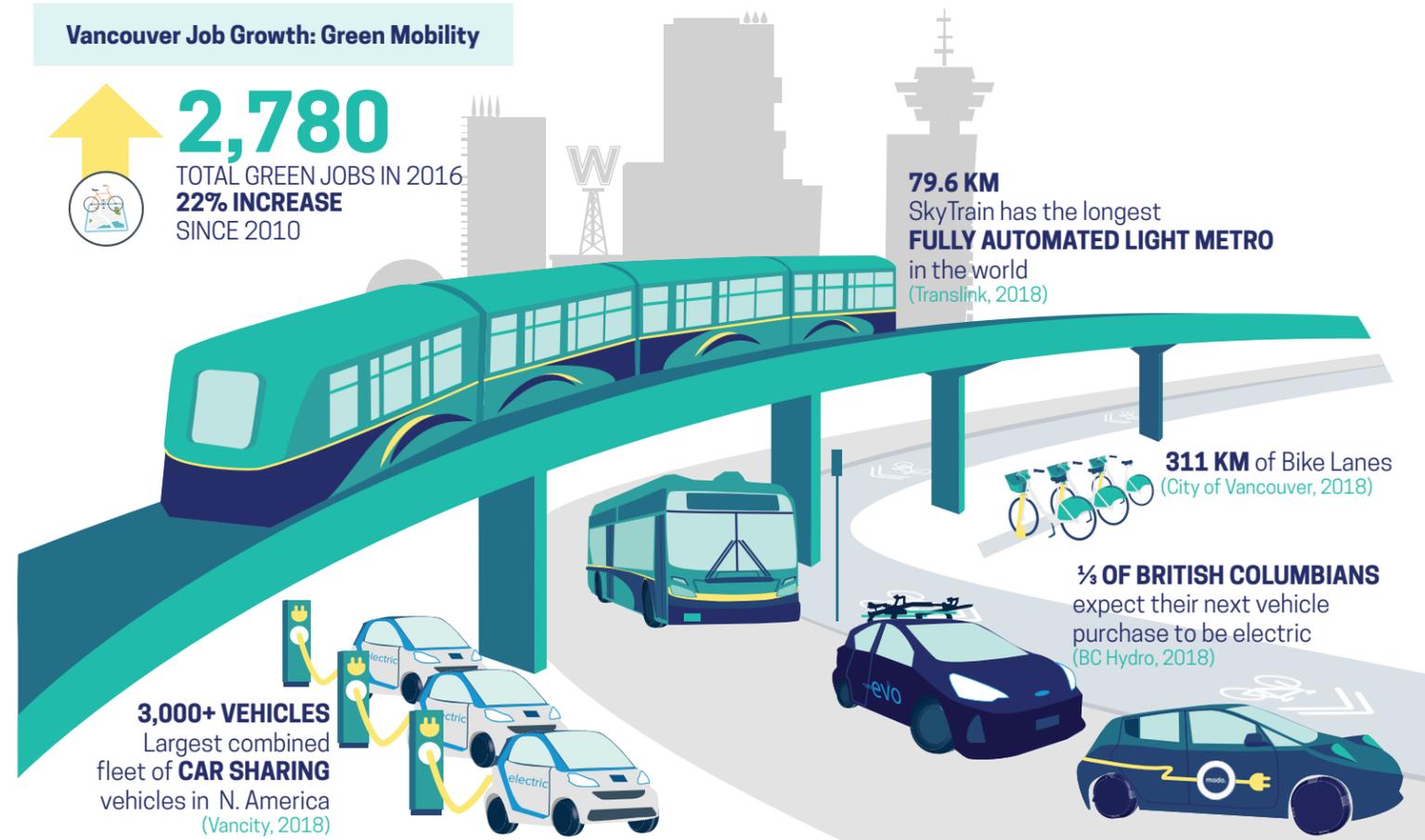
Meanwhile, maritime electric propulsion is already here. **Corvus Energy** supplied its lithium-ion solution to an all-electric ferry owned by Norwegian ferry operator Fjord and **Plan B Energy Storage**, started by Corvus' founders, also provides solutions for marine, grid and heavy industry.

Vancouver Job Growth: Green Mobility



2,780

TOTAL GREEN JOBS IN 2016
22% INCREASE
SINCE 2010



Pathways to electric vehicles

By 2025, every sixth car sold will be electric.¹¹ Along with the goal of being 100 percent renewable by 2050, Vancouver is signatory to a "fossil fuel free streets" declaration that commits major areas of the city to be zero emissions by 2030.

In passenger and light duty vehicles, the market already delivers a range of plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs). Alongside global brands, boutique manufacturers offer niche vehicles, like **Electra Meccanica's** SOLO, a single-seat BEV available for under \$20,000 targeted at commuters.

The market for lithium-ion batteries for vehicles is expected to reach \$30.6 billion in 2024¹², and demand for batteries means increased appetite for materials and components. **Global Li-Ion Graphite Corporation** acquired a graphite mine located close to Tesla's Gigafactory, hoping to supply graphite for the factory's planned 500,000 lithium-ion packs a year. **First Cobalt**, **Giga Metals** and **MGX Minerals** aim to responsibly mine nickel and cobalt from clean sources in Canada. While **Nano One Materials** creates nanostructured cathode materials to improve battery life span and energy density. **Vanadium Corp** is betting on vanadium redox flow batteries, and they are recovering vanadium from waste. **Retriev Technologies** recycles batteries from PHEVs and BEVs, while **American Manganese** has a recycling process that captures 100 percent of cathode materials.

The third pathway to EVs is fuel cell electric vehicles (FCEVs) – a born-in-B.C. innovation with strong footing in heavy-duty applications, like buses, trams and rail. **Ballard** modules are powering the world's first fuel-cell-powered electric tram in China, as well as over 600 buses and trucks around the world. **Loop Energy** builds fuel cell "range extenders" for trucks and buses at a 30 percent lower cost than traditional fuel cells. The **Mercedes-Benz Fuel Cells** manufacturing facility is the first automated automotive facility dedicated to fuel stacks and sub-assemblies as well as the advancement of fuel stack production technology.

Hydrogen for FCEVs can be produced using a number of different technologies. It is most economically extracted from natural gas, but while switching from combustion of fossil fuel to hydrogen offers significant carbon savings, deriving hydrogen from a fossil fuel is not ideal. Processes such as electrolysis, on the other hand, allow for very low carbon intensity fuels. **Hydrogen Technology and Energy Corporation** is developing a network of six retail hydrogen fueling stations in Vancouver and Victoria, B.C. along with an electrolysis production facility. They will be opening the first retail hydrogen dispenser in Canada in June 2018. **Hydrogen In Motion** has a portable hydrogen storage solution, and delivers tanks of hydrogen directly to consumers, while **Hydra Energy** provides hydrogen-as-a-service and can retrofit entire heavy-duty vehicle fleets to run on a switchable, dual-fuel hydrogen and diesel system.



1,000

PUBLIC CHARGING STATIONS
in B.C. (250+ in Vancouver)
(Plug In B.C., 2018)

50%



of all trips starting in Vancouver are made
by **WALKING, CYCLING OR TRANSIT**
(City of Vancouver, 2016)



200

CLEAN ENERGY VEHICLE
(CEV) companies with 3,850
jobs in B.C. (MNP, BC Ministry of
Energy & Mines, 2016)



GREEN JOBS

» electric vehicle mechanics » engineers
» green fleet managers » transportation
planners » route optimization software
developers » bikeshare fleet technicians



CANADIAN FUEL CELL INDUSTRY

» \$220 Million revenue and 1,785 jobs
» 31% of Canadian facilities are located in B.C.
(Canadian Hydrogen and Fuel Cell Association, 2016)

Deep Dive: The Connected Car

Since 1996, onboard computers have been integral to car design, controlling basic features like heated seats, climate control and digital displays. Today, these computers optimize internal functions, transmit engine performance data, and enable “infotainment” applications like GPS navigation, traffic updates and smartphone integration. **Mojio’s** platform – with its open ecosystem of apps and backed by Amazon’s Alexa Fund – turns vehicles into “smart” devices that can analyze driver behaviour, automate insurance renewal, schedule preventative maintenance and more. Connected cars can reduce energy consumption through efficient driving and improved performance.

Many driver assistance systems use the computer, along with onboard sensors and cameras, to warn about drifting outside lanes or getting too close to other traffic. Going further, **Movee Innovations** offers advanced sensor technologies – integrated with GPS, roadside traffic infrastructure and artificial intelligence – to provide all the connected infrastructure required for autonomous transportation.

Connected cars and bikes also enable more convenient vehicle-sharing options – and a way out of expensive car ownership. Vancouver has the largest combined sharing fleet of any city in North America (about 3,000 vehicles from **car2go**, **Evo**, **Modo** and **Zipcar**).¹³ As a result, the equivalent of 8,200 cars have been kept or taken off Vancouver roads.¹⁴ Offering two-wheeled transportation, **Mobi** manages 1,500 shared bikes for locals and visitors, while **VeloMetro** has engaged UBC for a pilot program for their fully enclosed, electric-assisted single passenger vehicle – the Veemo. The Veemo fleet, requiring no driver’s license yet with plenty of space for bags and heavy books, helps students and staff move easily around the large campus.

Policy & Programs

Federal

Accelerated Depreciation

- EV charging stations qualify for higher depreciation rate in Capital Cost Allowance

Provincial (British Columbia)

Renewable Low Carbon Fuel regulation

- Requires renewable fuel content of at least five percent for gasoline and four percent for diesel

Fleet Champions Program

- EV business case analysis, telematics, and incentives for charging stations

Charging Solutions & Incentives

- Incentives for charging stations for homes, multi-dwelling buildings and workplaces

B.C. Clean Energy Vehicle Incentives*

Plug In B.C.

Type of Vehicle	Incentive
PHEVs, BEVs and FCEVs > 15kWh	\$5,000 (+ up to \$1,000 for FCEVs)
PHEVs 4kWh < 15kWh	\$2,500
BEVs (speciality vehicles e.g. motorbikes, buses, fleets)	\$2,000 - \$50,000
Scrap a gasoline vehicle	\$6,000

* Vehicles with a MSRP of over \$77,000 are not eligible

Municipal

Vancouver Transportation 2040 Plan

- Make the majority of trips on foot, bike, and transit
- Eliminate dependence on fossil fuels

Vancouver Building Bylaw

- New buildings to provide charging to 100 percent of residential; 10 percent of commercial parking stalls

Vancouver EV EcoSystem Strategy

- Expand access to home and workplace charging
- Improve public charging network
- Integrate EV infrastructure planning into City processes

Surrey Alternative Fuel Bylaw

- New service stations to provide low carbon alternative fuel

Further Reading



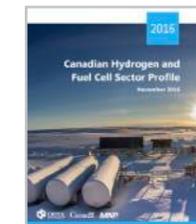
Clean Energy Vehicle Economic Opportunities Assessment

BC Ministry of Energy and Mines, 2016



Stuck in Neutral: Tracking the Energy Revolution 2017

Clean Energy Canada 2017



Canadian Hydrogen and Fuel Cell Sector Profile

CHFCA 2016

Education & Training

University of British Columbia: Clean Energy Research Centre and Centre for Interactive Research on Sustainability

Simon Fraser University: School of Mechatronics Systems Engineering

University of Victoria: Institute for Integrated Energy Systems



Electra Meccanica’s SOLO is a single-seat BEV available for under \$20,000 targeted at commuters

WHO TO WATCH

American Manganese | www.americanmanganeseinc.com

Critical metal company with focus on recycling lithium-ion EV batteries and able to capture 100 percent of cathode materials

Ballard | www.ballard.com

Fuel cell technology for heavy-duty applications such as buses, trucks and rail

Corvus | www.corvusenergy.com

Purpose-engineered energy storage solutions for marine, oil and gas, and port applications

Cowlines | www.cowlines.com

An advanced trip planning app that helps get you there faster while reducing your carbon footprint

Electra Meccanica | www.electrameccanica.com

Designs and manufactures SOLO: a single passenger, three-wheeled battery electric vehicle

Freightera | www.freightera.com

Online marketplace that assists companies in finding the greenest and most efficient shipping options

Hydra Energy | www.hydra-energy.ca

Retrofits fleets and builds onsite fueling infrastructure to deliver hydrogen-as-a-service at a fixed price

Hydrogen in Motion | www.hydrogeninmotion.com

Develops cost effective low pressure high density solid state hydrogen fuel tanks and delivers them for fuel cell applications

Hydrogen Technology and Energy Corp | www.htec.ca

Builds and operates hydrogen vehicle fuelling station networks and low carbon intensity hydrogen supply facilities

Loop Energy | www.loopenergy.com

Builds fuel cell ‘range extenders’ for trucks and buses at a 30 percent lower cost than traditional fuel cells

Moovee Innovations | www.mooveeinnovations.com

Uses sensor technologies and artificial intelligence to provide the connected infrastructure required for autonomous transportation

Moj.io | www.moj.io

Provides secure, hardware-agnostic digital platform for car monitoring and tracking

Nano One Materials | www.nanoone.ca

Builds nanostructured cathode materials to improve battery lifespan and energy density

Plan B Energy Storage | www.pbes.com

Provides energy storage solutions for marine, grid and heavy industrial applications

Retrieve Technologies | www.retrieve-tech.com

Lithium-ion battery recycling facility that recovers scrap components with a patent to regenerate materials for batteries

Routific | www.routific.com

Route optimization platform that saves delivery fleets up to 40 percent in fuel consumption

UrbanLogiq | www.urbanlogiq.com

Analyzes diverse municipal data sets to assist governments in understanding community needs

Vanadium Corp | www.vanadiumcorp.com

Recovers vanadium from a variety of sources via innovative new processes

VeloMetro | www.velometro.com

An electric-assisted, enclosed single passenger bike for sustainable urban transport and sharing service ‘Veemo’



MATERIALS MANAGEMENT

Digitization, data and design are leading Vancouver's waste management models towards a more **circular economy**



VEC Program Spotlight

VEC's Industry Innovation Labs believe that collaboration can transform an entire industry. Today's challenges require entire industries to rethink their value chains to stay relevant in a transforming world. A two-year Apparel Textiles Leverage Lab, brought together industry leaders to reimagine the way they work. The lab spawned two new ventures, one industry association, and a strong foundation for further collaboration.

Materials management has evolved from waste management and recycling to a system focused on extracting the most value from limited resources. Today, the sector intersects with nearly every stage in the product lifecycle, from product design and material choice to manufacturing and delivery. It includes waste reduction and repair, resource sharing, deconstruction, upcycling, and even mineral and metal recovery.

In Vancouver, materials management is driven by a powerful combination of policy, innovation and consumer awareness. Vancouver aims to send zero waste to landfill or incinerator by 2040. Its goals are supported by the province, which is a leader in extended producer responsibility and has more programs than any other jurisdiction in North America. These programs have spurred investment in regional recycling infrastructure, while Vancouver's green demolition bylaw has catalyzed an active deconstruction and remanufacturing sector. This growth in the resource recovery sector has also stimulated a wide range of social enterprises.

B.C. boasts extensive research and educational capacity in design, material science, and sustainable forestry, enabling new businesses that are designing or leveraging waste materials to deliver new products. City residents that value greener products and resource sharing are helping Vancouver on the path to becoming zero waste.

Trends

New approaches to organics

When the city and region banned food scraps from disposal in 2015, traditional large-scale composting facilities were left scrambling to meet demand. Policy had suddenly allowed new technology and decentralized methods to process organic waste at smaller scales and on site at client facilities.

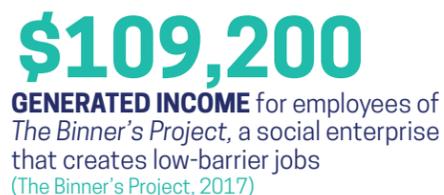
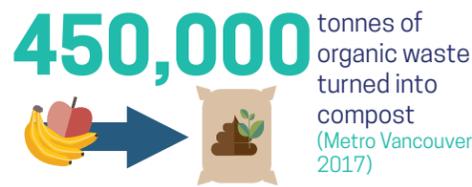
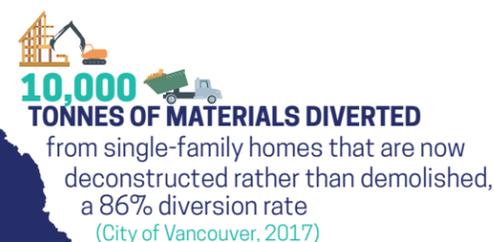
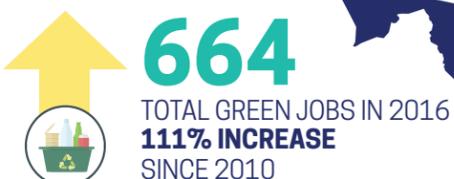
Recycling Alternative helps organizations to bring **Green Good Composters** on site and turn organic waste into soil amendments for gardens and green roofs. This composter even separates plastics from the mix. **Anaconda Systems** processes organic waste within the city limits – with no foul odour or runoff.

Enterra Feed Corporation harnesses black soldier fly larvae to turn pre-consumer waste food into protein and fat used in animal feed and organic fertilizers. **West Coast Reduction** also processes post-industrial animal and other organic waste into valuable feed products, while **Heilu Food** uses the black soldier fly larvae to create cooking oils. **Biocube's** mobile biodiesel processor is a 20' shipping container creating renewable fuels from fruit and waste vegetable oil.

Mining waste for metals & minerals

More than 44 million tons of electronic waste are created every year worldwide,¹⁵ presenting a massive business opportunity for companies like **Ronin8**. Their technology separates metals from non-metals in e-waste, enabling each material stream to be processed in a way that unlocks its maximum value.

Vancouver Job Growth: Materials Mgmt.



Deep Dive: Bio-Based Materials

A circular economy requires moving away from nonrenewable resources like fossil fuels. Although fossil fuel energy sources can be replaced with renewable sources, the infrastructure, supply and accessibility of substitutes still need to be scaled up.

In Vancouver, many innovators are working to replace fossil fuel-based materials with bio-based materials. As an alternative to synthetic plastic (made of petroleum and natural gas) **Good Natured Bioplastics** produces one of North America's widest assortments of plant-derived consumer products and packaging.

In their sub-brand line "Conscious," **H&M** strives to displace synthetic textiles such as nylon, polyester, acrylic and spandex (made from natural gas or oil and the largest contributors of microplastics into the environment). Instead H&M sources biosynthetics from suppliers that adhere to global standards of environmental and social compliance.

Design houses such as **Nicole Bridger** and **Dish Denim** incorporate biosynthetics for high performance features, such as increased breathability, moisture wicking, and natural antibacterial properties. Wholesaler **KenDor** specializes in environmentally and socially responsible textiles, including biosynthetics such as Tencel, Lyocell, and Modal.

Nova Biorubber aims to replace nonrenewable or synthetic rubber (derived from crude oil) with a natural rubber found in Russian dandelions. While a significant portion of the world's rubber is already plant based, the trees from which rubber is typically derived are slow-growing and unable to keep pace with demand. Russian dandelions are fast growing, nonallergenic, and have been proven to be noninvasive in the Canadian climate.

Policy & Programs

Municipal

City of Vancouver Zero Waste 2040 Strategy

- Eliminate all disposal of solid waste to landfill or incinerator by 2040
- Green demolition bylaw: pre-1940 homes must be deconstructed, with 75 percent of material reused or recycled (90 percent for character homes)
- Single-use item reduction strategy

Metro Vancouver

- Creates economic incentives for diversion of recyclable materials including food waste, clean wood, and mattresses through disposal bans enforced at regional facilities.
- Educates the public on waste reduction through campaigns such as "Food Isn't Garbage" and "Create Memories Not Garbage"
- Educates industry on circular economy innovation at their annual Zero Waste Conference
- Funds the National Zero Waste Council to raise awareness and encourage implementation of a circular economy
- Regulates private solid waste facilities, and bans the disposal of hazardous and recyclable materials including food waste, clean wood and drywall at regional solid waste facilities

Provincial

Province of B.C.

- 22 industry-led 'extended producer responsibility' recycling programs covering 14 different product categories of consumer products including: packaging; electronics and electrical products (including all batteries); beverage containers; tires; and household hazardous waste

Education & Training

Emily Carr Centre for Design Innovation + Entrepreneurship: Showcasing B.C.'s expertise as a global leader in wood construction, products, and design solutions.

Kwantlen Polytechnic University Wilson School of Design: New, cutting-edge facility for graphic design, fashion, product design, technical apparel, fashion marketing, and interior design.

National Zero Waste Council: Council of six of Canada's largest regions driving innovation to support a circular economy.

National Industrial Symbiosis Program Canada (NISP Canada): Business-to-business network for resource collaboration.

Repair Cafes: Free meeting places with tools and materials to repair clothes, furniture, electrical appliances, bicycles, crockery, appliances, toys and more.

UBC Centre for Advanced Wood Processing: Education, training and technical assistance for the wood products manufacturing industry.

UBC National Composites Research Network: Academic and industry collaboration supporting composites industry



Kwantlen Polytechnic University - The design programs at the KPU Wilson School of Design train students to explore sustainable solutions utilizing material processes that promote product functionality and circularity.

Further Reading



Towards the Circular Economy: Textiles Sector in Vancouver, Canada

Vancouver Economic Commission
2015



Getting to a Circular Economy: A Primer for Canadian Policymakers

Smart Prosperity Institute
2018



City of Vancouver Zero Waste 2040

City of Vancouver
2018

WHO TO WATCH

Anaconda Systems | www.anacondasystems.ca

Organic waste management without odour or runoff

Biocube | www.biocubeco.com

Transportable biodiesel refinery that produces commercial quantities of high quality biodiesel from waste and renewable feedstocks

ChopValue | www.chopvalue.ca

Product engineering and design firm that creates innovative material with recycled chopsticks as a resource

Debrand | www.debrand.ca

Secure product recycling for diverse materials from textiles to medical devices

Enterra Feed | www.enterrafeed.com

Manufactures and markets sustainable insect-based feed ingredients and fertilizers

Fab Cycle | www.fabcycle.ca

Collects and recycles textile waste, including scraps, offcuts and end of rolls

FoodMesh | www.foodmesh.ca

B2B marketplace that matches surplus food to a verified network of businesses and charities

Good Natured Products | www.goodnatured.ca

North America's widest assortment of consumer products and packaging options derived from plants

Heilu | www.heilufood.com

Protein, micronutrient powder and a coconut oil-like butter from insects

Kabuni | www.kabuni.com

Blockchain platform for 3D printing at industrial scale that protects, prints, and pays

Nova Biorubber | www.novabiorubber.net

Safe and renewable biorubber, biolatex and inulin from rubber plant in North America to solve latex allergy and satisfy rubber demand

Quupe | www.quupe.com

Online sharing platform allows consumers to rent common goods from neighbours

Plastic Bank | www.plasticbank.org

Enables the exchange of plastic for money, items or blockchain secured digital tokens

Recycle Smart | www.recycle-smart.ca

Cost-effective recycling programs with bin sensor technology for businesses and commercial properties

Red Flag Design | www.redflagdesign.ca

Design company focused on material innovation producing high-quality duffel bags & display elements from decommissioned sails

Recycling Alternative | www.recyclingalternative.com

Local leader in innovative approaches to recycling, community partnerships and inclusive employment

Ronin8 | www.ronin8.com

Separates metals from nonmetals to unlock maximum value of each stream with no burning or emissions

Venzee | www.venzee.com

Replaces spreadsheets with AI-powered data transformation for the retail industry

West Coast Reduction | www.wcrl.com

Modern rendering facilities with safe, environmentally friendly recycling solutions for the agriculture industry



LOCAL FOOD

Home of the 100-mile diet, Vancouver's bounty and locavore culture makes it a haven for **food entrepreneurs**

The local food sector includes jobs in food production, processing, trade and service, as well as a small number of jobs in food-related advocacy and policy.

Since the 100-mile diet was conceived in B.C. in 2005, consumer demand for local food products has skyrocketed. Vancouver is experiencing a boom in everything from urban farms to craft breweries and artisanal manufacturing, and from food trucks to farmers markets. Decades of policy change has driven greater regional food security in the region.

One of the most critical players in the local food ecosystem is the Vancouver Farmers Market, which has experienced consistent, double-digit growth sales since 2004, with sales volumes of \$8.5 million in 2016. Changes in procurement policy by institutions like UBC, SFU and the Vancouver Parks Board have likewise accelerated demand, with the latter now buying at least 44 percent of all food from local sources.

Agritech is an application of clean technology to the agricultural sector and Vancouver's agritech sector has spawned multiple award-winning companies whose innovative solutions are recognized globally.

Trends

Green Agritech

Semios is a leader in onsite sensors and predictive analytics for agricultural crops, allowing farmers to monitor the health of their fields from a cell phone. **Ecoaction's** Crop Sense software also sends updates about pests and diseases by monitoring plant physiology, chemical composition and photosynthesis. **Terramera's** non-toxic pesticide uses only natural plant defences to dramatically reduce harmful runoff from fields, while **gUAVs** uses drones to deter pest birds in B.C.'s blueberry farms. **Boost Environmental Systems** helps farmers break down organic material while producing greater volumes of biogas (green energy) and a high-quality fertilizer.

Smart logistics and shared services

Locavore culture and slow food are mainstays of Vancouver's local food scene, that has a seemingly insatiable demand for small-batch products. Businesses range from microbreweries and distilleries to artisanal manufacturers of ice cream, cheese, juice and fermented foods. These companies are supported by a robust food incubation network, including shared kitchens like **Commissary Connect**. Meanwhile, services like **West Coast Canning** help microbreweries with mobile canning and packaging, while **Direct Tap** provides kegs and distributions services, allowing small batch beers to make it to a wider market.

The **B.C. Food Connection** website matches small scale manufacturers with commercial kitchens and co-packing facilities.



VEC Program Spotlight

VEC delivered an Economic Development Strategy for the False Creek Flats, a diverse industrial area that is also home to 70 food-related enterprises and 'Produce Row', a critical food distribution cluster that delivers healthy, low cost food to urban dwellers and employs 1000+ people. The strategy provides a long-term vision for "the Flats" to become more productive, sustainable, and connected.

Urban Farming

The continued success of the local farmers markets indicates that shoppers are keener than ever to pay urban and local farmers directly – that is, to keep the money within the local economy. This trend is also driven by consumers' increased awareness of the carbon emissions associated with the growth, preparation and delivery of food. Limitations of space in Vancouver have led to some creative implementation of urban farming and gardens – a trend that took inspiration from the guerilla gardening movement.

Sole Food transforms vacant urban land into street farms that grow high-quality fruits and vegetables that supply local restaurants and markets. **Sky Harvest** grows microgreens and specialty greens on an organic-certified farm and delivers its products by bicycle to its local customers. **Victory Gardens** consults with urban residents on how to best build and maximise the productivity of their container and patio-top gardens.

Strong food incubation ecosystem

Vancouver hosted Canada's inaugural **Slow Money** conference in 2014, leading to a groundswell of new forms of investment in the local food ecosystem. **Feeding Growth** is an initiative led by the **UBC Farm** in partnership with **Vancity**. Its "Scale your Progressive Food Business" workshop series has been completed by 96 food entrepreneurs across 88 food enterprises.

Initiatives like **Knives and Forks Community Investment Coop**, one of B.C.'s first community co-investment (CIC) funds, provide mentorship and small loans to promising local food ventures.

Another local food micro-loan fund (administered by a partnership between **FarmFolk CityFolk**, the **Island Chef's Collaborative**, and **Vancity**) provides zero-interest microloans (\$1,000-\$20,000) to farmers, fishers, ranchers, harvesters and processors. **Bioenterprise B.C.** offers coaching, technical expertise and access to a global investor network for agritech businesses.

Demand for traceability along the supply chain

Vancouverites are also concerned with the ethics, quality and transparency of food supply chains: people seek out brands that are transparent about their ethical and environmental policies and practices.

SPUD uses its connections with local farmers to provide an online shopping and delivery service for fresh local produce. Its subsidiary, **Food-X**, serves as a sustainable warehouse and delivery option for third-party grocers. **Meatme.ca's** platform connects consumers with small-scale local farmers who raise their animals free range on natural pasture. Their delivery service allows people to claim portions of the animal being slaughtered, minimizing waste and emissions from factory distribution.

Sustainable kitchens like **Forage** source their ingredients from local wild food harvesters and small farms, and strive for zero-waste kitchens by advocating for the return of "nose-to-tail cooking" in which all parts of an animal are fully used.



8.5% of British Columbians have **VEGETARIAN DIETS** and just under 4% are vegan (University of Dalhousie poll, 2018)

13 **COMMERCIAL AND COMMISSARY KITCHENS** open for business (B.C. Food Connection, 2018)

500 companies are members of **B.C.'S SMALL SCALE FOOD PROCESSOR ASSOCIATION** (BCFPA, 2018)

GREEN JOBS

- » small batch food manufacturers
- » chefs
- » local food processors
- » urban farmers
- » microbrewery operators
- » food packers
- » farmers markets
- » culinary schools

B.C. FOOD PROCESSING

According to the B.C. Agrifood & Seafood Sector 2016 Snapshot, B.C.'s food processing sector generated \$14 B in sales, \$4.5 B in GDP and \$3.8 B in exports (B.C. Ministry of Agriculture, 2016)

Deep Dive: Alt Meat & Dairy

Consumer concern for animal welfare and the environmental and health impacts of meat consumption is high in Vancouver. Globally, the average person eats twice as much meat than is recommended, leading to an increase in obesity and type-2 diabetes.¹⁶ Meanwhile, the livestock industry contributes to 15 percent of global carbon emissions.¹⁷

Today, B.C. has Canada's highest concentration of vegetarians and vegans. This has spurred substantial local food science and innovation, as well as a dramatic increase in the local availability, diversity and quality of meat and dairy alternatives.

These include the development of cheese and dairy alternatives made by **Daiya Foods** – purchased by Otsuka Pharmaceutical for \$405 million – and **Vega**, which produces plant-based nutritional products and recently sold to WhiteWave Foods for \$706 million.

In addition to these trailblazers, other companies specializing in plant, nut and even insect-based products have proliferated in Vancouver. These include **Gardein**, makers of 'meatless meats'; **Sunrise Soya**, one of North America's largest tofu manufacturers and also one of the first to go GMO-free; and **Coast Protein**, which has brought cricket protein products to the mass market.

Other local artisanal manufacturers found a ready, willing market of Vancouver buyers for their plant-based, small-batch dairy and protein replacements. Among them are **Tempea**, local makers of unpasteurized tempeh; **Nuez**, makers of nut-based milk; **Umaluma**, serving plant-based gelato; and **SPREAD'EM** Kitchen, who provide cultured cashew-based products as an alternative to cream cheese spreads.

Financing

Investment Agriculture Foundation of B.C. | www.iafbc.ca

- **Canada-BC Agri-Innovation Program:** funding for industry, academia, value-added food processors and retailers for late-stage research; pilots and demonstrations; commercialization and adoption of innovative technologies
- **Agri-Food Future Fund:** funding for agri-tourism, environmental management, Aboriginal agriculture, food and beverage processing, agroforestry and emerging sectors
- **Agriculture and Agri-food Adaptation program:** funding for projects that allow sector to seize opportunities, respond to emerging issues, and pilot new solutions to remain competitive
- **Agri-Food Environment Initiative:** funding for wide range of environmental issues such as soil, air and water quality, wildlife and habitat, water conservation, re-use of by-products, use of pesticides
- **Food and Beverage Processing Initiative:** funding for wide range of projects that enhance industry competitiveness, build reputation of health and lifestyle-oriented products, or enhance industry networks
- **Agricultural Area Planning Program:** fund up to 50 percent of the cash costs of an agriculture area plan project, up to a maximum of \$45,000

Other funding programs

Bioenterprise B.C. | www.bioenterprise.ca

Maintains a global network of investors including; venture capital firms, angels, family offices, corporate venture arms, and financial institutions

FarmFolk CityFolk | www.farmfolkcityfolk.ca

FarmFolk City Folk, Island Chef's Collaborative and Vancity's Micro Loan Program: zero interest microloans of \$1,000 to \$20,000 for farmers, fishers, ranchers, harvesters and processors

The Kathi Fund | www.thekathifund.ca

Annual Award: \$1,000 cash award plus \$10,000 in creative services and mentorship for female entrepreneur

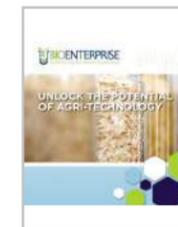
Knives and Forks Investment Coop | www.knivesandforks.ca

Provides mentorship and small loans

Vancity | www.vancity.com

Small Growers Fund: up to \$75,000 for farming operation or business closely connected to farming and local food

Further Reading



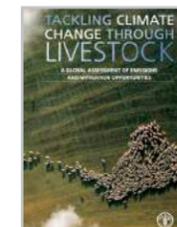
Unlock the Potential of Agri-Technology

BioEnterprise 2017



Vancouver Urban Farming Census 2014 - 2016

Vancouver Urban Farming Society 2017



Tackling Climate Change Through Livestock

Food & Agriculture Organization of the U.N. 2013

WHO TO WATCH

Boost Environmental Systems | www.boost-enviro.ca

Enhances energy and nutrient recovery from wastewater as a source of extra revenue

Coast Protein | www.coastprotein.com

Brings cricket protein products to the mass market

Commissary Kitchen | www.commissaryconnect.com

Food incubator that has spawned more food restaurants and companies than anyone else

Direct Tap | www.directtap.com

Provides logistics and delivery solution for local craft breweries and distilleries

Ecoation | www.ecoation.com

Pinpoints crop stress and extends the growers presence

Enterra | www.enterrafeed.com

Provides renewable animal feed from black soldier flies

Food-X | www.food-x.com

Serves as a sustainable warehouse and delivery platform for third-party grocers

Foodee | www.food.ee

Provides corporate lunches delivered by bicycle

Forage | www.foragevancouver.com

Sources ingredients from local, wild food harvesters and small farms for their sustainable, waste-averse restaurant

Gardein | www.gardein.com

Produces 'meatless meats' as a healthy protein option while championing sustainable diets

gUAVs | www.guavas.info

Unmanned Aerial Vehicle (UAV) system to disperse nuisance birds from crops

Meatme.ca | www.meatme.ca

Connects consumers to small scale local farmers who raise their animals free range on natural pastures

Semios | www.semios.com

Uses big data and predictive analytics to assist farmers to remotely monitor the health of their fields

Sky Harvest | www.skyharvest.ca

Grows organic microgreens and specialty greens on their urban farm and delivers by bicycle

Sole Food Street Farms | www.solefoodfarms.com

Transforms vacant urban land into street farms

Education & Training

Kwantlen Polytechnic University: Bachelor of Applied Science, Sustainable Agriculture and Food Systems; Institute for Sustainable Food Systems at KPU: Farm Business Planning

University of British Columbia: Master of Food and Resource Economics; Centre for Sustainable Food Systems at UBC Farm: Practicum in Sustainable Agriculture and 'Feeding Growth' workshop series

University of the Fraser Valley: Agriculture Technology diploma Bachelor of Agricultural Science, Horticulture major; Bachelor of Business Administration for Agriculture Management; Wide variety of certificates including Livestock Production, Milker Technician, Horticulture Crop Production and Protection, Berry Production, Field Vegetable Production and Integrated Pest Management

Vancouver Island University: Bachelor of Science in Fisheries and Aquaculture

Vancouver Urban Farming Society: Various events and workshops



VANCOUVER: A Sustainable Business Ecosystem

Vancouver businesses leverage a **strong ecosystem of sustainability-related services and resources** to achieve deep green operations

From its roots as a resource town, Vancouver has built out capabilities in environmental engineering, environmental assessments and site remediation that it has exported all over the world. Since then, spurred by a strong community focus on carbon, Vancouver has become an epicentre for contemporary services like carbon accounting, zero waste consulting and sustainability reporting.

Along with supportive regulations and a strong investment climate, this sustainable business ecosystem has provided the foundation for a business sector in Vancouver that excels in delivering green products and services while integrating deep green practices into its operations.

Entire industries in Vancouver differentiate themselves as world leaders based on their clean and green innovations. The Vancouver International Film Festival (VIFF) hosts an annual Sustainable Production Forum advancing a global reputation for green excellence both on and off screen. Tourism Vancouver promises a city that is “Spectacular, by Nature” and one committed to sustainable travel. The Sustainable Apparel Coalition will host its annual meeting in Vancouver in 2018.

As they reap the rewards of a triple bottom line approach, Vancouver businesses are confirmation that the green economy is a big opportunity.

Reporting and transparency

Measuring and communicating what a business is doing to achieve specific sustainability goals enhances accountability and trust. Increasingly, procurement processes will use environmental and social indicators to evaluate bids, and third-party certifications allow comparisons across businesses and industries.

A certification can more readily communicate complex sustainability efforts to end users, and most are industry specific. **Ecolabel Index** helps users evaluate the wide variety of third party certifications now available, and select those that are rigorous and respected. The **Climate Smart Business** program uses software, peer networks and consulting expertise to empower small and mid-sized businesses to measure, track and ultimately reduce carbon, energy, water, waste – and costs. Climate Smart’s carbon mapping tool, the ‘Business Energy and Emissions Profile’, helps communities identify opportunities for new energy infrastructure (e.g. electric vehicle charging stations) and programming (e.g. sector-specific climate action workshops). **B Corp** certification indicates rigorous standards in social and governance practices in addition to environmental goals, while **Loco BC**’s Community Impact Assessment evaluates local economic impact.

Beyond certification, networks such as **Buy Social Canada** match buyers and suppliers that are driven by social values, while **Blockchain For Climate** puts climate initiatives on the blockchain to verify offset projects and democratize carbon markets. Embedding sustainability into the very articles of incorporation, Community Contribution Companies can limit dividends to shareholders and distribute profits to community or non-profit entities, and B.C. may soon allow Benefit Corporation status which codifies responsibilities of social purpose, accountability and transparency.

Collaboration for industry transformation

Today industries need to rethink their value chains in order to stay relevant in a world with transformational technology, limited resources and a new energy paradigm. **The Leverage Lab** convenes stakeholders across a focal industry to collaboratively reimagine the way they work. The Apparel Textiles Leverage Lab (2016-17) spawned two new ventures, one new industry association, and a strong foundation for further collaboration.

Microbreweries in the booming craft beer sector have formed collaboratives to manage redistribution of spent grain to farmers for feed and soil amendment. **DirectTap** and sister company **FreshTap** provide shared logistics solutions for breweries, wineries, and cideries and enable restaurants to serve wine on tap, removing the need for individual wine bottles.

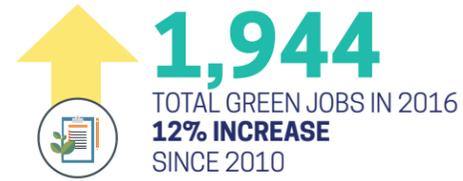
Keep It Green Recycling and **Green Spark Group** support film and television production with solutions like the Sustainable Lockup to securely store and redistribute set materials for reuse; while **Creative BC**’s Reel Green program delivers carbon literacy training to film industry professionals.



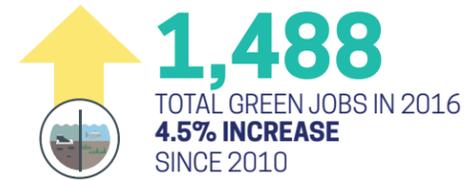
Vancouver’s Business Climate Pledge

In the lead up to the UN climate talks in Paris (“COP21”), 200 Vancouver businesses signed a pledge to demonstrate their support for strong climate action, including **Brinkman Climate, Eastside Games, Hootsuite, Hydra Energy, LUSH Fresh Handmade Cosmetics, MEC, Solegear, TELUS, Vancity** and the **Vancouver Aquarium**.

Job Growth: Sustainability Services



Job Growth: Environmental Engineering



VEC 2018 Vancouver Green Business Survey responses

- ZERO** 10% are greening their operations by striving to become zero waste
- 30%** have at least some products and/or services that restore or preserve the environment
- 36%** are diverting additional waste streams beyond what is regulated
- 61%** include social and/or environmental criteria in their purchasing decisions
- 82%** are motivated to reduce waste, conserve energy, and reduce emissions by concern for the environment
- 86%** consider it important to conserve energy

Financing a Green Economy

Vancity’s enviroFund invests five percent of profits into innovations addressing environmental issues. Investment firm **Changequity** will buy a carbon intensive company and transform it into a green business, as they did with **Novex Couriers** and **Westcoast Sightseeing**. **Active Impact Investments** and **Renewal Funds** invest in early-stage, mission-driven companies to catalyze social and environmental change. Even non-accredited investors can get involved by joining a Community Investment Co-op like **Knives and Forks**.

Businesses walking the talk

The Soap Dispensary, **Kitchen Staples** store and **Nada Grocery** offer bulk products for customers to purchase in their own containers. **Lunapads** makes their reusable menstrual products with minimal waste from sustainable fabrics and zero waste pattern making. **Ædelhard**’s custom suits and **wiivv**’s custom insoles use fitting algorithms and 3D printing to change the way we produce fashion, creating far less waste and speculative production.

Product as a Service

Begun as a Vancouver Tool Library project, **The Thingery** is a community-sourced and community-managed lending library operated in a modified shipping container, while **qupe** enables item lending between platform users. **Frogbox** (leasing sturdy plastic moving boxes) started in Vancouver in 2008 and is now operating in 21 locations in North America. Other lending services include **Flaunt Fashion Library** (dresses), **Lanyard Library** (lanyards), and **UmbraCity** (umbrellas).

A global hub

The biennial **GLOBE Forum and Expo** launched in Vancouver in 1990 and is the largest international conference and expo for sustainable business leadership in North America. In 2006, 12,000 people from 100 countries attended **UN-Habitat**’s World Urban Forum III; TED’s annual conference has been held in Vancouver since 2014. **Sustainable Brands** flagship event is in Vancouver in 2018, as is the **Sustainable Apparel Coalition**’s AGM and public forum.

VEC SUPPORT FOR VANCOUVER'S GREEN ECONOMY

Join us in growing the world's fastest-growing low carbon economy. Here is a selection of VEC's programs in the Green Economy space:

CAPITAL MENTORSHIP PROGRAM

Fast Track Your Fundraise

Capital Mentorship Program
www.vancouvereconomic.com/cleantech-capital

The Capital Mentorship Program delivers entrepreneur training, investor education and collaboration to increase investment activity in Vancouver's startup ecosystem. The first series of this program focused on raising seed and series A capital rounds.

"I was impressed with the quality of the founders I met and the depth of the technology being developed in Vancouver. What I saw helps reinforce our firm's thesis that the next wave of great software startups will come from the Cascadia region."

Frank Chang,
 Co-Founder & Managing Partner Flying Fish Partners

THRIVING VANCOUVER

a project of Vancouver Economic Commission

Thriving Vancouver
www.thrivingvancouver.com

Thriving Vancouver connects the Vancouver business community to curated resources, such as solutions providers, workshops, events and vendors, with the aim of empowering businesses to introduce sustainable options into their daily operations.

"VEC is a leading voice on how to grow the green economy here and abroad. They take innovation seriously and set a compelling tone for our future, helping businesses like ours grow with impact."

Elizabeth Sheehan,
 President ClimateSmart Business

GREEN & DIGITAL DEMONSTRATION PROGRAM

Accelerate your path to the global marketplace

Green & Digital Demonstration Program (GDDP)
www.vancouvereconomic.com/gddp

GDDP participants gain access to City of Vancouver assets for product testing and showcase opportunities. The GDDP enables successful applicants to refine solutions, attract investment and increase marketplace exposure while leveraging the City's \$31.5B green and innovative brand.

"GDDP is a technology partnership that eliminates traditional bureaucratic obstacles to innovation at the municipal level. The VEC acts as an external advocate, uniquely positioned to remove obstacles that would otherwise curtail innovation."

Jason Harmer
 CEO Get Workers

VANCOUVER STARTUP CITY

Vancouver Startup City
www.vancouvereconomic.com/startupcity2017

Vancouver Startup City increases access to funding and deal flow opportunities; investor networking; and startup education. Past programs have included Startup City: Capital and Startup City: Impact – both week-long activations of the Vancouver startup ecosystem.

"VEC provided Thomson Power counsel, encouragement and a sense of belief that Canadian technology companies belong in Canada and the ecosystem being built in Vancouver can support all of us bringing game changing innovative products to market. VEC has provided us with a voice, locally, provincially, federally and internationally."

Ian McAvoy,
 CEO Thomson Power

Endnotes

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- 2 World Bank Carbon Pricing Dashboard (accessed May 29, 2018)
- 3 Canada Green Building Council, 2014
- 4 Canadian Hydrogen and Fuel Cell Association, 2016
- 5 BC Hydro, 2018
- 6 University of Dalhousie poll, 2018
- 7 'Economic Impacts of the BC Property Development Industry in 2016', Urban Development Institute, February 2018
- 8 'B.C. Building Performance Study', Light House Sustainable Building Centre and B.C. Building Owners and Manager Association, February 2014
- 9 'BC Clean Energy Projects: Investment, Job Creation and Community Contributions' Clean Energy Association of BC, April 2016
- 10 'The Emissions Gap Report 2017', United Nations Environment Program, November 2017
- 11 UBS Global Autos Survey, November 2017
- 12 'Advanced Energy Storage for Automotive Applications', Navigant Research, 2017
- 13 'Changing Gears: Exploring the car sharing culture shift in Metro Vancouver', Vancity, January 2018
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- 15 'Global E-waste Monitor 2017', International Telecommunication Union of the United Nations, 2017
- 16 'Changing Climate, Changing Diets Pathways to Lower Meat Consumption', Chatham House, 2015
- 17 'Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities', Food and Agriculture Organization of the United Nations, 2013

Acknowledgments

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Sarb Mund, Commissary Connect
Ian Neville, City of Vancouver
Murray Penner, Gordon Food Services
Aaron Quesnel, Sky Harvest
David Ramslie, Integral Group
Mark Sakai, Greater Vancouver Home Builders Association
Eesmyal Santos-Brault, Recollective Consulting
Akua Schatz, Canada Green Building Council
Paul Shorthouse, Delphi Group
Darren Stott, Green Chain Consulting
Rebecca Till, Vancouver Parks Board
Dayna Wilkinson, Sysco

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