

Clean Transportation:

Findings and actions to
strengthen the sector in the
Metro Vancouver region

November 2021

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About Us

Invest Vancouver is the Metro Vancouver region's economic development leadership service, created to advance broadly shared prosperity for all residents of the region. This report has been prepared by Invest Vancouver, which offers independent, objective research, analysis, and economic development recommendations crafted to position the region for success in a rapidly evolving global economy; one in which capital is highly mobile and where firms have many choices about where to locate. The aim of the report is to provide actionable intelligence that will better inform and guide the strategic work of Invest Vancouver itself, as well as the work of key decision makers.

Invest Vancouver is a service of the Metro Vancouver Regional District, operating in support of the Metro Vancouver regional economy and the 2.7 million residents who depend on it.

I. Executive Summary

Advancements in clean transportation technologies are critical to reducing greenhouse gas emissions and addressing the ongoing climate emergency. The sector also presents an economic development opportunity, if the Metro Vancouver region can take urgent action to address obstacles faced by clean transportation firms seeking to start, locate or expand here.

The region is well-positioned for success, with a burgeoning clean transportation sector that includes strong entrants in particular niches and that has an advanced and growing hydrogen cluster. Invest Vancouver has undertaken this study as part of its work to build capacity in key industries in which the region has established and emerging industrial strengths, such as in the clean transportation sector.¹

The key asset in the region's clean transportation sector is talent; firms in the sector overwhelmingly report that they are present in the region because of the access to and the leveragability of the collected knowledge and experience in the workforce. That talent is developed, supported, and supplemented by strong ties to research institutes and universities, incubators, and accelerators.

Policies that incentivize the reduction of greenhouse gas emissions are helping to create a local market in the Metro Vancouver region for clean transportation vehicles, components, and services. The firms that meet this demand, however, don't necessarily need to be located in the region. To support a flourishing clean transportation industry, the Metro Vancouver region needs to be an attractive place for firms that have a choice about where to locate.

Urgent Needs:

- Streamline industry-relevant permitting processes
- Invest in industry-critical physical spaces
- Launch a hydrogen hub in the region

In the clean transportation sector as a whole, the most pressing challenges revolve around delays and uncertainty related to permitting and the general lack of available industrial land. [These obstacles need to be urgently addressed as their persistence risks seeing growing, successful firms unwilling to invest further in the region or leaving entirely when they cannot find suitable space.](#)

The region also has a unique opportunity created by the presence of firms along the entire hydrogen value chain, from supply, transportation, and storage through membranes, fuel cells, and testing. The Metro Vancouver region has an early lead in the area due, in large part, to the presence and growth of Ballard Power Systems and the ecosystem that has developed around it. Other locations around the globe are moving forward with hydrogen; however, and the region needs to help early- and development- stage firms, particularly with the establishment of a hydrogen hub, if these firms are going to grow and thrive here.

Invest Vancouver seeks to understand two aspects of clean transportation in the Metro Vancouver region: What competitive advantages (if any) do firms in this industry enjoy by locating here? And what barriers (if any) keep the region from being a more attractive place for firms that have a choice about where to site their headquarters and operations? These questions are addressed based on primary qualitative research, consisting of interviews with chief executives (CEOs), founders, and senior executives from clean transportation firms at all stages of development and ownership types. This process led to the formulation of 13 recommendations to support a thriving clean transportation sector in the Metro Vancouver region.

¹ For more on the regional economic development strategies pursued by Invest Vancouver, see the technical paper *Preparing Metro Vancouver for the Digital Economy*.

Recommendations Overview

Economic Development-Related Theme	Theme Urgency Level*	Key Recommendations
Talent Development and Training Programs	Low	<ul style="list-style-type: none"> Expand capacity within the BCIT Chemical and Environmental Technology program to increase the number of students graduating from 30 to 60 by 2025
Permitting Processes and Rules	High	<ul style="list-style-type: none"> Modernize permitting processes for projects to provide greater accountability, certainty, predictability, and reduced risk Update and harmonize rules governing hydrogen
Physical Spaces	High	<ul style="list-style-type: none"> Invest in industry-critical physical spaces to be leased to firms at below-market rates Amend the CleanBC Facilities Electrification Fund eligibility to include utility upgrades of warehouses to meet clean technology research and development (R&D) power needs
Financial Capital Formation and Access	Medium	<ul style="list-style-type: none"> Assess the capital formation and syndication relationships and network interactions within the region's clean transportation industry through predictive analytics work
Cluster Capacity Building Opportunities	High	<ul style="list-style-type: none"> Launch a hydrogen hub Fund a large-scale hydrogen powered heavy-duty vehicle demonstration project Establish a centre to assert global leadership in hydrogen certification Create certainty by establishing a long-term electric power rate for hydrogen production Expand eligibility for zero-emission vehicle (ZEV) subsidies to include hydrogen fuel cell vehicles Strive for technology-neutral rules whenever possible
Culture of Innovation	Medium	<ul style="list-style-type: none"> Encourage greater participation in "Project Greenlight" and other public-private partnerships to encourage a culture of innovation across the Metro Vancouver region

*The urgency level has been assigned based on the risk that the underlying gaps could prompt clean transportation firms to leave the region, or choose another location to set up or expand their operations.

II. Clean Transportation Overview

The Metro Vancouver region is home to a vibrant network of emerging and mature clean transportation firms, which collectively benefit from the push to lower and eventually eliminate harmful transportation-related emissions. The sector is supported by research universities, specialized academic programs, start-up accelerators and incubators, and government policies.

Progressive municipal, regional, and provincial goals, targets, and initiatives aimed at lowering greenhouse gas emissions, particularly those from transportation, help create and sustain a local consumer market for low- and zero-emission mobility products and services. Indeed, the transition to clean transportation is well under way, with zero-emission vehicles (ZEVs) accounting for 9.4 percent of all light-duty vehicle sales in the province in 2020, the highest rate of adoption of ZEVs in North America.²

Creating a local market for clean transportation, while vital to meeting climate goals, is distinct from building and scaling a clean transportation *industry*. More specifically, ZEVs and their components, plus the related infrastructure, fuels, and services being adopted in the Metro Vancouver region, do not necessarily need to be designed, sourced or built

locally. Firms located elsewhere, whether outside of the region or the nation, can and do meet many of these needs. **Supporting a clean transportation industry, therefore, begins with the recognition that firms serving global markets can choose where to site their headquarters, research and development (R&D) activities, and production facilities.**

To understand how to make the region an attractive place for clean transportation firms, consider the location decisions from their point of view. What is the cost and ease of doing business? How long does it take to get permits? Is a suitable location available? How difficult is it to find skilled workers? Are there opportunities to collaborate with and to transfer technologies out of research universities? Is it easy to connect with global suppliers, partners and customers? How is the access to capital? Are there investors? How hard will it be to find initial customers, especially for innovative early-stage products? This report considers these questions and more, with the **goal of identifying the challenges, roadblocks, and headaches faced by clean transportation firms in the Metro Vancouver region and recommending policies and actions to ameliorate them.**

² Province of British Columbia, Zero-Emission Vehicle Update 2020.

Layout and Methodology

This report seeks to understand two aspects of clean transportation in the Metro Vancouver region: What competitive advantages (if any) do firms in the industry enjoy by locating here? And what barriers (if any) keep the region from being a more attractive place for firms? Answering these questions is critical for economic development, public policy, industry and labour association, and education and workforce development decision-makers. A purely statistical approach, such as an industry contribution analysis, would provide an estimate of economic, job, and fiscal impacts of clean transportation firms, but would not address competitive advantages or barriers. Indeed, there is no quantitative approach that will zero in on the answers to these specific questions.

Instead, this report is based on primary qualitative research, consisting of interviews with chief executives (CEOs), founders, and senior executives from clean transportation firms at all stages of development and ownership types, including, in certain instances, firms that no longer exist because they were acquired, or because they folded. Invest Vancouver conducted in-depth interviews lasting from 30 minutes to more than an hour covering everything from business climate, infrastructure, physical spaces, capital, and workforce, to network organizations, R&D, suppliers and customers. Interviewees were encouraged to discuss the production and strategic gaps they have encountered along the product / service value chain continuums, from "idea" to "export", in this industry.

Firms were identified for inclusion using existing industry resources and relevant news articles; by suggestions from local government members of the Invest Vancouver Advisory Committee; from industry associations and their memberships; by examining

and classifying job postings aggregated by Emsi Analyst; by querying the PitchBook database of firms; and by reviewing relevant company materials.

Invest Vancouver met with interviewees from almost one-third of the region's clean transportation firms. The interviewees' experiences and insights underpin the report findings, and have not been attributed to specific individuals or firms to encourage candid discussion. Additional information was collected in helpful discussions with: the B.C. Ministry of Energy, Mines and Low Carbon Innovation; BC Hydro; FortisBC; and the Port of Vancouver, as well as with multiple industry associations.

Unless explicitly stated otherwise, the characterization of the industry gaps, and Invest Vancouver's recommendations for addressing them, do not represent the official policy or position of any of the firms, associations, or government entities mentioned in this report.

The report is presented in two sections. The first provides an overview of the clean transportation firms in the region, as well as the supporting assets that make it an advantage to locate, expand, hire and/or re-invest in the region. This section was prepared based on secondary research, including a literature review of previous studies supplemented with data from Emsi Analyst and PitchBook, and verified in discussions with the interviewees. The second describes the barriers preventing the region from being more attractive to clean transportation firms at different stages of firm development, and Invest Vancouver's specific, deployable recommendations for addressing them.

Identifying Clean Transportation Firms Based in the Metro Vancouver Region

The clean transportation sector is comprised of firms that are working to decarbonize transportation and to reduce greenhouse gas emissions. Following previous work done in this area, Metro Vancouver's clean transportation sector is divided into three categories: low- and zero-emission vehicles and components; renewable and low carbon fuels and charging infrastructure; and transferable technologies and services.

With these categories as a guide, deciding which firms to include still made for some hard choices. To be included, the firms have to be working on transportation (or an input to transportation, such as biofuels); their product, process, service, or technology needs to be exportable; and the firm

has to be located in the Metro Vancouver region. Thus, local firms doing valuable work on renewable electricity, such as run-of-river hydroelectricity and tidal power, are not included despite the important contribution of clean energy to green transportation. Nor are firms doing innovative work on metal-air batteries, which are not primarily intended for transportation uses. There are firms providing mobility as a service that are helping reduce greenhouse gas emissions directly, for example by sharing electric cars or bikes, or indirectly by reducing demand for fossil fuel powered trips, that are not included because their focus is on the local market. And some leading B.C. companies in renewable fuels, for example, are not included because they are based outside the Metro Vancouver region.

Image credit: Breeze Traffic



Clean Transportation Firms in the Metro Vancouver Region

In total, there are at least 60 export-oriented firms, of which 52 are firm headquarters, in the three above-identified clean transportation categories across the region. As locally anchored firms grow, their activity has major positive impacts, with a direct effect not only on employment, tax revenue, and earnings, which flow to the headquarters, but also on the municipalities in which they locate as they become part of the local social and community fabric. Region-wide, these firms directly employ more than 2,800 people,³ and sustain many more indirect

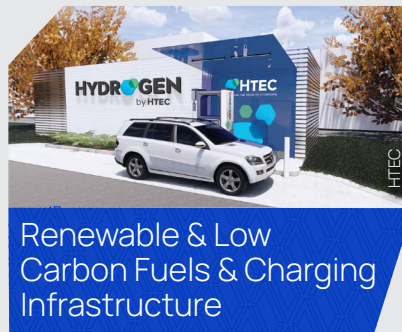
and induced jobs, which are created when the firms and their employees make purchases of goods and services in the local economy.

As a group, the firms are relatively young – 70 percent were founded in the past 15 years – which is unsurprising for an emerging field such as clean transportation. And, the presence of so many new and early-stage firms helps explain the median firm size of 21 employees.

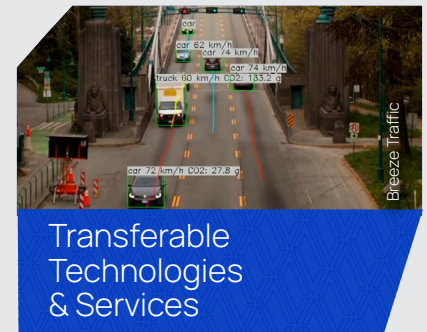
Figure 1 lists firms in each clean transportation category in the region.



Alinker, AVL Fuel Cell Canada Inc., Ballard Power Systems, Blue-O Technology, cellcentric, Corvus Energy, Damon Motorcycles, ElectraMeccanica Vehicles, FTXT Energy Technology, FVT Research, GreenPower Motor Company, Grin Technologies, Ionomr Innovations, Loop Energy, Molicel, Nano One Materials, Rivian, Robert Allan Naval Architects and Marine Engineers, Sandvaul, Unilia Fuel Cells, VeloMetro Mobility



AddEnergie Technologies, Analytics Systems, Consolidated Biofuels, Daanaa Resolution, Delta-Q Technologies, Ekona Power, Electrum Charging Solutions, Enbala, EverGen Infrastructure, G4, Greenlane Renewables, Greenlight Innovation, HTEC Hydrogen Technology and Energy Corporation, Hydra Energy, Hydrogen in Motion, IRDI System, Lab 498 Products/VoltSafe, Palcan Power Systems, Parkland Fuels, Powertech Inc, Quadrogen, Recharged Technologies, Shift Clean Energy, Tandem Technologies, West Coast Reduction, Westport Fuel Systems



7 Generation Capital, Breeze Traffic, Freightera, Greenline Technologies, Liftango, LOOPShare, Mojo, Plugzio, Poparide, Routific, Spare, Uplight, VuLog

Firms identified in green are within the hydrogen cluster.

Figure 1: Clean Transportation Firms by Category in the Metro Vancouver Region

³ The direct employment number will soon be higher still, as many of the firms report they are hiring now and/or expect to add more people soon.



The internal combustion engine-based automotive manufacturing industry, including suppliers of parts and components, is highly concentrated in central Canada. Ontario accounts for virtually all light-duty passenger vehicles produced in Canada, while Quebec leads in recreational, heavy-duty, and speciality vehicles, plus buses. Given the deep supply chains and concentrations of talent there, it is unremarkable that Ford and GM are investing in battery electric vehicle production in Ontario.

The production of low- and zero-emission vehicles and components in the Metro Vancouver region, in contrast, is comprised of firms working in specialized niche markets. Surrey-based Damon Motors, for example, will soon begin commercial production of high-end electric motor cycles; Pitt Meadows-based FVT Research designs and installs electric drives that convert underground mining equipment to ZEVs; Vancouver-headquartered GreenPower Motor Company supplies electric buses; and Vancouver-based Robert Allan Naval Architects and Marine Engineers designs (among other things) electric tugboats. There is also an impressive collection of firms working on all aspects of hydrogen fuel cells, headlined by Burnaby-based Ballard Power Systems, cellcentric, and Loop Energy.

In renewables and low carbon fuels and charging infrastructure, there are firms working on renewable natural gas and biogas (such as Burnaby-based G4 and Quadrogen) and low carbon fuels (such as Burnaby-based Parkland Fuels, which uses feedstock from West Coast Reduction to produce biodiesel). Also batteries (Maple Ridge-based MoliceL makes batteries for a variety of uses, including transportation) and battery chargers (Burnaby-based Delta-Q). Firms working on all aspects of hydrogen production and storage (such as Vancouver-based Ekona Power, Vancouver-based Hydrogen in Motion, North Vancouver-based HTEC, and many others) comprise the largest group in this category.

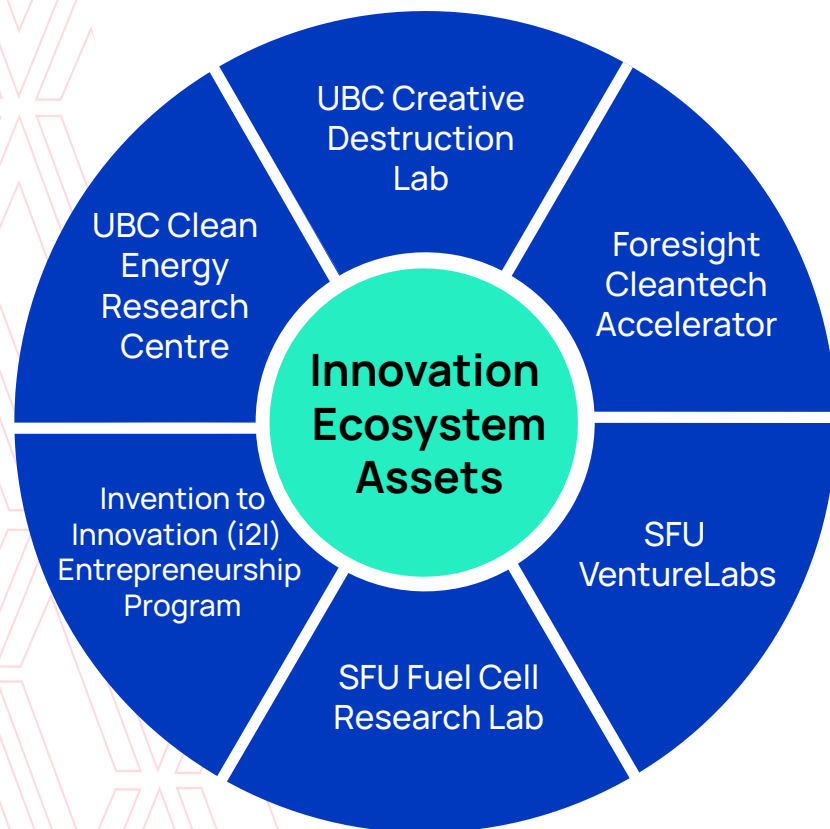
Transferable technologies and services is a small but exciting collection of firms working on clean transportation-related apps, software, technologies, and services. Vancouver-based Breeze Traffic, for example, converts “dumb” intersections to smart ones that can be optimized to reduce vehicles emissions using AI and machine vision; Richmond-based Plugzio sells a smart outlet and billing service that allows building owners to charge electric vehicle owners for power; and Vancouver-based 7 Generation Capital offers turn-key electric vehicle solutions for fleet operators.

Clean Transportation Assets in the Metro Vancouver Region

Firms across the clean transportation sector identify their top reason for locating in the Metro Vancouver region as frictionless access to skilled, “ready to work” talent. Firms started or moved here to take advantage of the knowledgeable and experienced workforce. In particular, the region has deep pools of talent in the following occupational categories: mechanical systems engineers; infrastructure team leads; fuel

systems engineers; test engineers; and research scientists/engineers. The region’s clean transportation sector is further supported by an active network structure and strong ties to research institutions and accelerators (see figure 2). Interviewees from firms in all three clean transportation categories praised the local innovation ecosystem.

Figure 2: Innovation Ecosystem Assets in the Metro Vancouver Region



Capital Investment

From 2017 through to 2021, firms headquartered in the region attracted more than \$2.6 billion in capital investment (see figure 3).⁴ This investment activity has been concentrated in low- and zero-emission vehicles and components (67%); followed by renewables and low-carbon fuels and charging infrastructure (29%), and transferable technologies and services (4%). The largest deals year-to-date are highlighted in the box (see figure 4).

Capital Investment (2017-2021)

Investment in Firms Headquartered in the Region		
Year	\$ invested (millions)	Deal count
2017	94	22
2018	271	7
2019	102	19
2020	663	21
2021	1,536	16

Source: PitchBook 2021

Figure 3: Capital Investment in Firms Headquartered in the Region

2021 Deal Highlights

- \$922M cellcentric (Daimler Truck AG and Volvo Group)
- \$217M HTEC
- \$139M Westport Fuel Systems
- \$100M Loop

Source: PitchBook 2021

Figure 4: 2021 Deal Highlights

⁴ The actual total is likely much higher, due to limitations with PitchBook which doesn't include, for example, a situation where a firm from outside the region sets up a new operation here.

Public Sector Financial and Technical Support for the Clean Transportation Sector

B.C. Hydrogen Strategy is setting the course for B.C. to be a world leader in the growing hydrogen economy.

Scientific Research and Experimental Development (SR&ED) tax programs to encourage Canadian businesses of all sizes and in all sectors to conduct R&D in B.C. and Canada.

B.C. Low Carbon Fuel Standard provides a financial incentive for low carbon fuel use. This generates revenue for low carbon transportation fuel suppliers and supports investment in clean fuels and vehicles.

CleanBC Go Electric Advanced Research and Commercialization (ARC) program supports the development of companies operating in the zero-emission vehicle (ZEV) sector.

B.C. Centre for Innovation and Clean Energy will be an incubator for the research and commercialization of technologies, including carbon capture, utilization and storage, production and distribution of low-carbon hydrogen, biofuels, synthetic fuels, renewable natural gas and battery technologies.

BC-SMART Low Carbon Fuels Consortium brings together industry, the provincial government and UBC to encourage the production and use of drop-in biofuels to decarbonize long-distance transport.

III. Findings and Recommendations

Talent Development and Training Programs

Findings

The clean transportation sector requires specialized knowledge covering a wide range of occupations along the educational attainment continuum, including: mechanical and systems engineers; research scientists; technologists; machinists and technicians; and technical experts in areas ranging from software development to clean energy processes. The quality and specialization of the talent available in the Metro Vancouver region have been major draws for firms choosing to locate here. This is especially true of the hydrogen sector, where the engineering expertise in the region leads the world. Indeed, one firm described choosing to locate in the Metro Vancouver region “as a shortcut,” because the ability to hire skilled engineers with hydrogen fuel cell expertise shaved years off its development schedule. Accordingly, this has also led to aggressive firm-to-firm competition for experienced engineers, with firms “poaching” talent from each other.

And while the clean transportation sector represents an attractive field for people looking for a career that contributes to a more sustainable future, the Metro Vancouver region faces significant challenges retaining talent and attracting new workers from outside the region due to the high overall cost of living, and in particular, high housing costs. This is especially seen in mid-career-level talent for in-demand positions, such as mechanical engineers, where a lack of affordable single-family homes deters relocations to the region. This could become an acute constriction point on growth as more affordable locales, such as the Calgary and Edmonton metropolitan regions, look to compete in the clean energy space, particularly in renewable natural gas (RNG).





Image credit: Damon Motors

In-Demand Hard Skills in the Hydrogen Cluster:

- New Product Development
- Mechanical Engineering
- Supply Chain
- Chemistry
- Instrumentation
- SolidWorks (CAD)
- Thermodynamics
- Chemical Engineering
- Data Analysis

Source: Emsi 2021.1

Figure 5: Top Hard Skills Identified in Hydrogen Sector Job Postings 2018-2021.

Technologists are an in-demand occupation in the region's hydrogen sector, with skills such as chemistry and instrumentation being highly sought after (figure 5). Technologists are also a critical component in the R&D phase of emerging clean energy technologies, such as hydrogen and biofuels. The British Columbia Institute of Technology (BCIT) Chemical and Environmental Technology program was

specifically referenced during the interview process as an excellent program that graduates approximately 30 'ready to work' individuals per year in emerging clean energy fields. Often students graduating from this program have secured employment long before graduation, as their skill sets are in short supply. Fostering in-region talent is a critical step in offsetting the Metro Vancouver region's out-of-market talent attraction issues, as Metro Vancouver-based talent is often less willing to leave the region, housing challenges notwithstanding.

Recommendation:

[Expand capacity within the BCIT Chemical and Environmental Technology program to increase the number of students graduating from 30 to 60 by 2025.](#) A shortage of available technologists within the clean transportation sector has led to engineers and research scientists being underemployed as technologists. While BCIT currently does not have any plans to expand the program, it is in the midst of a program and curriculum review. That the program's graduates are effectively "over-subscribed" is clear evidence it is aligned with industry needs; increasing the capacity of such an industry-responsive program (or creating a similar program at another college or university campus) seems to be an easy choice.

Permitting Processes and Rules

Findings

Mirroring the experience of firms in other fast-growing industries, clean transportation firms are routinely encountering problems securing required permits in a timely fashion. Transferable technologies and services firms, whose physical space requirements are often modest, faced the least trouble, while those in renewable fuels and hydrogen reported the greatest difficulties. The process of getting permits for working with (and in particular, storing) hydrogen has been described by industry interviewees as “ridiculous,” “frustrating,” and “dreadful”. In a related problem, existing regulatory regimes do not always account for hydrogen, as in rules covering the sale of gasoline and diesel at gas stations, which understandably did not anticipate the sale of hydrogen.

Interviewees were candid in describing the importance of a clear, timely, technology-based permitting process. One interviewee described the permitting issue as an “almost certain barrier to further in-region investment,” and several interviewees acknowledged that their firms were adding space outside of the region in locations where permitting processes are perceived to be less onerous. The uncertainty, lack of transparency, and delays encountered in the permitting process could deter additional investments made in-market. Fixing burdensome and time-consuming permitting processes should be a top priority.

Recommendations:

[Modernize permitting processes for projects to provide greater accountability, certainty, predictability, and reduced risk.](#) Delays to obtaining permits are a significant barrier to success for clean transportation firms and risk future investments in this sector. A modernized approach needs to be implemented

for the region to compete in this global market. As an example, Surrey City Council recently approved guaranteed permitting timelines as part of a shift to a more customer service-focused approach that includes multiple best practices such as:

- single point of contact / one project, one planner
- pre-application meetings
- enhanced digital service
- improved communications, including more regular permit status updates

A similar initiative of process reform should be considered by other cities within the Metro Vancouver region that are interested in attracting more clean transportation investment. Invest Vancouver will support this effort by conducting a best management practices scan of municipal permitting processes elsewhere in Canada and globally with the aim of identifying promising permit approval approaches that competitive firms expect when selecting a business location.

[Update and harmonize rules governing hydrogen.](#)

There is currently a patchwork approach across the region to the rules governing hydrogen. Through relevant industry associations, such as the Canadian Hydrogen and Fuel Cell Association, industry and government should collaborate on a set of sample “model regulations” covering the distribution and sale of hydrogen that can be broadly relied upon, locally adapted, and eventually adopted by municipalities across the region.

Physical Spaces

Findings

Suitable physical spaces are in critical need for clean transportation firms, especially those that are engaged in industrial activities, such as storing of hydrogen and testing of hydrogen fuel cells or other clean energy processes including RNG or biofuels. The vacancy rate for industrial land region-wide has fallen below one percent (see figure 6), which is reflected in interviewees reporting site searches taking 12 to 18 months, or more. The problem is especially acute for light and heavy industrial spaces; the latter of which is required for chemical processes, for example, involved in low pressure hydrogen storage. Spaces larger than 50,000 square feet are particularly in need but hard to find, and those larger than 100,000 square feet are simply unavailable, which precludes many anchor-potential firms from considering and/or investing in the region.

Given these market conditions, it is unsurprising that many interviewees reported feeling “lucky” to have found the space(s) that they currently occupy. Policy makers should be worried about potential new entrants to the industry or market who are not as lucky, as well as existing firms looking to expand. All of the interviewees from firms in the hydrogen cluster, and many of those from non-hydrogen firms, reported their firms were growing, adding employees, and looking for space. If they were not currently looking for space, they expected to be looking within the next several years. If they are unable to find suitable industrial space in the region, these firms will be forced to look elsewhere, however deep the local pool of specialized talent.

Beyond issues of scarcity and cost, industrial land policy presents myriad challenges. From the perspective of clean transportation firms, they need options. As employers, they want centrally located, transit accessible sites that avoid burdening their employees with long commutes. Some firms working on RNG and hydrogen have addressed these needs by effectively converting warehouse space into de facto R&D spaces with addition of higher capacity electrical service. (Testing their prototypes, for example, requires considerably more power than is supplied to a typical warehouse, so the building's power supply has to be upgraded.)

Industrial Lands in Metro Vancouver

- Industrial lands comprise 4% of the region's land base, and accommodate 27% of the region's jobs.
- Industrial land prices in Metro Vancouver are amongst the highest in North America.
- Industrial jobs pay 10% higher than the regional average
- Business activity on industrial lands generates 30% of the region's total Gross Domestic Product (GDP).
- The Q3 2021 vacancy rate for industrial land in Metro Vancouver was 0.5%.

Sources: Metro Vancouver, Colliers

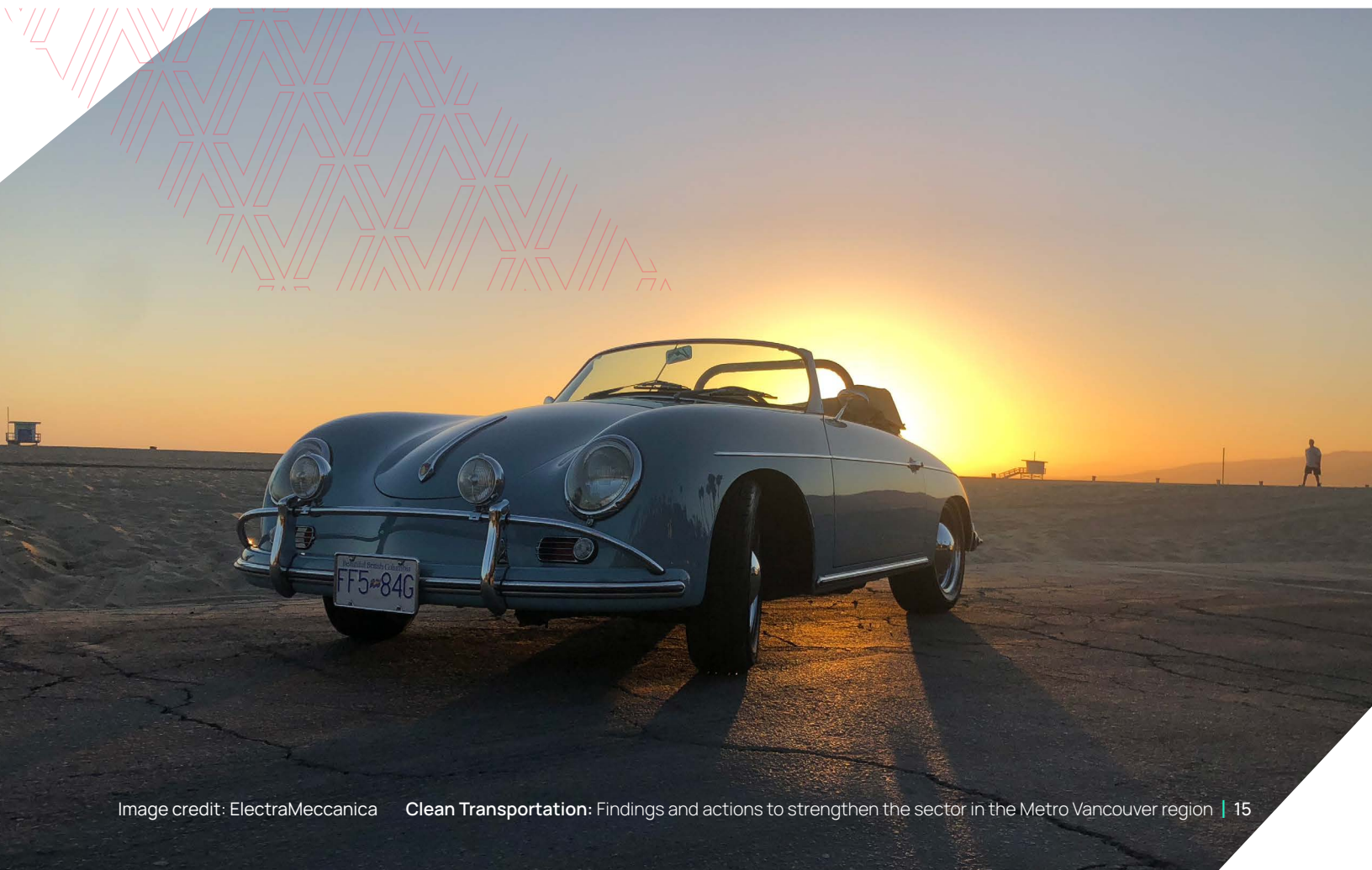
Figure 6: Industrial Lands in Metro Vancouver

Recommendations

Invest in sector-critical physical spaces to be leased to firms at below-market rates. For example, to assist with applied/translational research, prototyping, design, commercialization, production, and market penetration, the recently announced InBC fund should carve out a portion of the assets under management to invest in building or renovating clean transportation sector-supporting physical spaces, such as sites with hydrogen storage, and leasing them to clean transportation firms at below-market rates. Unlike investing directly or indirectly, through a fund-of-fund strategy or otherwise, in start-up and development-stage firms, investing in physical assets, such as sector-supporting facilities, would serve many vintages of start-up and development-stage firms, while providing the fund with an appreciating asset

and coupon (in the form of lease payments) that could be re-invested in the fund.

Amend the CleanBC Facilities Electrification Fund eligibility to include utility upgrades of warehouses to meet clean technology R&D power needs. To reduce barriers to suitable industrial spaces, the eligibility of the CleanBC Facilities Electrification Fund should be amended to include clean technology R&D firms as eligible to receive a subsidy to upgrade their utility connections to meet their sizable power needs. Reducing the financial burden of having to upgrade warehouse spaces to suit their power needs will provide the clean transportation sector's R&D-intensive firms with more options when it comes to finding physical spaces in the region.



Financial Capital Formation and Access

Findings

For firms operating in a globally competitive environment, access to debt, equity or specialty financial capital is a crucial input at every stage along a firm's development life-cycle. Many interviewees cited access to capital as a particular challenge. Fortunately, many of the interviewees said their firms have recently closed or are about to close funding rounds.

Generally, interviewees expressed support for the clean technology-related funding programs available through the federal and provincial governments, while still describing them as "difficult to access," even for interviewees who are serial entrepreneurs who have successfully secured funding from the same public sources for previous ventures. Some interviewees believed there is a public funding bias against certain clean fuel technologies, including hydrogen, associated with government funding programs. In addition, some interviewees also voiced concern that the financialization of real estate and the continued price escalations across most segments of the real estate market, with its potential for comparatively "quick and easy wins," were crowding out investment in other industries, including clean transportation.

Other interviewees expressed disappointment that despite the perceived environmentally conscious resident population of the province, local investors have been less willing to invest in clean transportation technologies compared to investors from the European Union and China. For some clean transportation firms, where the investment and demonstration opportunities for their technologies are coming from other countries, relocating out of the region becomes a more attractive option.

This was the case for Corvus Energy (Corvus), the battery technology company that found a receptive audience in Norway. In 2019, Corvus relocated their headquarters, effectively becoming a Norwegian company, with all the direct and downstream value-added economic benefits flowing to Norway instead of the Metro Vancouver region.

Finally, interviewees that had successfully built and 'exited' companies in the past were more easily able to navigate the capital finance and investing ecosystem due to relationships formed in past roles. This relationships-based funding often excludes women and communities of colour, who may be excluded from or not have access to the same network that traditionally offer connections to investors.

Recommendations

[Assess the capital formation and syndication relationships and network interactions within the region's clean transportation industry through predictive analytics work.](#) Private capital access, formation, and redeployment ('post-exit', for example) in the clean transportation sector, as well as across other industries in which the Metro Vancouver region has specialization, is a hotly debated issue; some believe there is a systemic lack of proof-of-concept, 'pre-seed', and 'seed'-stage capital in the Metro Vancouver region, while others believe the more pressing problem is not having enough "investment worthy" firms. And, of course, both could be equally or unequally true. This requires further analysis, as the economic development strategies differ markedly depending on what is found. For this reason, Invest Vancouver is undertaking a major investigation of the role of capital in this and other industries as a prelude to developing recommendations in this area.

Cluster Capacity Building Opportunities

Findings

A hydrogen-based industry cluster has developed in the Metro Vancouver region, encompassing all aspects of the hydrogen ecosystem, including production, transport, storage, membranes, fuel cells, testing, and consulting. Firms in the industry cluster have been attracting private capital investment and adding employees. The sector is poised to become an economic driver for the region if pressing challenges can be overcome, such as:

- breaking the supply/demand deadlock;
- creating opportunities to demonstrate hydrogen technology in the region; and
- addressing the lack of industrial space and resolving the difficulty with permits, as discussed above.

The growing hydrogen industry cluster represents a lucrative economic and fiscal opportunity for the region (see figure 7), as it is well positioned globally since so few other economic regions have an equally concentrated cluster of firms working with hydrogen. A concentration of firms in the same industry (or adjacent, complimentary industries) can foster the cross-pollination of ideas and create a reinforcing cycle where skilled workers are drawn to a regional industry's pooling of employment prospects in their respective fields, and new firms are attracted to or created by the collected pool of talent. This dynamic can be seen in the constellation of firms founded by former Ballard Power Systems employees, and the arrival in the region of AVL (an Austrian firm that is the world's largest independent powertrain company), as well as the joint venture between Daimler Truck and Volvo Group, cellcentric.

As touched on above, the hydrogen industry cluster's greatest strength is the presence of an unparalleled collection of experienced workers. It is bolstered by strong ties to the University of British Columbia (UBC),

Simon Fraser University (SFU), and BCIT, along with locally-allied industry associations and accelerators, and the industry stands to benefit from provincial, and federal hydrogen strategies.

It is estimated that by 2050 clean hydrogen will make up as much as 25 percent of the world's net-zero energy mix, generating a **\$20 trillion** infrastructure investment opportunity, new technologies, companies, jobs, and ultimately a cheaper energy system.

Source: Bloomberg New Energy Finance

Figure 7: the Future Hydrogen Economy

Yet, the development of the region's hydrogen industry cluster is at a critical juncture. The industry is plagued by a classic 'chicken-and-egg' problem with respect to supply and demand; namely, there is little incentive to supply hydrogen without demand, and such demand will never materialize without the promise of a steady supply. Access to readily available green hydrogen in the region (taking advantage of B.C.'s abundant supply of clean electricity) would encourage the testing of new technologies to lower greenhouse gas emissions, such as within heavy-duty vehicles. Firms that are pressing ahead with supply face multiple challenges, particularly with respect to regulations that do not account for hydrogen as a fuel.

Firms based here have to look elsewhere for demonstration opportunities, most notably in the Province of Alberta and countries, such as Italy, Germany, and China. One interviewee likened the situation in hydrogen to "trying to demonstrate a new computer graphics card by pointing to shelves full of computer parts in a room without an electrical outlet." Even more important than the obvious need to demonstrate new technologies, firms need opportunities for real-world testing. Multiple



Image credit: HTEC

interviewees stressed the importance of being able to test (and refine) their technologies closer to home. Deploying hydrogen applications in-region would be a powerful indication of support for the industry.


Permits and suitable workspace challenges (as described above) are acute for firms working with hydrogen. There is a real risk that unless these challenges can be overcome, firms will drift away one location, demonstration project, or permitting decision at a time, as happened with Corvus (described above).

Recommendations

Launch a hydrogen hub. Getting a reliable in-region hydrogen hub established in the Metro Vancouver region is a crucial component of the B.C. Hydrogen Strategy. The strategy emphasizes the importance of co-locating hydrogen production with end-use applications. In collaboration with the Ministry of Energy, Mines and Low Carbon Innovation and the Canadian Hydrogen and Fuel Cell Association, Invest Vancouver has agreed to convene member-municipalities to accelerate this project. Municipalities should support this effort as both a major economic development opportunity for the region's clean transportation sector and an opportunity to decarbonize hard-to-decarbonize sectors of the economy.

Fund a large-scale hydrogen powered heavy-duty vehicle demonstration project. No one wants to be the “first mover” on what are perceived to be unproven technologies. So understandably, municipalities and the Port of Vancouver are conservative in their procurement and purchasing decisions, and, for this reason, expecting them to commit huge sums to purchase early-stage technologies may not be realistic. The province, however, should purchase a small fleet (for example) of heavy-duty hydrogen-powered vehicles for lease to interested municipalities. By shifting some of the financial risk associated with early adoption, such a strategy might help encourage more expansive local deployment. And scaling up from tests to production will eventually help move hydrogen technologies along the cost curve towards lower prices and, most important, early deployments will serve as in-region ‘test beds’ for locally developed technologies. This is one way to move the industry along the development continuum from start-up stage, to development-stage, to commercial-stage, to production-stage, to global export-stage.

Establish a centre to assert global leadership in hydrogen certification. Create a centre that can test fuel cells and balance of plant components to the specifications of the U.S. Department of Energy, the European Union (“harmonized protocols”, FCH-JU), and Japan (NEDO). The goal should be to follow the path in solar energy testing and certification blazed by Germany, and create accredited hydrogen



certification labs, such as the Fraunhofer Institute of Solar Energy Systems does for photovoltaics. This would deepen the R&D, design, and prototyping capacities of the hydrogen industry cluster here in the province, attract work from major original equipment manufacturers, and provide additional “stickiness” to the industry in the region. (Powertech Labs does some of the only global balance of system certification work and would be a logical partner.)

[Create certainty by establishing a long-term electric power rate for hydrogen production.](#) The new CleanBC industrial electrification rates offered by BC Hydro provide up to seven years of discounted power for industries setting up or expanding operations in B.C., including hydrogen. With the cost of major industrial facilities amortized over decades, it makes sense to create a matching, longer-lived rate structure as an incentive for “first movers” assuming the risk of building facilities for water electrolysis production of hydrogen in B.C. Certainty around the cost of green hydrogen production through electrolysis will act as signal to investors that hydrogen is a priority area for the province. Additionally, as more capital is invested in the production of hydrogen, technological improvements will be made and the cost of producing hydrogen will decline. Encouraging in-region production of green hydrogen will also mean that the need to use out-of-province higher carbon-intensity gray or blue hydrogen will decline in the region.

[Expand eligibility for ZEV subsidies to include hydrogen fuel cell vehicles.](#) Due to accelerating gains in productivity, specialization, and experience, hydrogen technologies will likely follow the same declining price per unit trend of other clean technologies, such as solar panels and electric vehicles. For now, hydrogen

technology is earlier along the price curve (meaning it is more expensive), so the price cap for ZEV rebates, which were intended to prevent the public from subsidizing luxury battery electric vehicles, excludes fuel cell vehicles. The province should consider setting a provisionally higher limit for ZEV rebates specific to fuel cell vehicles, which would then decline over time as those productivity and other gains are realized and prices decline. This would have the effect of encouraging the use of hydrogen fuel cell vehicles in the province and Metro Vancouver region, providing industry with the opportunity to demonstrate their technologies and advancing improvements to bring the price down.

[Strive for technology-neutral rules whenever possible.](#) With rapidly changing technology, it is important to avoid locking in or locking out potential technological solutions, especially when the excluded ones just might beget entirely new industry sectors. For example, burning green hydrogen in a modified internal combustion engine is omitted from the provincial Commercial Vehicle Pilot program, and the Motor Fuel Tax regulation provides an exemption for hydrogen, but only “when used in fuel-cell vehicles.” There is broad scope for applying this technological neutrality principle with respect to hydrogen in particular, and clean transportation in general. Technology-neutral policies should be standard, sending the signal to entrepreneurs and start-up companies all over the world that British Columbia offers a competitive landscape that values and wants you, your firm, and your intellectual property (and potential royalties) to come innovate, build, scale, headquarter, and export from here.

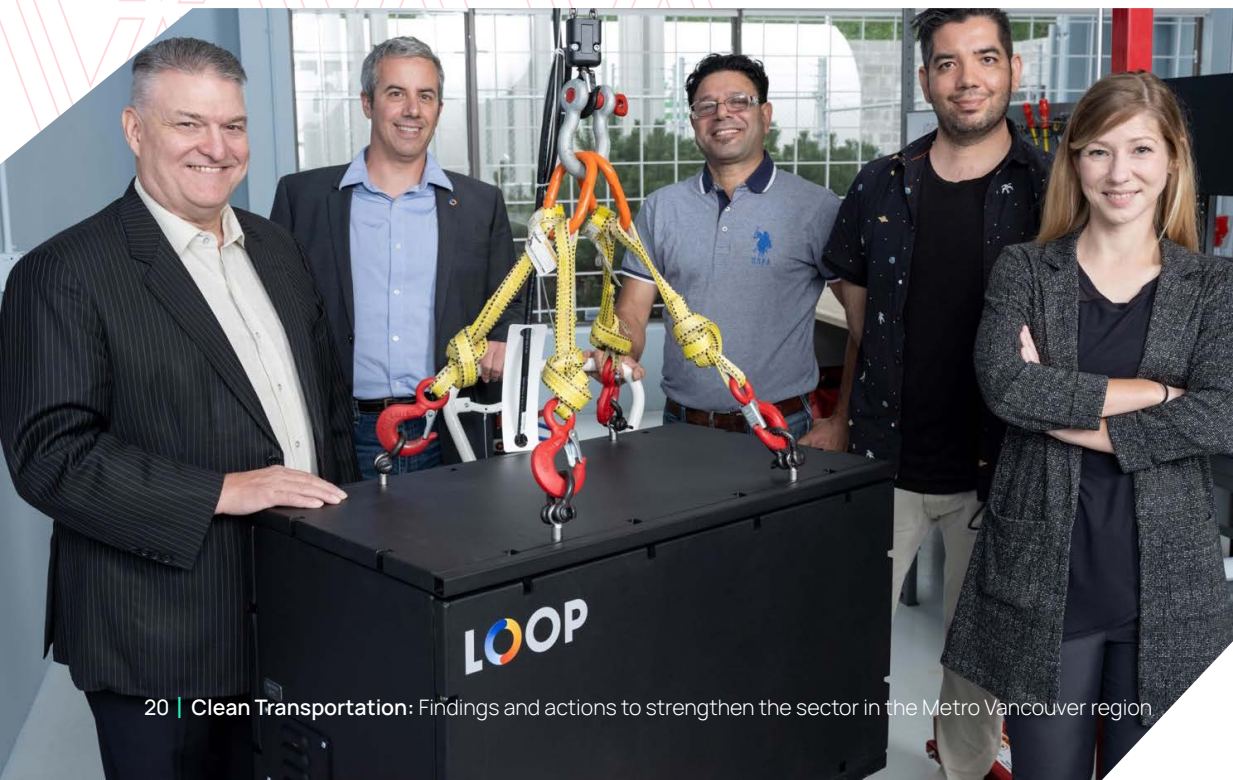
Culture of Innovation

Findings

Interviewees from firms in all three categories of clean transportation mentioned the need “to create a culture of innovation in the region.” There is a general disappointment, amongst interviewees, that the commitment to tackling the climate emergency is not matched by public support for local firms developing the technologies that will make lowering greenhouse gas emissions possible. Municipalities, in particular, were cited for their “risk-aversion” when it comes to their procurement policies and purchasing new or emerging technologies from “home-grown” enterprises. Multiple firms described finding local governments in the U.S. and Alberta, for example, more open to supporting new technologies and enterprises in their procurement decisions than governments here.

Recommendations

Encourage greater participation in “Project Greenlight” and other public-private partnerships to encourage a culture of innovation across the Metro Vancouver region. Project Greenlight is a membership-driven demonstration platform that forges strategic partnerships between public and private enterprises (“members”) and technology companies (“innovators”). Governments and government agencies should commit to greater participation in Project Greenlight, as well as in similar public-private partnership programs as a way to balance their understandable desire to de-risk their procurement decisions by purchasing “already commercialized” technologies with economic development. The goal should be to catalyze innovation and to build capacity within target industries, such as clean transportation, by using procurement levers to produce an environment in which innovative firms and new (and previously unknown) industry sectors can thrive, expand, hire and reinvest in the region.



IV. Conclusion

Talent, the innovation ecosystem, supporting incentive and regulatory environment, and leading hydrogen expertise mean that the Metro Vancouver region is well-positioned to seize the opportunities presented by the transition to a cleaner future. Yet, urgent action is needed to address barriers to investment for the clean transportation sector. Most time sensitive are the need to modernize and streamline the permitting process, improve access to highly-limited industrial space, and support a hydrogen hub to accelerate industry growth. The recommendations in this report will allow the region to go beyond creating a market for low carbon transportation and create a thriving clean transportation industry.

Invest Vancouver would like to thank all interviewees for their time and for sharing their insights.

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