British Columbia Electric Bicycle (E-Bike) Market Review

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1.0 Introduction

As the concern for environmental standards and physical health steadily rise in cities, active transportation becomes a key solution to promote health, safety, and environmental sustainability. Additionally, in addressing active forms of transport, mobility and access across all ages and abilities are often mentioned as an essential objective in city- and region-wide plans. While electric assist bicycles ("e-bikes") are an appropriate and alternative form of transport, the potential use and impacts of e-bikes as well as its market in British Columbia remain limited and unclear. Given the lack of resources to investigate such potential, the aim of this paper is to provide a market review of e-bikes in British Columbia and identify key industry stakeholders in this growing market as well as current city plans that support this emerging mode of transport. Moreover, to encompass a comprehensive review of this topic, the characteristics of e-bikes manufactured in British Columbia and data regarding sales, usage, and ownership will be explored.

2.0 Background - *What is an electric bicycle? (ICBC Definition)*

Although the characteristics of e-bikes remain substantially different from a standard bike, it is important to note the variations within the category of e-bikes and what is considered eligible as an e-bike in British Columbia. Firstly, this type of vehicle is recognized by the Insurance Corporation of British Columbia (ICBC) as electric bikes or motor-assisted cycles which "is a two- or three-wheeled cycle with a seat, pedals and an electric motor (up to 500 watts)" (ICBC, n.d.). Common to most regulations, e-bikes are required to have pedals to qualify as a motor assisted cycle and are exempt from vehicle registration and licensing. As a result, they are clearly segregated from limited speed motorcycles (LSM), otherwise known as electric scooters and mopeds. Other basic conditions that are required for an e-bike is that they must not exceed 32km/hr on ground level without pedaling (ICBC, n.d.). In regards to motor function, motor assisted cycles must be equipped with the technology where the user can turn the motor on and off, or the motor turns on only after the bike attains a speed of 3km/hr (ICBC, n.d.). Additionally, e-bikes must be designed so the motor can be terminated by either applying the brake, releasing the accelerator, or by having the rider stop pedaling (ICBC, n.d.). Other specific and relevant requirements specified by the BC Motor Vehicle Act (MVA) and ICBC are that e-bike must only have one motor, and the wheel must be greater than 350mm in diameter (MVA, RSBC 1996).

3.0 Methodology

The methodology for obtaining specific e-bike characteristics within British Columbia included a general web search to identify local e-bike manufacturers and retailers. The weight, battery, and cost details of the retailed e-bikes were then obtained from the specific description on the manufacturer website. The data collected was then used to formulate average prices and weights of e-bikes both manufactured and sold in BC. In regards to sales data, given the lack of reports on e-bike sales specific to British Columbia, market reports and articles were collected that estimated the market size of e-bikes in North America. Ownership data was based on previous research journals that observed demographic characteristics of e-bike users in the North American context. Usage data was obtained through case studies of programs and initiatives that utilized e-bikes throughout the province. Lastly, Official Community Plans (OCPs) of municipalities were reviewed to find bylaws and policies regarding existing charging stations for e-bikes and future charging infrastructure requirements.

4.0 E-bike vehicle characteristics

4.1 Energy

The batteries often used for e-bikes are outlined in Ulrich's (2005) research regarding personal electric vehicles. He identifies sealed lead-acid battery, nickel metal-hydride, and lithium-ion batteries as the three energy storage technologies used in commercial electric vehicles and provides a comprehensive comparison of cost, power, and maturity. Firstly, sealed lead-acid battery is most commonly used and has a longstanding history of utilization for small electric vehicles, including e-bikes. The main reason being that they are

inexpensive and can be charged with a simple charge algorithm (Ulrich, 2005). However, a significant disadvantage is its heavy weight that make e-bikes difficult to maneuver without power. In contrast, lithium-ion batteries are now "the lightest high-power batteries available commercially" (Ulrich, 2005, p. 454) and provide the highest power density, and are used most frequently for e-bikes manufactured in North America. It should be noted that e-bike manufacturers in British Columbia identified in this review all utilize the lithium-ion battery technology. Given these differences in technology, Ulrich (2005) identifies lithium-ion battery as having the highest cost per unit mass and cost per unit energy.

In regards to the motor power of e-bikes, the maximum motor power permitted for e-bikes are 500 watts in Canada (ICBC, n.d.). However, locally manufactured e-bikes range between 180W and 750W. Given the regulated limit for motor power, manufacturers often limit the highest speed for e-bikes that exceed 500watts to 32km/hr to meet Canadian regulations.

4.2 Cost

Due to the technological and energy capacity required for electric bicycles, e-bikes are generally more expensive than standard bicycles (Dill, 2012). In British Columbia specifically, the average retail price across e-bike retailers ranged from approximately 1600USD to 7000USD, amounting to an average of approximately 3150USD. However, the average retail price by e-bike manufacturers located in British Columbia are relatively lower and averages to approximately 2800USD. This difference in price may be attributed to the larger selection of e-bikes available at retail stores that include e-bikes with advanced technology from regions that have a bigger e-bike market such as Western Europe. Moreover, the price seems contingent upon the motor power and range as prices increase with greater motor power and higher range per charge.

4.3 Weight

In terms of e-bikes manufactured within British Columbia, the average weight ranged between 24.68 kg and 27.34 kg. Given the extra motor and battery technology required for e-bikes, they weigh greater than standard mountain and road bikes with mountain bikes weighing approximately 11kg on average. However, modern e-bikes with a motor of 350W tend to weigh less, ranging between 16.2kg and 26kg across different manufacturers. Moreover, some manufacturers design e-bikes with motors of 180W and 250W which tend to weigh significantly less and are comparable to standard road bicycles.

4.4 Speed

Due to the Canadian regulation of 32km/hr as the maximum speed and 500 watts for batter power, most manufacturers in British Columbia have designed their e-bikes in compliance to the law. In relation to standard bikes, the different speeds between e-bikes and standard bicycles was studied at an on-campus bicycle sharing system by Langford, Chen, and Cherry (2015). As a result of their field testing of participants completing a series of trips on regular bicycles, e-bikes, and walking, Langford, Chen and Cherry (2015) were able to record the speed for each mode of travel per trip among different road facilities. Overall, they found that "[t]he travel speeds for e-bike users are higher on average, 13.3 kph, than those for regular bicycle users, 10.5 kph" (Langford, Chen & Cherry, 2015, p. 54). This may be largely attributed to the additional energy that is supplied with the e-bike that enables riders to travel at a higher speed regardless of terrain and distance. However, on shared use facilities such as greenways, regular bicycles trips had a slightly higher average speed in comparison to trips on e-bikes. This is attributed to the nature of the trip on shared use facilities, as a number of regular bicycle users indicated that they chose to ride the greenways for the exercise component (Langford, Chen & Cherry, 2015). Moreover, among these shared use facilities, there was a higher variation in speed among regular bicycle users, while e-bike speeds were more consistent which may be due to the fact that "e-bike users can more easily maintain their travel speed across rolling terrain due to the added benefit of the e-bike motor" (Langford, Chen & Cherry, 2015, p. 56).

5.0 Sales, ownership, and usage data

5.1 Sales

Based on the literature review, the market for e-bikes seem to be largest in China. Fishman and Cherry (2015) attribute this large market to government regulations as e-bikes are given the same rules as standard bicycles, meaning e-bikes are able to utilize the existing bicycling infrastructure. Secondly, many cities have implemented policies that ban gasoline powered scooters and mopeds (Fishman and Cherry, 2015). In addition, INSG Insight (2014) recognizes the higher availability and accessibility of e-bikes in comparison to other markets due to cheaper technological costs stemming from the heavy use of lead-acid batteries. Meanwhile, the market in North America is relatively small in comparison to Asian and European markets in terms of sales and exports. Navigant Research (2016) attributes the stagnant e-bike market in 2015 to low gasoline prices as well as the lack of affordable e-bikes.

The lack of market information on e-bikes in Canada and the province of British Columbia signifies that both the sales and usage remain relatively low in comparison to other regions. In regards to overall sales of e-bikes, co-author of the 2013 Electric Bikes Worldwide Report, Ed Benjamin, estimates that "at one-tenth the U.S. market's size…just under 20,000 e-bikes were sold [in Canada] last year" (Flavelle, 2014) as the U.S. had an estimated total of 185,000 sales. More recently, the Vancouver Sun has reported that "[l]ocal e-bike firms are experiencing a sharp uptick in sales in the past two years, ranging from 100- to 500- per-cent growth" (Shore, 2016). Therefore, this indicates that the e-bike market has the potential to continue growing in Canada, especially in recent years as e-bikes are becoming increasingly recognized as an emerging mode of sustainable transport.

5.2 Ownership

In a research study conducted by MacArthur, Dill and Person (2014), online surveys were used to obtain information on the ownership and motivation behind purchasing e-bikes in North America. Firstly, respondents of the online survey were predominantly male and middle aged or older (MacArthur et al., 2014). Therefore, the market of e-bikes as well as early adopters of e-bikes is limited to a particular demographic in North America. In regards to the use of conventional bicycles, 55% of the respondents had ridden a conventional bicycle on a weekly or daily basis before purchasing a bicycle (MacArthur et al., 2014). Therefore, e-bikes may increase the ridership of those who are not regular users or may be less inclined due to health limitations. Based on this market review, the main demographic of e-bikes owners are generally middle to older aged men in North America. This is supported by OHM founder, Michael DeVisser who markets his e-bikes as a premium brand, and finds that the buyers "tend to be financially established riders between 40 and 60 years old" (Shore 2016).

5.2 Usage

Similar to sales data, research and data regarding e-bike usage in British Columbia remain limited. However, there have been programmatic and commercial initiatives that signify a growing recognition of e-bikes as a viable mode of transport. Firstly, e-bikes are now used as part of a commercial tool at Whistler where tourists can enjoy either self-guided or guided tours on rental e-bikes through the company, Whistler EBikes. Similarly, Pedalor, a cycling tour company in Victoria, offers bike tours with the option to use an e-bike for an additional fee. Moreover, out of the eleven identified e-bike retailers in British Columbia, four of these shops offered rental services. These services provide the opportunity for interested riders to gain familiarity of electric bicycles within these municipalities.

In North Vancouver, Canada's first electric bike-share program was launched in 2013. Known as the North Shore Electric Bikeway, this program was launched as a partnership between Café for Contemporary Art (CAFCA) and the Presentation House Gallery. However, with the CAFCA being permanently closed, the update and status of this program remain unclear. In Vancouver, e-bikes are also used for business purposes

as Securiguard, a security company that offers security services, began incorporating e-bikes for their security guards to use in patrol as part of their Go Green Initiative. Although limited and operated on a small-scale, these programs allude to the potential of growth in e-bike use.

VeloMetro—a Vancouver company that produces enclosed electric-assist recumbent tricycles—launched a pilot of an electric assist bicycle sharing program at the University of British Columbia campus in the fall of 2017. Their e-bikes—known as Veemos—encompass the flexibility and variety that is allowed under the guidelines of motor assist cycles. While the motors and enclosed fixture seemingly resemble scooters or smart cars, the pedals used for propulsion characterize this vehicle as an e-bike.

6.0 Charging Requirement and Infrastructure in BC cities

6.1 Metro Vancouver

6.1.1 Vancouver

As the largest city in British Columbia, Vancouver holds the largest number of retail stores that specializes in e-bikes. In advocating active transportation, the City of Vancouver (CoV) presented their Transportation 2040 Plan in 2012. Within this plan, electric-assist bicycles are recognized as a growing mode of transport under the Encourage and Promotion section of active transportation choices. More specifically, an enlisted action is to "establish guidelines and regulations on the types of electric-assist and electric vehicles that can use active transportation facilities" (CoV, 2012, p. 60) with the goal to protect and enhance safety for vulnerable road users. Meanwhile, the provision of public charging infrastructure listed in the plan pertains only to electric vehicles and scooters. However, their current Off-street Bicycle Space Regulations require every two Class A bicycle spaces to be equipped with an electrical outlet, which can help accommodate e-bike parking in residential and office buildings (CoV, 2016).

6.1.2 New Westminster

The City of New Westminster does not include the promotion of e-bikes in their Official Community Plan (OCP). However, an amendment was made to the existing bylaw to refine parking regulations within the city, including those for bicycles. This zoning bylaw (No. 6680, 2001), outlines several standards for both long and short term bicycle parking. Under the long term bicycle parking standards section, the bylaw sets out standards for bicycle storage facilities in which "[e]lectric outlets shall be provided in all bicycle storage facilities such that no parking space is more than 5 metres from an outlet" (City of New Westminster, 2001, p. 155-4). Therefore, although e-bikes nor its accommodating infrastructure are explicitly mentioned in the OCP, the parking bylaw is designed to enhance e-bike use by residents.

6.1.3 North Vancouver

In the District of North Vancouver, electric vehicles are valued as evidenced by their electric vehicle requirements for new developments in 2014. These requirements differ between the different types of development which include multi-family, commercial and industrial, and bicycle storage. The requirements that pertain to e-bikes are outlined below. As such, the District of North Vancouver sets out comprehensive regulations relating to charging infrastructure for e-bikes.

Type of Development	Requirement
Multi-family	Conduit in place so all stalls can later be wired for level 1 (110v) charging
Commercial and industrial	Appropriate amounts of level 1 (110v) and level 2 (240v) charging will be determined based on: • Proximity to regional roads and highways • Expected length of stay based on long term land use tenure
Bicycle storage	All secure bicycle storage must include level 1 (110v) electric outlets for electric bicycle charge

(Source: District of North Vancouver, 2014)

Although the City of North Vancouver does not outline requirements for e-bikes, e-bikes are mentioned in the appendix where feedback from the City's online survey are summarized. Under feedback related to enforcement, policy and promotion, the promotion of e-bikes is listed under the general comments received from cyclists.

6.1.4 West Vancouver

The District of West Vancouver recognizes the growing trend of e-bikes in their Strategic Transportation Plan created in 2010. The plan addresses the suitability of e-bikes that is particular to West Vancouver due to its hilly terrain and aging demographic. Therefore, their plan to accommodate e-bikes is listed as part of their Year One Strategies to work with the Transportation Committee to implement organized education and awareness programs that include promoting e-bikes (District of West Vancouver, 2010). These programs work in conjunction with educational tools that highlight the impacts of greenhouse gas emissions. Although policy changes regarding charging stations and infrastructure are not listed in the plan, some considerations are listed such as working with alternative technology organizations such as the Vancouver Electric Vehicle Association, running trial charging stations in new developments, and having a low-speed vehicles lane for zero emissions vehicles to share the roadway (District of West Vancouver, 2010).

6.2 Capital Regional District

Prior to exploring the e-bike regulations, standards, and policies of municipalities in the Capital Regional District (CRD), it should be noted that the CRD allows e-bikes on all regional trails (CRD, 2013).

6.2.1 Victoria

The City of Victoria addresses e-bikes under their Transportation and Mobility section within their OCP that was adopted by Council in 2012. Like many other electric vehicle and bicycle initiatives, the plan is addressed as a way to reduce greenhouse gas emissions. Thus, the OCP states that the City will give consideration to "[t]he provision of charging stations for electric cars, electric scooters and bicycles in new multi-unit residential, commercial, office and mixed use development" (2017, p. 56) as a way to reduce transportation-generated greenhouse gas emissions. The City seems to be following this guideline as four out of the five City owned parkades are equipped with recharging stations for e-bikes. This may be due to the City's Bicycle Parking Strategy which recommends 50% of long term bicycle parking facilities to have electric outlets for e-bikes, similar to the City of Vancouver (City of Victoria, 2011).

6.2.3 District of Saanich

The District of Saanich has proposed plans for e-bike infrastructure through their Climate Change Adaptation Plan and Climate Action Plan 2010. Firstly, in their prioritized and short-term actions, the promotion of amenities for e-bikes is listed while the long-term action states to develop a plan for electric

charging stations in core centers of the District. Moreover, the District is unique in terms of the policies related to e-bikes as the Council approved the restoration of tax exemption for electric bikes in 2016 (Zinn, 2016). However, this exemption applies only to pedal-assist e-bikes while throttle-assist bikes remain to be taxed. This exemption was approved to encourage green transportation as emphasized through their climate change plans.

6.2.4 District of Oak Bay

The District of Oak Bay lists guidelines that support the growth of e-bike infrastructure in the Oak Bay Active Transportation Strategy developed in 2011. These facilities include a plan for creating a Public Bike Station for one year as a trial. This Bike Station is based out of the University of Victoria's Bike Kitchen which is a shelter accommodated with repair tools. The initial trial calls for one charging station for two scooters or e-bikes.

7.0 Transportation Agencies

7.1 TransLink

While policies set by cities and municipalities impact the extent of e-bike usage, it is essential to consider the compliance and regulations of e-bikes on public transit services. The integration of e-bikes as a standard mode of transportation is highlighted by TransLink's new policy in 2015 to allow electric and folding bikes onto transit. This new policy allows electric and folding bicycles onto the SkyTrain, West Coast Express, and SeaBus while following the standard regulations that apply to bicycles. However, e-bikes remain to be prohibited from buses while folding bikes are now allowed. This is largely due to the weight restriction of 50 pounds when loading a bicycle onto the front of the bus (TransLink n.d.).

7.2 BC Transit

In contrast, the buses run by BC Transit do not prohibit the loading of e-bikes, however, sets out strict standards to be allowed on the bus bike rack. Firstly, e-bikes must weigh less than 55 pounds, have wheels that fit the rack, and have the battery removed. Additionally, only e-bikes with lithium batteries are permitted (BC Transit n.d.).

8.0 Cycling Coalitions

8.1 British Columbia Cycling Coalition

At the British Columbia Cycling Coalition (BCCC), e-bikes are advocated due to its ability to remove accessibility barriers and its sustainable component compared to the automobile. Currently in British Columbia, there have been efforts to promote clean energy and reduce the emissions of greenhouse gases through tax policies and rebate programs. Thus, the most recent issue regarding e-bikes have been the Provincial Sales Tax (PST) on these e-bikes despite PST being exempt for bicycles and transportation fares (Vallee 2015). Additionally, clean energy vehicles are eligible for tax rebates while e-bikes remain ineligible (Vallee 2015). According to Vallee (2015), this tax system poses difficulties for bicycle businesses as electric parts such as the battery are charged with the PST, while standard bicycle parts are not. Additionally, as e-bikes are sold on the high end of the market, the PST charge remains relatively large, which may deter individuals from purchasing e-bikes when compared against the cost of conventional bicycles. It is important to note that when the province was under the Harmonized Sales Tax (HST), e-bikes received tax exemptions (Vallee 2015).

8.2 Greater Victoria Cycling Coalition

Similar to BCCC, the Greater Victoria Cycling Coalition (GVCC) also advocates for e-bikes through their magazine, Cycle Therapy. The magazine emphasizes stories that highlight the benefits of e-bike use such as the sense of freedom that certain riders with physical limitations regained. Additionally, the magazine offers tips and basic information regarding electric-assist bicycles that benefit interested users prior to purchasing an e-bike.

8.3 HUB Cycling

The Road Safety Law Reform Group of British Columbia—which include HUB Cycling— published a position paper regarding the BC Motor Vehicle Act in April 2018. Their proposed reform includes the alteration of the definition for a motor assisted cycle to exclude self-propelling two-wheeled cycles as it may cause safety concerns when these self-propelled cycles share the infrastructure with pedal-assist bicycles and conventional bicycles (Road Safety Law Reform Group of British Columbia, 2018). This classification is evident in Toronto where human power for propulsion is required in power-assisted cycles, thus vehicles and bicycles that are able to be propelled without muscular power are not categorized as bicycles (City of Toronto, 2017). The Group also advocates having weight limitations for motor assisted cycle classification due to the potential safety risk associated with the difference in weight between pedal-assist e-bikes and certain self-propelling e-bikes.

9.0 Conclusion and Recommendations

As a result of this market review, there seems to be a significant potential for growth of e-bikes in British Columbia. However, obtaining adequate data regarding sales, ownership and usage remains a challenge given the lack of publicly available data. Thus, as a newly emerging mode of transport in North America, it is evident that the e-bike market lags far behind standard road and mountain bicycles. However, as a growing market, it becomes essential to understand the methods necessary to expand the market in British Columbia to achieve the full potential of e-bike usage. Firstly, as mentioned previously, regulations and rules of the road when operating an e-bike must be addressed by each municipality to allow users to ride with ease without facing any ambiguity surrounding the law. Secondly, the European bicycle market analysis of 2015 indicates how some countries such as “UK, France, Spain and Italy may have a natural cap on the growth of e-bikes because they do not have the underlying conditions that encourage cycling in general” (European Cyclists’ Federation, 2016, p.13). Given this finding, it may be necessary to encourage the development of general cycling facilities to encourage the adoption of e-bikes. In the context of BC, this may also signify that municipalities with higher cycling activities and facilities may also become the early adopters of e-bikes. Lastly, the market and ownership of e-bikes is limited with the majority of electric bicyclists being in the middle age range and in the high income bracket. Thus, the promotion of e-bikes and its capabilities may be necessary along with accommodating infrastructure to widen the demographic of e-bike riders.

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