

UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

**Charging Ahead: Increasing UBC's Sustainable Mode Share with E-Bikes**

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# CHARGING AHEAD: Increasing UBC's Sustainable Mode Share with E-Bikes



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THE UNIVERSITY OF BRITISH COLUMBIA  
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# CONTENTS

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I. Executive Summary	5
II. Introduction & Background	8
III. Research Problem Statement, Questions and Objectives	10
IV. What We Know About the Barriers to E-Bike Use: A Review of the Literature	12
V. Research Methodology	17
VI. Limitations	21
VII. Findings	23
1. <i>Inadequate Route Infrastructure</i>	26
2. <i>Lack of E-Bike Infrastructure</i>	28
3. <i>Financial Disincentives</i>	29
4. <i>Weather &amp; Climate</i>	30
5. <i>Safety</i>	32
6. <i>Cumbersomeness of E-Bikes</i>	34
7. <i>Lack of Storage at Home</i>	35
8. <i>Appearance and Hygiene-Related Concerns</i>	36
9. <i>Lack of Information</i>	38
10. <i>Convenience of other Modes</i>	39
11. <i>Subcategory barriers</i>	40
VIII. Analysis	45
IX. Best Practices & Recommendations	49
1. <i>Increase the Quantity and Quality of Bike Parking Infrastructure on UBC Campus</i>	54
2. <i>Provide High-Quality, Integrate End-of-Trip Facilities on UBC Campus</i>	55
3. <i>Establish financial incentives for UBC Faculty and Staff</i>	55
4. <i>Organize an Education and Awareness Campaign on Campus</i>	56

X. Conclusions and Future Research	58
XI. Acknowledgements	60
XII. References	62
XIII. Appendices	66
<i>Appendix A - UBC's Try an E-Bike Program - Purchasing Guide</i>	67
<i>Appendix B - Focus Group Questions</i>	68
<i>Appendix C - Interview Questions</i>	69
<i>Appendix D - List of Barrier Codes</i>	70

## List of Figures

Figure 1: Reviewing focus group participants' ranking of barriers to e-biking.

Figure 2: Map of the locations of the homes of the 14 participants in the study.

Figure 3: Absence of separated bike lanes on West Mall on UBC campus.

Figure 4: UBC bike storage map.

Figure 5: Bike-share bicycles on campus in the rain.

Figure 6: A shared lane on the street in Vancouver.

Figure 7: Cyclist shower and changing facilities in the UBC Life Building.

Figure 8: A parking lot and a parking garage at UBC.

Figure 9: A bicycle parked undercover near Ponderosa Commons with a helmet.

Figure 10: One of 13 free bike cages provided by UBC.

Figure 11: The prices of e-bikes at a Vancouver bike shop.

Figure 12: Secure bicycle storage at Curtin University.

Figure 13: End-of-trip facility for bicycles at Vancouver General Hospital.

Figure 14: Map of existing and future secured shared bicycle storage at UBC.

## List of Tables

Table 1: Demographics of participants

Table 2: Top 10 most significant barriers

Table 3: Top 3 subcategory barriers

# I. EXECUTIVE SUMMARY

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## INTRODUCTION & BACKGROUND

UBC aims to achieve a sustainable mode share of 67% by 2040. Currently, 55% of trips to and from UBC are made by sustainable modes, with only 1.4% of trips made by bicycle. E-bikes could play a significant role in bridging this gap as they enable more people to switch from commuting by single-occupancy vehicle to a sustainable mode.

## RESEARCH PROBLEM STATEMENT, QUESTIONS AND OBJECTIVES

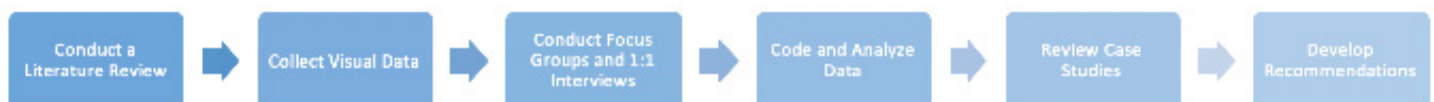
The overarching goal of this study is to generate knowledge to help UBC attain a greater sustainable mode share through e-bikes:

- 1) What are the barriers to e-bike use to and from UBC campus and how do they rank in importance?
- 2) Identify opportunities that will encourage target groups to switch to e-bikes. What strategies can UBC implement? What barriers can UBC eliminate?
- 3) Investigate measures that other post-secondary institutions have taken to incentivize e-bike use, and whether they could be applied to the UBC context.

## WHAT WE KNOW ABOUT THE BARRIERS TO E-BIKE USE: A REVIEW OF THE LITERATURE

Barriers identified in our literature review can be categorised into four categories: personal barriers, technological barriers, environmental barriers, and societal barriers. Examples include lack of information, weight, weather, and stigma.

## RESEARCH METHODOLOGY AND LIMITATIONS



*\*Please note that most participants of research were part of a previous Try an E-Bike pilot program, and thus had already shown interest in e-bikes and therefore may not be representative of the general UBC population. Furthermore, our research had limitations due to time constraints, team size, and lack of training pertaining to data collection.*

## **FINDINGS AND ANALYSIS**

The top 10 categorized barriers according to the frequency of responses were:

1. Inadequate Route Infrastructure
2. Lack of E-Biking Infrastructure at UBC
3. Financial Disincentives
4. Weather and Climate
5. Safety
6. Cumbersomeness of E-Bikes
7. Lack of Home Storage
8. Appearance/Hygiene-Related Concerns
9. Lack of Information
10. Convenience of Other Modes

## **RECOMMENDATIONS**

We have focused our following recommendations to target barriers that UBC can actively alleviate or reduce:

- 1) Increase the quantity and quality of bike parking infrastructure on campus
- 2) Provide high-quality, integrated end-of-trip facilities on campus
- 3) Establish financial incentives for UBC faculty and staff
- 4) Organize an education and awareness campaign on campus

## **CONCLUSIONS AND FUTURE RESEARCH**

A combination of these recommendations will be required to make e-biking a feasible alternative for the average commuter to UBC and a true competitor to the convenience of driving. There is a need for future campus-specific cycling research focusing on the barriers faced by commuters to using regular bikes or e-bikes as well as an in-depth consultation process with current bikers and e-bike users to determine what adequate bike storage should look like.



## **II. INTRODUCTION AND BACKGROUND**

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In response to environmental concerns and in alignment with its declaration of a climate emergency in 2019, the University of British Columbia (UBC) aims to achieve a sustainable mode share of 67% by 2040 (Campus + Community Planning, 2014). Currently, 55% of trips to and from UBC are made by sustainable modes (walking, cycling, and transit), but over 40% are still made by automobile (Campus + Community Planning, 2018). One major problem is that commuters to UBC face the challenges of long distances and steep topography that many would not dare attempt by conventional bicycle or other active modes, preferring instead to drive or take public transit to campus (UBC Campus + Community Planning, 2018). However, electric-powered bicycles - or e-bikes - provide users greater ability to tackle hilly terrain and longer distances (Dill & Rose, 2012), making the mode a feasible candidate as a sustainable transportation option for UBC commuters.

Furthermore, with mounting concerns around climate change and other environmental impacts, faculty, staff, and students may be more open to considering a novel transportation mode that is more environmentally friendly than automobiles. This presents an opportune moment for UBC to promote e-bikes in an effort to convert automobile drivers. Indeed, in automobile-dominated countries such as Canada, e-bikes can successfully change automobile users' travel behaviour as they have greater capacity to replace automobile trips than conventional bikes (Kroesen, 2017). E-bikes also show promise in drawing in user groups such as women, seniors, and people with disabilities, who are more likely to opt out of conventional cycling due to the unique barriers they face (Dill & Rose, 2012). However, despite its advantages, few commuters to UBC currently travel by e-bike (Campus + Community Planning, 2018). Building off a previous e-bike pilot program on UBC campus, this research aims to identify the barriers preventing UBC commuters from choosing e-bike riding as their primary mode of transport to campus. With the insight and recommendations provided by this report, UBC will be better equipped to address barriers and promote greater uptake of this sustainable mode.

# **III. RESEARCH PROBLEM STATEMENT, QUESTIONS AND OBJECTIVES**

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As of 2018, only 1.4% of trips to UBC are made by bicycle, and a minority of those cycling trips are by e-bike. Given its goal of achieving a sustainable mode share of 67% by 2040 (Campus + Community Planning, 2014), UBC needs to encourage many more commuters to cycle rather than drive. Campus + Community Planning has identified that e-bikes could play a significant role in bridging this gap as they enable more people to switch from commuting by single-occupancy vehicle to a sustainable mode. One initiative UBC Campus + Community Planning undertook toward this end was the Try An E-Bike Program, which ran from July to October 2019. This program provided UBC faculty and staff 24-hour e-bike rentals and e-bike purchase discounts from one of six participating local bike shops (see page 5 in Appendix A). A total of 381 staff/faculty enrolled and ultimately 43 rented and 17 purchased an e-bike through participating retailers. While this pilot program successfully converted some automobile commuters to e-bike users and raised awareness around e-bikes as a transportation option more generally, much still needs to be done to increase e-bike use among commuters to campus. One major component of that work is determining the barriers that UBC can remove to encourage more people of all types to consider commuting to campus by e-bike. This is the primary research question behind this report.

While the overarching goal of this study is to generate knowledge to help UBC attain a greater sustainable mode share through e-bikes, our study is underlain by several objectives toward that end. Our first objective is to identify barriers to e-bike use to and from UBC campus and how do they rank in importance? For example, what is preventing commuters to UBC from purchasing and using e-bikes as their primary mode of transportation? Our second objective is to identify opportunities that will encourage target groups to switch to e-bikes. What strategies can UBC implement? What policies and infrastructure are needed? What barriers can UBC eliminate? And finally, our third objective was to investigate measures that other post-secondary institutions have taken to incentivize e-bike use, and whether they could be applied to the UBC context.

This research project was completed as part of the course requirements for PLAN 522, a Master's level course at the UBC School of Community and Regional Planning. The project was made possible through a partnership with UBC Campus + Community Planning and the SEEDS Sustainability Program.

# **IV. WHAT WE KNOW ABOUT THE BARRIERS TO E-BIKE USE: A REVIEW OF THE LITERATURE**

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In recent years e-bikes have experienced a surge in popularity, attributable primarily to improvements in battery and motor technology leading to increased affordability (Fishman & Cherry, 2016, p. 72; Sangani, 2009). China in particular has witnessed the bulk of this growth worldwide, while The Netherlands and Germany lead e-bike sales in Europe, and new market growth is emerging in North America (Fishman & Cherry, 2016). Top motivations for purchases of e-bikes were found to be the capabilities provided beyond those of a conventional bicycle - for example, traveling longer distances and over hilly terrain - and as an alternative to environmentally unfriendly automobiles (Dill & Rose, 2012; Sangani, 2009). Notably, e-bikes have the potential to expand the bike riding population to include more women, older adults, and people with physical limitations (Dill & Rose, 2012).

Existing research also indicates that people's perspectives of e-bikes depend on their relation to the mode, whether as a non-user, trial user, regular user, or governance stakeholder. Among non-users, there may be different levels of interest in and knowledge of e-bikes (Fyhri & Sundfør, 2014). Those who have tested an e-bike notice its disadvantages relating to weather, speed, and price (Flüchter et al., 2014; Fyhri & Sundfør 2014) but also appreciate its value--the longer people use it, the more often they use it and the more they are willing to pay for it (Fyhri & Fearnley, 2015; Fyhri & Sundfør 2014). E-bike users were also found to perceive e-bikes as more comfortable, faster, and more suitable for further distances than conventional bikes (Edge et al., 2018).

Those who use e-bikes regularly may appreciate it for the economic and health benefits (versus cars) more than its environmental benefits (Plazier et al., 2017). Not only are e-bikes cheaper than automobiles to purchase, but so too is the electric 'fuel' used to power them. For households facing financial constraints, e-bikes could be a more viable option than automobiles. However, one study noted the upfront costs of e-bikes could act as a major barrier to its use (Edge et al., 2018). Despite these financial concerns, researchers suggested that political will and subsidies could play a vital role in promoting the uptake of e-bikes (Edge et al., 2018). It is also interesting to note that research comparing the cardiovascular health impacts among conventional and electric bikes was inconclusive in

determining which mode provided greater benefit to the user (Höchstmann et al., 2018; Hoj et al., 2018). This finding could have implications for users who view using an e-bike as ‘cheating’ (Aguilar, 2015).

As for their environmental benefits, while e-bikes do run on cleaner fuel (electricity) and are considered low-carbon vehicles, the question remains as to whether the source of pollution emissions and waste is just simply being swapped from tailpipe - as in the case of automobiles - to the site of e-bike and battery factory production, which could have significant implications for the true environmental benefits of e-bikes (Drage, 2012, as cited in Behrendt, 2018, p. 65; Work, 2013). Furthermore, the carbon reduction potential of e-bikes is contingent upon the carbon cost of producing the electricity to begin with (McQueen et al., 2019). However, it was found that e-bikes emit 4.9 grams of carbon dioxide per person mile, which is significantly less than cars at 274 grams of carbon dioxide per person mile (McQueen et al., 2019). Researchers also found that mode shares comprising a 14% mode share split between conventional bikes and e-bikes resulted in a 10% reduction in carbon emissions (Mason et al., 2015).

Despite the positive prospects for e-bikes, Chisholm and Healy (2018) raise timely concerns about the current lack of consideration for e-bikes and other “middle-modalism” (p. 96) in transportation planning and infrastructure design. These researchers urge for planning and facility design that recognizes the growth of these modes and that accommodates various types and speeds; a failure to do so, they posit, could lead to safety issues and misinformed, premature bans on these promising modalities (Chisholm & Healy, 2018). Further, Aguilar (2015) and MacArthur and Kobel (2014) also identified the lack of information and legal ambiguity as barriers for people to use e-bikes. Cross-jurisdictional differences in e-bike laws make it difficult for citizens to know or understand the legal requirements for e-bike usage. For example, some US states require a driver’s license, while others do not regulate e-bikes at all (MacArthur & Kobel, 2014).

E-bike use is also difficult to regulate due to the variability of speed of different models; some US states allow e-bikes to be used on bike infrastructure, while other states do not (MacArthur & Kobel, 2014). And while governance stakeholders—those involved with supporting e-bike usage, from politicians to retailers—generally see the potential environmental, health, equity, and

transportation benefits of e-bikes, they may be concerned about barriers for some social groups, safety regulations, and the cost of infrastructure (Edge & Goodfield, 2017; Plazier et al., 2018).

Another issue with e-bikes raised in the literature relates to real or perceived safety concerns (Rose, 2012). Several studies compared safety implications by analyzing international crash occurrence and severity data records (Haustein & Moller, 2016; Hertach et al., 2018; Schepers et al., 2018; Sundfor & Fyhri, 2017). Some studies yielded varying results when comparing the number and severity of e-bike versus conventional bike collisions. Certain studies found that e-bike users were less likely to be in a crash, yet they were more likely to experience a severe crash (Haustein & Moller, 2016; Schepers et al., 2018). Other researchers, however, did not find a significant difference in the number or severity of crashes for conventional cyclists compared to e-bike users (Hertach et al., 2018; Hoj et al., 2018). E-bike users were also found to have safety concerns related to traveling in winter weather, with young children, or carrying extra loads (Edge et al., 2018).

Most relevant to our specific research context were studies that explored e-bikes and their capacity to induce travel behaviour changes. Studies found, to varying extents, that e-bikes have the potential to impact travel behaviour and can effectively reduce car use (Kroesen, 2017). Main factors identified as influencing e-bike use were weather and temperature, road infrastructure, and prevalence of charging stations (Collado et al., 2014). Furthermore, Moser et al. (2016) found that in order to increase e-bike conversion, approaches that include public commitments, invitations for friends to participate, and positive social feedback from friends and family can foster lasting changes in travel behaviour. Kroesen (2017) also observed that in car-dominated countries such as Canada, e-bike trips mainly replace car trips, whereas in European countries that have a more prevalent cycling culture, e-bike appears to substitute conventional bike trips. Other researchers found that e-bikes can replace shorter trips where automobiles were used (Edge et al., 2018). Importantly, however, car ownership is not impacted by e-bike adoption (Kroesen, 2017). Increasing charging opportunities, implementing public sharing models, and providing ample secure parking were found across the board as successful interventions to overcome common barriers to e-bike use (Collado et al., 2014).



Ma et al. (2019) found that factors such as the weather, temperature, cost, and road infrastructure were closely related to e-bike riding behavior. Specifically, Dill and Rose (2012) reported a few e-bike owners who preferred riding their e-bike in the rain more than they would a regular bicycle due to the increase in speed and comfortability. This shows great potential for the adoption for e-bikes in Vancouver's rainy climate . Furthermore, Collado et al. (2014) examined a location with hilly topography comparable to the distance and elevation found along commuter routes to UBC and found that e-bikes have high potential to reduce these physical barriers. This suggests that UBC is a great candidate location for e-bike adoption. Collado et al. (2014) also noted that the presence of a public sharing service specific to e-bikes, like Vancouver's Mobi bike share network, could address the financial barriers to e-bike conversion which may be applicable to the UBC campus context. However, there remains a gap in the literature regarding the influence of economics behind travel behaviour. Specifically, as UBC students receive highly subsidized access to public transit, more research into the behaviour changes from the lens of financial motives and value of money is needed.

Research remains inconclusive regarding the potential of e-bikes to convert automobile drivers. One study by Johnson and Rose (2015) study revealed that about 74% of e-bike users had been regular cyclists prior to purchasing an electric bike. This could suggest that it may be more difficult to achieve our project's goal to convert automobile commuters to e-bikes if they are not regular cyclists. Similarly, Kroesen (2017) confirmed that while e-bike ownership significantly reduces the use of the conventional bicycle (i.e. by converting conventional bike trips to e-bike trips), this effect is significantly reduced when it comes to converting car and public transport use to e-bike use. However, Dill and Rose (2012) found that e-bikes can successfully change owners' cycling behavior and substitute for driving a motor vehicle to at least a minor degree. In either case, researchers generally agree that e-bikes have greater potential than conventional bikes to replace motorized modes (Kroesen, 2017). Since our key target group is automobile commuters to UBC, this finding has critical implications for the UBC context and is the driving theory behind our study.

# V. RESEARCH METHODOLOGY

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Our study builds upon the ‘Try An E-Bike’ pilot program conducted in 2019 by UBC Campus + Community Planning. The aim of this pilot program was to encourage faculty and staff to adopt e-bikes as their primary mode of transportation to campus. The reason why Campus + Community Planning only targeted faculty and staff is because they have a longer average tenure at the university than students, who typically only stay within the UBC community for a few years during their studies. Individual changes in travel behaviour among faculty and staff would thus have a longer impact.

We first collected and analyzed visual data related to our project scope. Photos were taken across campus as well as along routes to campus. The intent was to capture an overall picture of the existing cycling infrastructure at UBC as well as give visual representations of the barriers identified in the literature review. The visual data collected also helped to contextualize our research problem in the UBC context and enrich the qualitative data gathered in the focus groups and interviews. Through the process of collecting and taking these photographs, the researchers were able to better familiarize themselves with the current state and availability of cycling facilities and see first-hand the barriers and concerns surrounding e-biking with validity and depth.

Participants of the Try An E-Bike program were ideal target candidates from whom we could gain insight about barriers as they had shown an interest in e-biking but the majority of them ultimately opted out of purchasing one due to the barriers they encountered. The low conversion rate of the pilot program served as indication that participants encountered barriers to e-biking that merited further research. To gain insights on the barriers participants experienced, we conducted two focus groups with seven participants in total, facilitated by two researchers (see Figure 1). These sessions were approximately an hour long. Questions were based around e-bike use and related aspects of the commute; the questions from the focus groups are provided in Appendix B. Discussions were also recorded and transcribed.

To supplement the data gathered from focus group participants, we also conducted individual one-on-one interviews with the general UBC population. Due to time constraints, we recruited interview participants through our own personal networks. All interview participants were part of the UBC community as either students or faculty. Since the aforementioned pilot program included only faculty and staff, these interviews were intended to glean broader perspectives and in-depth insights, especially from students.



Figure 1: Reviewing focus group participants' ranking of barriers to e-biking  
Source: Jimin Park

Seven interviews were conducted in total. See Appendix C for the specific interview questions. These conversations were also recorded and transcribed (see Appendices F through L).

Based on the literature review as well as personal experience, barriers and subcategory barriers under each barrier were organized. While the overarching topic of “safety” would be a barrier, “lack of lighting” would be one of its subcategory barriers. An exhaustive list of the barrier categories and their respective subcategory barriers can be found in Appendix D. This list of barriers was used as codes to code the conversations.

Using transcripts from both focus groups and interviews, we identified barriers referred to by participants and coded them into appropriate coding categories in order to determine frequency of responses. Some codes we had anticipated and pre-determined, whereas others emerged from the data.

We then tallied the number of times that each barrier was mentioned by the participants. If the same participant mentioned the barrier more than once it was only counted in the first instance. This was done in order to give more weight to barriers that different individuals identified of their own accord, as opposed to one individual speaking of a barrier multiple times. If a participant mentioned different aspects of a barrier, the mention of each aspect was counted. For example, if one respondent mentioned both the lack of lighting as well as interactions with motor vehicles, we counted that as two responses for “safety.” This accounted for the complexity and nuances of the barriers.

Codes that were mentioned with the highest frequency by participants were ranked highest as barriers to e-bike use. Hence, the top 10 categorized barriers as well as the most significant subcategory barriers were identified. The details of these barriers were illustrated through quotes from the transcripts and photos taken as part of visual data collection. Finally, a comparison analysis of our findings with the literature was conducted.

Several limitations were encountered at each stage of this study. These included limitations with facilitating focus groups, selection of participants, and data analysis

processes. Other limitations were related to time constraints and lack of training pertaining to facilitation of focus group discussions of the research team. Each is discussed in detail along with mitigating measures taken in the following section.

## VI. LIMITATIONS

### **Potential for Participant Bias**

Due to our participant recruitment methods, the generalizability of our data may be limited by participant self-selection bias. The willingness of participants to take part in the focus group demonstrated their inclination toward experimenting new modes of transportation and may have had the effect of creating a self-selection bias.. This limitation is similar to one encountered in a study by Moser et al. (2016), in which limitations also included a participant self-selection bias. In both that study and ours, those who were interested in trying new mobility patterns were recruited as participants. Therefore, the findings may not be generalizable to the wider UBC population but rather to a subset of people who are open to alternative means of transport, specifically cycling (Moser et al., 2016).

### **Time Constraints**

The total time allocated to completing this research was constrained by the schedule of the eight-week course for which this project was completed. During this short period, our research team had to design our methodology, review existing literature, collect data via two different methods (focus groups and one-on-one interviews), collate and analyze data, identify the most important barriers faced by e-bike users and generate recommendations for ways forward. This time constraint limited our ability to recruit more participants, collect more data, and put more time into interpreting and coding data for greater consistency.. If more time had been allocated, further demographic analyses could also have been completed.

### **Lack of Training Pertaining to Focus Group Discussion Facilitation**

The lack of training and expertise in collecting data was also one of the limitations we encountered in our study. This was especially true during the focus group discussions, where our research team facilitators had to ask impromptu questions in response to the new and unique remarks made by the participants. Specifically, our team facilitators lacked previous experience in prompting participants to elaborate on their responses in further detail to get to the root of participants' comments and gain a more nuanced understanding of their barriers.

## **VII. FINDINGS**



Focus group and interview participants commuted to UBC from across Metro Vancouver, though the majority lived in the City of Vancouver (Figure 2). There were eight male participants, which was relatively higher than the number of female participants (Table 1). Half of the participants were between the ages of 25-34, while the rest were between the ages of 18-24 or 45-54. Nearly half of the participants were students, along with five staff members and three faculty members. Of the fourteen participants, five took the bus to commute and four drove to campus. The remaining participants rode a bike, e-bike, walked or used multi-modals.

We coded transcriptions from both focus groups and interviews using barriers identified in the literature review, others we collectively brainstormed from personal experiences and knowledge, and ones emerging from the data. Responses for codes of focus groups and interviews were summed up to order the top ten barriers as well as the three most significant subcategory barriers (Tables 2 and 3). The details of these barriers are illustrated through quotes from the transcripts and photos taken as part of visual data collection. A comparison of our findings with the literature is conducted in the Analysis section.



Figure 2: Map of the locations of the homes of the 14 participants in the study.

Table 1: Demographics of participants.

Category	Gender		Age				Occupation			Mode to Campus						
	Male	Female	18-24	25-34	35-44	45-54	Faculty	Staff	Student	Car	Bus	Bike	E-Bike	Walk	Bus & Bike	Bus & Car
Focus Group	3	4		4		3	2	5		2	2	1	1	1		
Interview	5	2	3	3	1		1		6	2	3				1	1
Total	8	6	3	7	1	3	3	5	6	4	5	1	1	1	1	1

Table 2: Top 10 most significant barriers.

Rank	Barriers	Responses
1	Inadequate Route Infrastructure	13
2	Lack of E-Bike Infrastructure at UBC	12
3	Financial Disincentives	11
4	Weather and Climate	10
5	Safety	9
6	Cumbersomeness of E-Bikes	7
7	Lack of Storage at Home	6
8	Appearance/Hygiene-Related Concerns	5
9	Lack of Information	4
10	Convenience of other Modes	4

## Barrier #1 - Inadequate Route Infrastructure

According to our findings, as shown in Table 2, the greatest barrier to e-bike use for commuters to campus is inadequate route infrastructure. Participants reported that a lack of comfortable e-bike infrastructure on route discouraged them from using e-bikes to commute to campus. Bike lanes separated from motor vehicles by a physical barrier were preferred to mitigate potential interaction with motorists and pedestrians.

One male student at UBC in the 18-24 age group noted that:

“one of the biggest barriers of biking to campus for [me], is the fact that there is not a protected bike lane . . . along Pacific Spirit Park” (Respondent: IV7, interview, Feb 13<sup>th</sup>, 2020).

Another male staff in the 25-34 age group mentioned the importance of separated bike lanes:

“You know, the separated bike lanes are a huge psychological and physical umm benefit. You know I’ve gone and bike around even the Netherlands and it’s just completely different right? To have that separation, complete separation, not just the line with the... to have a complete separation.” (Respondent: IV2, interview, Feb 6<sup>th</sup>, 2020).

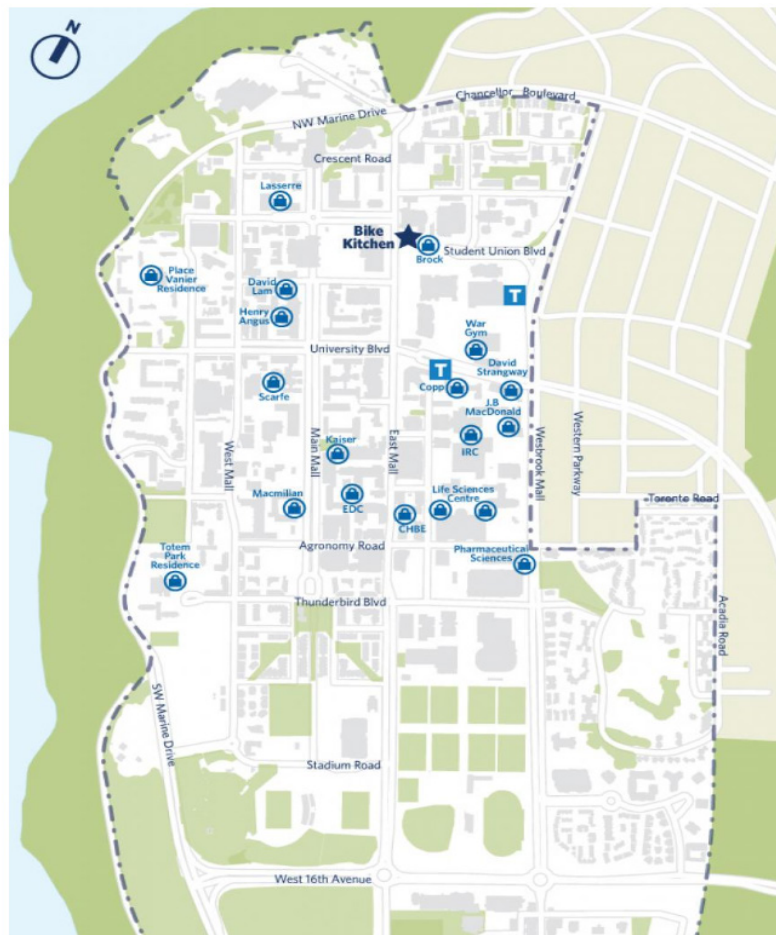


Figure 3: Absence of separated bike lanes on West Mall on UBC campus.  
Source: Pulkit Kathuria

Figure 3 depicts the absence of separate bike lanes on West Mall, a local route through campus. The cyclist is riding a conventional bike on the shared roadway. There is no bike infrastructure or insignia. Focus group participants raised the point that the intermingling of cyclists with automobile traffic along Wesbrook Mall, East Mall, and West Mall affects the speed of cyclists as they must stop with automobile traffic. This also poses a threat of being ‘doored’ by automobiles, that is, when a vehicle door is swung open and strikes a cyclist, due to passenger drop-offs in the morning.

## Barrier #2 - Lack of E-Bike Infrastructure

Another important barrier for commuters is the lack of e-bike infrastructure on UBC campus (Table 2). Though UBC currently provides several bike parking storage facilities serving central areas on campus (Figure 4), the quality of the facilities is lacking, specifically as they pertain to accommodating e-bikes. According to one male student participant in the 25-34 age group there is a need on campus for “better bike parking, specifically for e-bikes” (Respondent: IV4, interview, Feb 13th, 2020). There are currently no e-bike-specific parking facilities on campus.



*Bike Storage Map*

Figure 4: UBC bike storage map.

Source: Campus + Community Planning, n.d.

## Barrier #3 - Financial Disincentives

There are various financial disincentives that discouraged participants from buying an e-bike. The large up-front cost of an e-bike was reported as a major disincentive by many participants. A male student in the 25-34 age group mentioned the costs between a car and an e-bike:

“the price would have to be a little bit lower than a few thousand dollars. Cause I personally can’t afford that. My car is \$1,500. So it would mean that [an e-bike is] way more than, well maybe a little bit more than my car.” (Respondent: IV5, interview, Feb 18<sup>th</sup>, 2020).

In the case of public transit, the existence of the U-Pass program discourages many student participants from buying an e-bike. A female student in the 18-24 age group explained:

“I have the Compass Card, I paid for it. If I don’t use [the] U-Pass, I would waste my money.” (Respondent: IV3, interview, Feb 14<sup>th</sup>, 2020).

## Barrier #4 - Weather and Climate

Weather and climate is also a major factor. Within this barrier, riding in rainy and cold weather was mentioned most frequently. Some participants reported that they avoid riding in the rain and the cold mainly due to concerns over the hassle of having to dress appropriately for the weather. This hassle is associated with staying both warm and dry, but also the inconvenience of changing in and out of weather-proof gear. Some participants complained:

“I don’t know if I’m comfortable in the rain. I haven’t thought that through, how that would work. Because I have my backpack. It would get all wet”  
(Respondent: IV5, interview, Feb 18<sup>th</sup>, 2020).

“if you’re biking in the rain you get here and you’ve got all this soaking wet stuff. If you don’t have anywhere to put [wet rain gear] it’s really annoying to carry that stuff around.” (Respondent: IV6, interview, Feb 12<sup>th</sup>, 2020)

International research findings echo participant sentiments. Trial users in a Swiss town saw e-bike usage as dependent on fair weather (Flüchter et al., 2014), while Ma et al. (2019) also found weather to be a barrier.

Another concern was riding in snowy and icy conditions; a male staff member in the 35-44 age group mentioned his experience:

“I’ve tried going in snow and ice and I’ve fallen almost every single time.”  
(Respondent: IV2, interview, Feb 3<sup>rd</sup>, 2020).

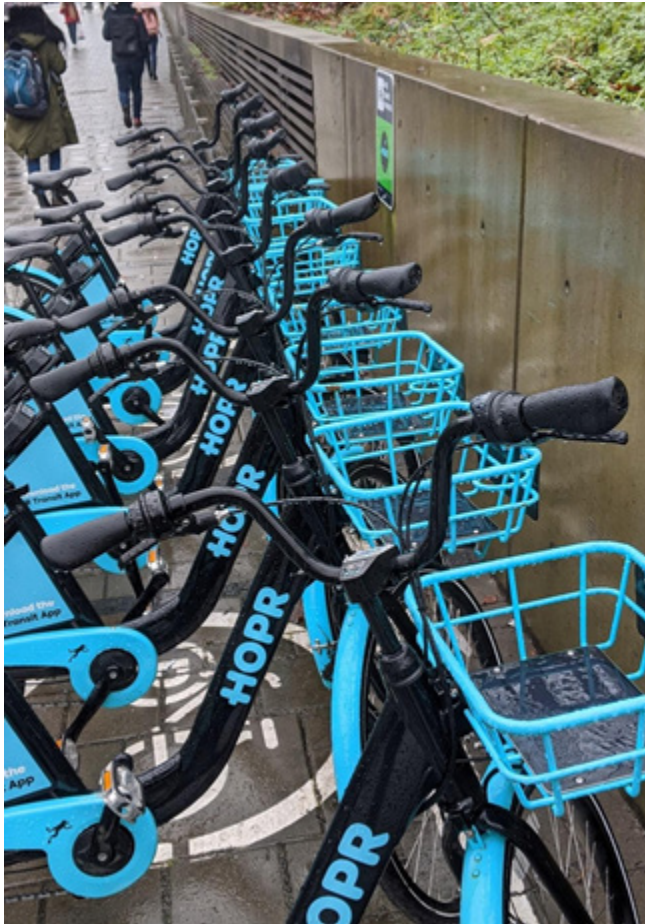


Figure 5: Bike-share bicycles on campus in the rain.  
Source: Chelsea Craig

Figure 5 shows bikes on campus going unused, dripping wet in the winter rain. While automobile drivers are cozy in their sheltered and temperature-controlled vehicles, e-bike users are exposed to the elements, which can include rain, wind, snow, brisk temperatures, or some combination of the four. Additionally, daylight hours are limited during the fall and winter seasons, shrouding cyclists in darkness. All these factors are further compounded by safety concerns relating to interactions with automobile traffic on the roads in such weather conditions, and thus it is no mystery why many commuters to UBC opt for the comfort of driving private vehicles over commuting by e-bike.



## Barrier #5 - Safety

Safety is the 5th most significant barrier based on the reflections of participants. Real or perceived safety concerns relating to on-street interactions with automobiles, particularly in the dark, were raised numerous by interviewees and focus group participants. A female participant (a staff member in the 45-54 age group) expressed her concern about safety:

“the street lamps are not bright, cars may [not] notice me while I’m e-biking.”  
(Respondent: FG2, Focus group, Feb 13<sup>th</sup>, 2020).

Many participants expressed their fear over the seemingly unavoidable possibility that they would be forced into sharing space with motor vehicles, other bikers, and pedestrians at some point on their journey to campus. It was mentioned by a male participant (a faculty member of UBC in the 45-54 age group):

“cars pull over without signaling. Variable speeds with bikes and e-bikes get even more complicated.” (Respondent: FG1, Focus group, Feb 13<sup>th</sup>, 2020).



Figure 6: A shared lane on the street in Vancouver.  
Source: Chelsea Craig

Figure 6 is a shared lane on a busy Vancouver arterial, and shared lanes do not separate cyclists from automobile traffic. In a low-cycling country such as Canada, the landscape is designed for and dominated by the automobile, which can make commuting by e-bike a scary prospect even for experienced cyclists. While the City of Vancouver is working to expand and enhance its network of cycling routes across town including routes to UBC, most do not offer dedicated cycling infrastructure that is separated from automobile traffic, which can be perceived as unsafe. As seen in Figure 6, some routes are located on busy arterials that require cyclists to merge and intermingle directly with speeding automobiles. Automobile drivers can also be impatient with cyclists who slow vehicle traffic, leading to aggressive, unpleasant, and unsafe interactions. Safety is a legitimate concern in these circumstances where cyclists are not accommodated with adequate designated cycling infrastructure, serving as a major deterrent to would-be e-bike users.

## Barrier #6 - Cumbersomeness of E-Bikes

Cumbersomeness of e-bikes was also a common complaint among participants. Those who rode an e-bike complained about the difficulty they had lifting their bike while lifting it up onto the bus or a wall. A female participant (a staff member in the 45-54 age group) remarked:

“I can’t lift [the e-bike] onto the bus bike rack, it’s too heavy for me, even if I take the battery off.” (Respondent: FG2, Focus group, Feb 13<sup>th</sup>, 2020).

Another female participant (a staff member in the 25-34 age group) also mentioned the cumbersomeness of e-bike batteries:

“it’s a scheduled stop that takes off like every 5 minutes. So I would have a few minutes to take off the battery, put it [away], get everything off my bike, wait for the bus to pull up, the bus is sitting there for five minutes so I have time. And that’s, that’s big. like I think if it wasn’t scheduled [to] pull over and go I would feel a bit more frantic.” (Respondent: FG7, Focus group, Feb 13<sup>th</sup>, 2020)

The weight of the e-bike also poses issues when storing the e-bike, as a female participant (a staff member in the 45-54 age group) illustrated:

“though they’ve put some bike racks inside the parking place . . . they are still on the wall. [The] e-bike is heavy and [I] cannot lift it up.” (Participant: FG2, Focus group, Feb 13<sup>th</sup>, 2020).

Due to the bulky and heavy nature of e-bikes, they are not conducive to transporting on the bus or, in certain situations, parking in storage facilities.

## Barrier #7 - Lack of Storage at Home

Lack of storage at home was also cited as an important barrier. The high value of the e-bikes seemed to bring participants to perceive them to be more vulnerable to theft. One female interviewee (a student in the 25-34 age group) mentioned this barrier:

“I wouldn’t want to leave [the e-bike] out on my balcony and there aren’t any safe spaces in my building to store an e-bike.” (Respondent: IV6, interview, Feb 12<sup>th</sup>, 2020).

Another female participant (a staff in the 25-34 age group) also mentioned:

“usually at home we stack our bikes, and so we probably wouldn’t be able to stack my bike if it was an e-bike. So there’s no place for me to store it.” (Respondent: FG4, Focus group, Feb 13<sup>th</sup>, 2020).

Overall, participants desired a convenient and reliable facility to park their e-bikes at home.

## Barrier #8 - Appearance/Hygiene-Related Concerns

While the assisted motor helps lower the physical demands of cycling, the lack of good quality cyclist end of trip facilities is still a problem and contributes to the barrier of appearance- and hygiene-related concerns.

E-bike users may feel self-conscious of smelling as mentioned by a male staff member in the 25-34 age group:

“So you kind of have to, after you’ve been in the rain, you’re kinda soaked, and then you kind of smell. Even if you change your clothes you still may smell and you get a little self-conscious.” (Respondent: FG6, Focus group, Feb 13<sup>th</sup>, 2020).

A male staff member in the 25-34 age group also explained that the disincentive of bad facilities on campus:

“The main reason why I multi-mode here (WMAX/campus) is so that I don’t get as sweaty to get into class and you know, facilities here aren’t that good for showers etc.” (Respondent: IV2, interview, Feb 6<sup>th</sup>, 2020).



Figure 7: Cyclist shower and changing facilities in the UBC Life building  
Source: Chelsea Craig

Cyclist shower and change room facilities are key infrastructure provisions for facilitating and encouraging e-bike use for commuting to campus. Whether it's hot and humid, rainy and wet or freezing cold, e-bike users and cyclists alike need shower facilities to clean off the sweat and dust or warm up from their commute. On UBC campus, shower facilities are available in some buildings, but not all. Several are centrally located in the basement floor of the UBC Life Building next to the Bike Kitchen bike repair shop (see Figure 7); others are scattered throughout campus. Unfortunately, UBC does not provide a public directory of shower and changing facilities, and it is not made abundantly clear who can access the facilities, or how.

## Barrier #9 - Lack of Information

Some participants were not aware of how to get started with an e-bike. There was a general lack of knowledge of where to purchase them, what model was a good fit for their needs, and the battery range capabilities. A male interviewee (a student in the 18-24 age group) explained:

“I’ve never really considered e-biking as a mode of transport at all, mostly because I don’t even know how I would go about acquiring an e-bike.”  
(Respondent: IV7, interview, Feb 13<sup>th</sup>, 2020).

## Barrier #10 - Convenience of Other Modes

Additionally, the convenience of other modes, particularly those with access to a private vehicle, was a barrier to some participants. A male student in the 18-24 age group mentioned the convenience of public transit:

“It’s easier for me to take the bus everyday than it is for me to [e-]bike.”  
(Respondent: IV7, interview, Feb 13<sup>th</sup>, 2020).



Figure 8: A parking lot and a parking garage at UBC  
Source: Adriana Valentina Farias

A male staff member in the 25-34 age group cited caregiving concerns:

“one of the biggest reasons I started driving is because I need two seats now because I’m carpooling with my son.”  
(Respondent: FG6, Focus group, Feb 13<sup>th</sup>, 2020)

Figure 8 shows two parking facilities in very close proximity at UBC. They are located on either side of Agronomy Road. The large amount and variety of parking available on campus makes driving very convenient. Even though there was a reduction of parking spaces with the introduction of the U-Pass in 2015, driving is still an important mode of transportation that many people use to commute to and from campus.



This is perhaps because commuters are sheltered from the weather, have access to direct and well-maintained routes, and do not have to worry about the topography of their route or the effort it will take to get there. While e-bikes require less effort than regular bikes, there is still a level of exertion that riders have to put in, which more often than not can be seen as an inconvenience.

Table 3: Top 3 subcategory barriers.

Rank	Subcategory Barriers	Responses
1	Lack of E-Bike Infrastructure (Secure Bike Parking)	11
2	Financial Disincentives (Cost of E-Bike)	9
3	Route Infrastructure (Absence of Separated Bike Lane)	6

### Secure Bike Parking

Secure bike parking was the most frequently reported sub-barrier based on the frequency of responses. Secure bike parking on campus was discussed enthusiastically among participants. One female participant (a staff member in the 45-54 age group) expressed her concerns about security:

“I don’t want to park in the bike racks or even in the cages because everyone will see when you get to the cage and it can be stolen out of there.”  
(Participant: FG2, Focus group, Feb 13<sup>th</sup>, 2020)

Though there are secure parking lots on campus, some spots within the lots are mounted on the wall, thus it would be difficult for e-bike users to park them. As a female staff member aged 45-54 illustrated:



Figure 9: A bicycle parked undercover near Ponderosa Commons with a helmet  
Source: Jimin Park

“though they’ve put some bike racks inside the parking place . . . they are still on the wall. [The] e-bike is heavy and [I] cannot lift it up.” (Participant: FG2, Focus group, Feb 13<sup>th</sup>, 2020).

For the bike in Figure 9, the bike racks provide a quick and convenient storage close to the end destination. However, the bikes are vulnerable to bike theft regardless of the type of bike lock. For cycling to be a practical and mainstream transportation choice, it is important to ensure people have secure places to park. Secure parking is even more even for e-bikes, given their high value. Parking with added security is particularly important in high-theft areas such as UBC campus where people will park for longer periods of time.



Figure 10: UBC Engineering Free Bike Cage Facility  
Source: Pulkit Kathuria

Figure 10 is a particular bike cage located close to the bus loop and is easily accessible due to its close proximity to major campus destinations. Most importantly, a key difference and feature of these bike cages are the integrated day-use lockers for storage of bicycle-related accessories such as helmets, shoes, and outerwear. This facility is free for all UBC faculty, staff, and students. However, there are only 13 of these facilities across campus, severely limiting the number of bikes it can hold (Campus + Community Planning, n.d.). On the UBC website, it states that you can register for a bike cage online at any time, but that “spots fill up quickly” (Carter, 2019).

### **Cost of E-bikes**

Of the 11 participants who cited financial disincentives as a major barrier, 9 specifically mentioned the cost of the e-bike as a barrier. Several participants reported being deterred by the expensive price tag of e-bikes. Students generally do not have the financial resources to afford e-bikes. A female student aged 18-24 explained her hesitation:

“I researched that an e-bike would cost me about \$2,500 - that is too much for me! I would rather take other transportation modes instead of the expensive e-bike.” (Respondent: IV3, interview, Feb 14<sup>th</sup>, 2020).

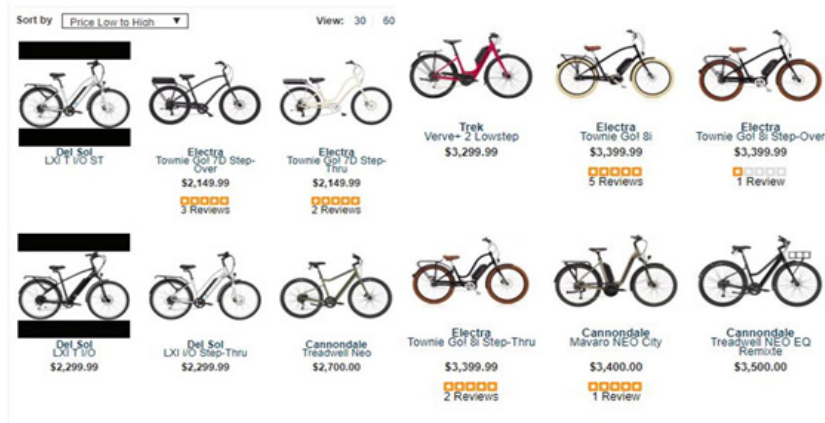


Figure 11: The prices of e-bikes at a Vancouver bike shop.  
 Source: Bicycle Sports Pacific Bike Shop, 2020.

Figure 11 shows the prices of some e-bikes at a local bike shop in Vancouver. E-bikes at this shop cost between \$2,000 and \$16,000 (Bicycle Sports Pacific Bike Shop, 2020). Though the price of an e-bike fluctuates with its performance, weight and other characteristics, most people would choose e-bikes with prices ranging from \$2,500 to \$3,500 according to the customer choices.

Compared to the prices of regular bikes, e-bikes are much more expensive due to the motors. As the main group of UBC is students, they usually do not have enough ability to afford e-bikes. Even for the staff and faculty, the expenditure of an e-bike would be a disincentive for them. Especially since most students have a U-Pass, and staff and faculty usually drive by themselves or take public transportation, they already have a comfortable, safe, and relatively inexpensive means of transportation. Hence, only a few people are willing to pay a relatively higher price for an e-bike. The cost of e-bikes would be a significant barrier for people considering using e-bikes to commute to UBC.

## Absence of Separated Bike Lanes

The absence of separated bike lanes is also an important issue for participants. One male participant reported the need to separate bike riders from cars:

“safety wise [what] I’m worried about is parked cars on the bike lanes. And on a road, there’s no dedicated bike lane and there are only a couple of streets with dedicated bike lanes. There’s not much space for the cars and bikes to co-exist on that one.” (Respondent: FG1, Focus group, Feb 13<sup>th</sup>, 2020).

## **VIII. ANALYSIS**

The focus groups and interviews provided our research team with extensive data on the range of barriers to e-biking. Eight of the top 10 barriers ranked in the previous section based on the frequency of participant responses appeared within our review of the literature whereas two of the top 10 barriers did not appear within our review of the literature.

The eight overlapping barriers are: inadequate route infrastructure, lack of e-bike infrastructure at UBC, financial disincentives, weather and climate, safety, cumbersome of e-bikes, lack of information, and convenience of other modes. The two non-overlapping barriers cited by our participants are: lack of storage at home and appearance & hygiene related concerns. In this section, we will compare the findings of our top 10 barriers and top 3 subcategory barriers from our research with the findings from our literature review.

Barriers limiting one's initial interest in e-bikes, such as cost and lack of information, were shared by both our participants and those from the literature. The high cost of the e-bike was the second highest recorded subcategory barrier of our study participants (see Table 3). Various other studies also determined that cost is a disincentive for potential users (Edge et al., 2018; Ma et al., 2019). One study in Norway found that price was, in fact, the only significant barrier for users to buy an e-bike (Fyhri & Sundfør, 2014).

In contrast to the Norway study, our study (see Table 3) found a wide range of barriers to e-bike use among our participants, including lack of information. One participant in our study remarked how he did not know how to "go about acquiring an e-bike" (Respondent: IV7, interview, Feb 13th, 2020). Existing literature also finds that many in the general public know very little about e-bikes in general (Aguilar, 2015; Fyhri & Sundfør, 2014) as well as the associated regulatory standards (MacArthur & Kobel, 2014).

The barriers of cost and lack of information are concerns that especially impact those who are considering e-biking for the first time. However, once an individual overcomes these barriers and decides to purchase an e-bike, many other barriers continue to persist, such as those associated with infrastructure both on campus, on route to campus, and at home.

Infrastructural concerns, both on route (inadequate route infrastructure) and on campus (lack of e-bike infrastructure at UBC), were shared by our participants and those from the literature. Lack of separated bike paths was the third highest recorded subcategory barrier of the participants of our study (see Table 3). Various research also reports a lack of separated bike paths as a barrier due to safety concerns (Aguilar, 2015; Ma et al., 2019).

Secure bike parking was reported as the top subcategory barrier by our participants (see Table 3). Research examining e-bike parking facilities reveal similar security concerns, citing theft as a reported barrier to e-bike use (Aguilar, 2015; Outram et al., 2010). Infrastructural concerns at home, however, such as lack of storage were only cited by participants of our study. This barrier, mentioned by six participants of our study (see Table 3), was not cited within the articles of our literature review.

Access to secure bike parking not only provides assurance to the rider that the bike will be safe from theft, but also safe from the elements. Weather and climate was the fifth most-cited barrier to e-bike use in our study. From the literature review, weather and climate was also cited as a barrier (Ma et al., 2019), with some participants viewing e-bike use as dependent on fair weather (Flüchter et al., 2014).

The weather and climate can cause appearance and hygiene related concerns. While this barrier was mentioned by five of our study participants, the barrier did not feature in our review of the literature was appearance and hygiene-related concerns. These concerns were not cited as a barrier to e-biking within the articles of our literature review, however, in recent research this is cited as a barrier to conventional bike riding, specifically for women (Garrard et al, 2012).

Weather and climate also causes safety concerns among our participants, the frequency of one rider's past experiences in the ice and snow relate to Hertach et al.'s (2018) finding that skidding on icy or wet terrain was the most prevalent cause of an e-bike crash. Another cause for safety concern mentioned by our participants is the differing speeds of the e-bikes to conventional bicycles. This concern is justified by a study that found the second most prevalent cause of an e-bike crash to be riding too fast for the situation (Hertach et al., 2018).



Another barrier found to deter our participants from riding the e-bike is the weight of the e-bike. Participants expressed concern over the difficulty of lifting the e-bike up a flight of stairs, onto a bus, or up onto a hook on the wall. Research also finds that the weight of the battery deters riders by adding considerable weight to the e-bike (Aguilar, 2015).

Finally, the convenience of other modes were mentioned by both participants in our study and those from the literature review. Four of our study participants mentioned the convenience of other modes such as cars (two participants), conventional bikes (one participant), and transit (one participant) as deterrents to e-bike use. Within our literature review, studies accurately reflect the convenience of cars. One study noted how in regions where there is a strong “car culture,” people are less likely to switch their mode of transportation (Aguilar, 2015). The convenience of transit did not appear in our literature review.

Another study revealed that about 74% of e-bike users had been regular cyclists prior to purchasing an electric bike (Johnson & Rose, 2015). Interestingly, a transit commuter was the only participant to voluntarily mention the convenience of the bicycle to the e-bike. This male student aged 18-24 noted that:

“one thing I like about bikes is that if something goes wrong, I know how to fix it. Whereas I feel like e-bikes are much more complex.” (Respondent: IV7, interview, Feb 13th, 2020).

A major barrier that featured in the studies of the literature review, but was not mentioned by our study participants were negative sustainability impacts. A study noted participant concerns about “the possibility of [the e-bike] having a negative environmental impact if users switch from conventional bikes” and “if the electricity on the grid is produced with GHG-emitting energy sources” (Aguilar, 2015). Our participants did not mention any sustainability concerns pertaining to e-bike use.

# **IX. BEST PRACTICES AND RECOMMENDATIONS**

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Some of the top barriers we have identified in our findings and analysis - such as weather, safety concerns in regards to unpredictable motorist behaviour, and the high retail cost of e-bikes - are not within UBC's direct control. Therefore, we have targeted the following recommendations on barriers that UBC can actively eliminate or reduce. These recommendations are informed by the best practices and learnings presented in the following three case studies: Curtin University's state-of-the-art Cycle Hub, Vancouver General Hospital's Cycling Centre for staff, and Thompson Rivers University's employee financial incentive program.

## Case Study #1: Curtin University Cycle Hub



Figure 12: Secure Bicycle Storage at Curtin University.  
Source: Curtin University, 2018a.

The Curtin University Cycle Hub in Perth, Australia is a best-practice example of how bicycle end-of-trip facilities can be integrated with secure parking to make cycling a more feasible sustainable transportation mode for urban commuters (see Figure 12). Completed in 2018, the Cycle Hub accommodates over 180 bikes with secure indoor parking and contains 130 lockers, 10 showers, toilet and changing facilities, and a fully-equipped self-serve bike repair station all in one convenient place for students, staff, and faculty (Curtin University, 2018b). UBC can derive lessons from the success of this on-campus cyclist end-of-trip facility and its ability to promote the switch to sustainable transportation. University students, staff, and faculty can access the facility using their campus swipe-cards. All external walls are made of transparent glass allowing the flow of natural light and providing a sense of openness and safety for users, unlike other bike parking facilities, which are commonly located in dark underground parking garages. High quality end of trip facilities like the Cycle Hub will be a significant component in reducing barriers to e-biking. What the Curtin Cycle Hub exemplifies is infrastructure that makes cycling a more attractive and feasible option for urban commuters, and that has real potential to lure drivers from cars onto bikes.

## Case Study #2: Vancouver General Hospital



Figure 13: End-of-trip facility for bicycles at Vancouver General Hospital

Source: Chelsea Craig

The Vancouver General Hospital's (VGH) award-winning end-of-trip facility is a great local example for UBC to emulate. The VGH Cycling Centre is a membership-based facility available to staff and volunteers working at or near the VGH campus (see Figure 13). It is open 24 hours a day, all year round. With 174 bike racks (including 12 outlets for electric bikes) and eight bike lockers, it is one of the region's largest facilities for bicycle commuting. The facility includes changing rooms, showers, towel service, storage lockers and bike stands with tools and pumps. Women's changing facilities also cater specifically to women's unique needs with a greater number of showers and sink basins. The facility is located at West 10th Avenue between Willow and Laurel Streets, in the centre of VGH campus, and has street level access, making it convenient for cyclists. This locally-renowned facility is specifically designed for VGH staff and is a model that can be replicated to the UBC context for faculty, staff, and students.

## Case Study #3: Thompson Rivers University

Thompson Rivers University (TRU) is leading the way in providing financial incentives for sustainable modes of travel to its campus. TRU offers two main streams of financial incentives for its employees: employee e-bike discounts and seasonal commuter parking passes.

### 1. *Employee E-Bike Discounts*

The TRU Employee E-Bike Purchase Program allows employees to receive an incentive of 10 percent off the purchase value of an e-bike, up to \$300. To further assist in the purchase of expensive e-bikes, full-time employees may apply for e-bike financing through TRU. Both incentives alleviate the high up-front cost of purchasing an e-bike.

### 2. *Seasonal Commuter Parking Pass*

As a thank-you to employees using cycling as their alternative mode of transportation (via either conventional or electric bike), TRU also offers a special Seasonal Commuter Parking Permit. Upon successful registration of their bike with the TRU Sustainability office, cyclists are eligible for a parking permit valid from mid-November to mid-March. This short-term seasonal parking permit encourages cycle commuting up until the onset of winter weather conditions and onward after the arrival of spring season by saving the equivalent of one semester of parking.

This case study highlights how campuses can provide financial incentives to make it easier for campus employees, who typically have a longer tenure at universities than students, to use e-bikes.

## Recommendations

In learning from the best practices presented above, we have developed the following recommendations for UBC to consider:

### 1) Increase the Quantity and Quality of Bike Parking Infrastructure on UBC Campus

First, UBC can increase the quantity and quality of bike parking that already exists on campus to help e-bike users feel safe bringing their expensive e-bikes to campus. It was clear from our interviews that bike cages on campus were not perceived to be adequately secure and the availability of individual bike lockers was limited and over-capacity (see Figure 14). Secondly, we recommend features such as automatic doors in order to make it easier to access the facilities with heavy and bulky e-bikes. Third, bike storage should be weather-proof, easily accessible,

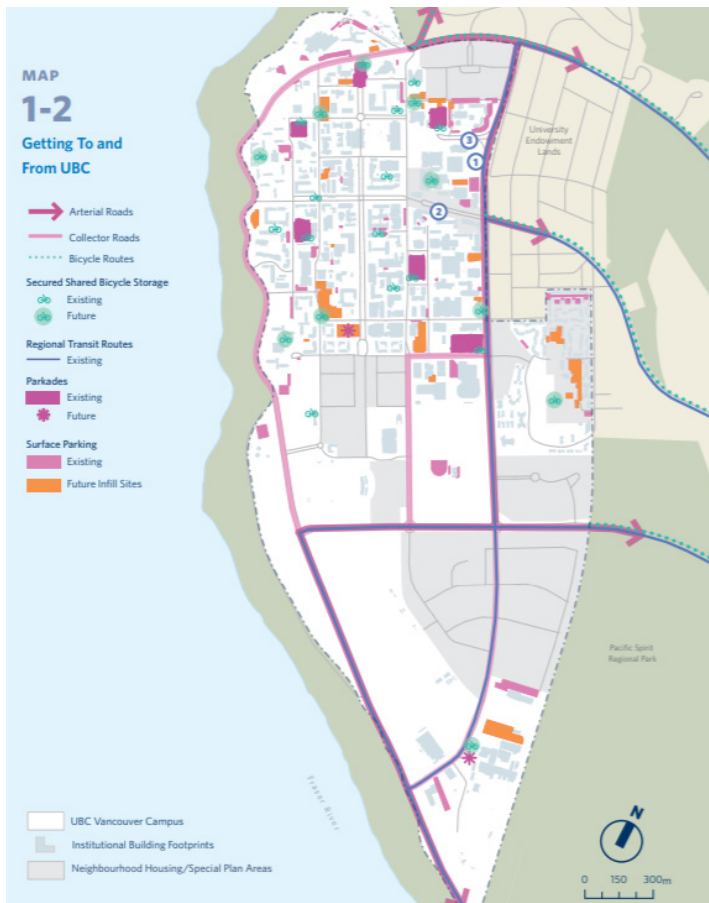


Figure 14: A map showing both existing and future secured shared bicycle storage at UBC.

Source: Campus + Community Planning, 2014, p. 42.

consistently available - and most importantly, secure from theft. We recommend a more in-depth consultation process with users to determine what adequate bike storage would look like. As we will elaborate upon in the next section, these parking facilities should also be located in immediate proximity to cyclist end-of-trip amenities like showers and lockers.

## **2) Provide High-Quality, Integrated End-of-Trip Facilities on UBC Campus**

We recommend that UBC provide more high-quality end-of-trip facilities, in the form of showers and lockers, to make it easier for people to switch to e-biking. It is important that showers and lockers are clean, comfortable, integrated with bike parking facilities, and that they meet the needs of all demographics of cyclists, like women, parents, and gender non-conforming users. Amenities such as hairdryers, baby changing stations, and laundry services will alleviate barriers to e-bike use that are unique to populations typically excluded in infrastructure design considerations and who in turn tend to opt out of cycling.

At the University of British Columbia, we have identified the existing Aquatic Centre located conveniently at the entrance to campus and near rapid transit as an optimal space to integrate bike parking and end-of-trip amenities with the existing facility. The Aquatic Centre is already equipped with showers, lockers, and change rooms that cyclists can utilize, cutting down construction and allowing for quicker and less costly implementation.

## **3) Establish Financial Incentives for UBC Faculty and Staff**

This recommendation builds off the partnership established with the previous pilot project to provide people with an opportunity for a long-term financial incentive to help with the large upfront financial commitment of purchasing an e-bike. First, in leveraging the collective buying power of UBC faculty and staff, we recommend establishing long-term corporate partnerships with local e-bike stores (eg. Electric and Cit-E-Cycles), outdoor goods stores to secure discounts on e-bikes, apparel, and accessories, as well as major bicycle manufacturers like Norco, Giant/Liv, and/or Specialized.

Second, we recommend that UBC adopt the Seasonal Commuter Parking Permit program offered by Thompson Rivers University (TRU). This program will allow staff and faculty that register their bikes with Campus + Community Planning to apply for a seasonable parking permit valid from mid-November to mid-March. This short-term seasonal parking permit will encourage cycle commuting up until the onset of winter weather conditions and following the arrival of spring season



when the weather improves while saving the equivalent of one semester of parking. In building off of TRU's program, we recommend that UBC offer the option of a short-term seasonal U-Pass for faculty and staff in lieu of the seasonal parking permit offered in the Thompson Rivers case study. This will make the initiative more effective by encouraging the use of transit as opposed to driving.

Originally, we had considered implementing a lease-to-buy program in order to financially incentivize UBC commuters through a reimbursement of U-Pass costs for all participants in the program. However, valuable feedback from our client indicated this may have the effect of cannibalizing transit, which would be an unintended and undesirable outcome. For this reason, we ultimately prioritized establishing corporate partnerships and seasonal parking permits as recommended financial incentives.

#### **4) Organize an Education and Awareness Campaign on Campus**

Moser et al. (2016) found that to increase e-bike conversion, an approach that includes individuals committing in public to change behaviour, inviting a friend to participate, and positive social feedback from friends and family can trigger lasting changes in travel behaviour. We believe a social media-driven campaign could be a 'quick win' initiative that would tackle two barriers simultaneously: lack of general information about e-bikes and social stigma toward e-bike use.

This campaign can build directly off of the educational information provided to participants of the Try An E-Bike pilot program (Refer to Appendix A). Information would include local stores that sell e-bikes, infographics explaining the different types of e-bikes, and a range of market prices for e-bikes. As cyclists make up just 1.4% of UBC's current mode share, with e-bikes comprising a small proportion of these trips, this educational campaign will create greater awareness about e-bikes as a transportation mode and foster a more enriched cycling culture on campus.

Negative stigma surrounding e-bikes was a deterrent for a couple of our study participants. One respondent stated that using an e-bike rather than a conventional pedal bike felt like a cop-out, especially for someone of her age and physical ability (Respondent: IV6, interview, Feb 12th, 2020). The takeaway from the study by Moser et al. (2016), where social feedback and interaction were harnessed

to encourage behaviour change, would be useful to apply in the student-dominated context at UBC. This campaign will utilize social media platforms to tackle negative stigmas of viewing e-biking as “cheating” in comparison to a conventional bicycle” (Aguilar, 2015, p.48) or only for MAMILS (Middle-Aged Men In Lycra). For example, this could be combated by highlighting research showing the marginal differences in cardiovascular health benefits between conventional and electric bikes (Höchsmann et al., 2018; Hoj et al., 2018). This stigma will be addressed through the proposed campaign while providing information on the benefits, capabilities, and process of switching to an e-bike.

The recommendations presented above are just a jumping-off point. A combination of these recommendations will be required to make e-biking a feasible alternative for the average commuter to UBC and a true competitor to the convenience of driving.

# **X. CONCLUSION AND FUTURE RESEARCH**

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The various observations and limitations in this study reveal the need for more campus-specific cycling research focusing on the barriers faced by commuters to using conventional bikes or e-bikes. Furthermore, research should focus on an in-depth consultation process with current cyclists and e-bike users to determine what adequate bike parking and end-of-trip amenities look like. In this way, we would be able to tap into the actual needs of the people, helping them overcome barriers to biking and at the same time encouraging others to try biking to campus.

As the major barriers for participants to commute to UBC with e-bikes are route infrastructure, secure bike parking, safety, the cost of e-bike, and weather and climate, further research could focus on these significant barriers to promote more widespread adoption of e-bikes beyond the local UBC context.

A number of sub-topics could not be covered in this research due to limited time and resources. These include technological issues and e-bike regulation. Moreover, research on the effectiveness of local government policy promoting e-bike use was not included, nor was research examining the time usage of an e-bike after charging. The wave of micro-mobility will require further research into how to accommodate varying speeds in our shared public streets and bike lanes. Finally, more targeted research is required into how e-bikes can make cycling more inclusive for a broader range of commuters, particularly for women, parents, and seniors.

In order to better understand the barriers for people to commute by e-bike and the impact of e-bike use, comprehensive studies are needed to quantify the barriers. E-bike research can benefit from the movement towards more data collection techniques that are occurring throughout the transportation discipline, relying on better technology to gather more detailed barrier information. This will help provide the necessary details to explore how to mitigate current and future e-bike use barriers on safety, bike parking, costs, weather conditions, and route infrastructure. Since roads accommodate multiple modes of travel, consultation on e-bike infrastructure on roads needs to include input from all road users, rather than just e-bike users.

Following UBC's declaration of a climate emergency in 2019, we recommend the measures and interventions recommended in this report be adopted as part of UBC's forthcoming climate response plan. Bold measures will need to be taken to change the transportation behaviour of UBC commuters and for UBC to achieve its sustainable mode share targets by 2040. The recommendations in this report are the very kind of ambitious and creative ideas needed.

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## **XIII. APPENDICES**

## **Appendix A - UBC's Try an E-Bike Program - Purchasing Guide**

<https://planning.ubc.ca/sites/default/files/2019-12/UBC-E-Bike-Purchasing-Guide-web.pdf>

## Appendix B - Focus Group Questions

1. Before you entered the e-bike pilot program, how did you usually get to campus?
2. Where were you coming from and how long did it take?
3. How do you usually get to campus now, after the e-bike pilot program?
4. Do you have to make stops along the way? What kind of stops?
5. What motivated you to try an e-bike?
6. How was your experience riding the e-bike to campus? What didn't you like?  
(Participants wrote answers on sticky notes and then talked about them.)
7. What were some things that made it most difficult to e-bike?
8. For you, what is/was the single most significant barrier to commuting to campus by e-bike?
9. Why did you ultimately decide not to purchase an e-bike after the pilot program ended? What are the various considerations that went into your decision?
10. What would need to happen to make it possible for you to e-bike to campus?
11. What could UBC do to make it easier for you to e-bike to campus? In other words, what would have changed your decision to not purchase an e-bike?
12. Any other thoughts?

## Appendix C - Interview Questions

1. How do you get to and from campus? How long does it take?
2. Why do you take that mode?
3. Do you have to make stops along the way? What kind of stops?
4. Are there any downsides to taking that mode? If so, what are they?
5. Would you ever consider e-biking to campus as an alternative? (e-bikes pedal and handle just like a regular bicycle, but are assisted with a chargeable electric motor)
  - a. IF YES: What's preventing you from doing it?
    - i. AFTER: What is the single greatest barrier preventing you from e-biking to campus?
  - b. IF NO: Why not?
6. What are the various things that would come into consideration in your decision to take an e-bike to campus or not?
7. What do you think UBC could do to make it easier for you to choose e-bike (or bike, if the respondent is unfamiliar with e-bikes) as your primary mode of transport to campus?
  - a. PROMPTS: This could include financial incentives, infrastructure, or policies. Dream big!
8. What would need to happen to make it possible for you to e-bike to campus?

## Appendix D - List of Barrier Codes

### Safety

- Lack of lighting or darkness
- Interactions with motor vehicles

### Security

- Theft

### Technical concerns

- Battery range anxiety
- Flat tires
- Mechanical failures

### Integration with other modes (not safety)

- with transit
- with car racks

### Financial disincentives

- Existence of UPass program
- Cost of E-Bike
- Cost of cycling gear (apparel, panniers, lights, etc.)

### Weather and Climate

### Route infrastructure

- Absence of separated bike lanes
- Inadequate cycling infrastructure
- Unpleasant route surfaces
- Intersections, traffic signals

### Trip Characteristics

- Caregiving/Passenger-serving trips
- Trip Chaining
- Load Carrying Capacity of E-Bikes
- Necessity of car

### Lack of storage at home

### Lack of E-Bike Infrastructure at UBC

- Bike parking
- Showers
- Lockers
- Changing room

### Lack of Incentives

#### Factors related to the person

- Physical demand/conditions of e-biking
- Skill level
- Disability/condition

#### Societal factors

- Laws related to e-biking/policy restraints
- Stigma attached to e-biking (“cheating”)
- Family’s concerns about safety

#### Convenience of other modes

#### Lack of information

- Regarding what model to buy
- Education about e-bikes
- Bike routes
- Regarding location of charging stations or secure parking
- Wayfinding

#### Appearance and Hygiene Related Concerns

- Dirty clothes
- Bike Clothing
- Need to look professional
- Wet hair
- Smelling Bad
- Need to shower
- Sweating

#### Cumbersomeness of e-bike

- Weight
- Awkward
- Bulky

#### Logistical Complexities of e-bikes