Cycling into the Future:
Assessing attitudes towards e-bikes in a mid-sized, sprawled Canadian city

by
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Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

a) human research ethics approval from the Vancouver Island University Research Ethics Board; or

b) Advance approval of the animal care protocol from the Vancouver Island University Animal Care Committee; or

c) Has conducted this research as a co-investigator, collaborator, or research assistant in a research project approved in advance of the author’s involvement.

A copy of the application has been filed with the Research Ethics Board at Vancouver Island University and inquiries may be directed to that authority.

Vancouver Island University
Nanaimo, British Columbia

Updated Spring 2017
Abstract

Cycling offers an alternative to carbon-intensive transportation, yet cycling rates in North America remain relatively low. Electric bicycles offer a low-barrier entry to cycling that have the potential to encourage a transition to more sustainable and healthy transportation modes. This research aims to fill a gap in research on e-bike use and adoption in a Canadian context. A survey was conducted to assess openness and attitudes to e-biking for transportation in Nanaimo, BC. Interviews with e-bike retailers were conducted to determine what trends can already be seen in Nanaimo. The results from the survey and interviews indicate a high level of interest in e-bikes by non-cyclists, but barriers such as cost and risk of theft may prevent pursuit of e-biking. Interview results suggest that e-bikes are gaining in popularity in Nanaimo, predominantly by older adults for recreational purposes, but also with younger adults who are interested in e-biking for transportation. Policy recommendations to encourage e-cycling are described at the end of the document.

Keywords: Active transportation; electric bicycle; sustainable transportation; e-bike; transportation policy; cycling
Dedication

This is dedicated to my parents, who have always supported me, to my partner, who has always encouraged me to chase my dreams even when it takes me away from him, and to my fellow MCP cohort: we did it!
Acknowledgements

First, I would like to acknowledge the guidance and mentorship from my program director, Pam Shaw, and my supervisor, Lindsay Chase. Pam’s commitment to her students and her encouragement to take every opportunity that comes our way has continuously inspired me. Lindsay’s academic and professional guidance (with a constant sense of humour) have helped me get to where I am.

I would also like to acknowledge all those who listened to my ideas, bounced them back at me, and got excited about e-bikes with me. Those who read various drafts of proposals were an immense help. Thank you to the City of Nanaimo employees who helped get the survey out there, and to those who reached out afterwards to chat about e-bikes. A big thank you to the interview participants, who generously spent their time chatting with me.

Finally, I would like to acknowledge my friends and support network, who kept me sane and made sure I left the books sometimes and had some fun.
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## List of Acronyms

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAA</td>
<td>All Ages and Abilities (referring to cycling networks)</td>
</tr>
<tr>
<td>EV</td>
<td>Electric vehicle</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gases</td>
</tr>
<tr>
<td>OCP</td>
<td>Official Community Plan</td>
</tr>
<tr>
<td>PST</td>
<td>Provincial Sales Tax</td>
</tr>
<tr>
<td>RDN</td>
<td>Regional District of Nanaimo</td>
</tr>
<tr>
<td>TMP</td>
<td>Transportation Master Plan</td>
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</table>
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Transportation</td>
<td>Term describing modes of transportation that involve the traveler using their own power for travel. Can include walking, cycling, running, or any other type where the traveler propels themselves.</td>
</tr>
<tr>
<td>All Ages and Abilities</td>
<td>Refers to cycling infrastructure that is safe and comfortable for people of all ages and abilities to use.</td>
</tr>
<tr>
<td>E-bike</td>
<td>Shorthand for electric bicycle; refers to a bicycle with an electric motor that can assist the rider. May be used to refer to bicycles where the rider must pedal to trigger the motor assist, or to bicycles that include a throttle with the assist available at all times.</td>
</tr>
<tr>
<td>Pedelec</td>
<td>Generally refers to an electric bicycle where the motor only assists while the rider is pedalling.</td>
</tr>
<tr>
<td>Sharrow</td>
<td>A term used to describe shared road infrastructure. Usually indicated by a painted bicycle symbol on the road, it indicates that cars and bicycles should share the road.</td>
</tr>
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Chapter 1.

Introduction

While the modern planning profession began in response to the challenges of public health and infectious diseases in the 19th century, the challenges we face now are no less daunting. Climate change, pollution, and chronic diseases (“diseases of civilization”) have arisen out of many of the technological improvements which have led to a higher quality of life in much of the world. While environmental and public health problems are being seen at national and international scales, the causes and solutions to some of these problems can be addressed at a local, urban level. Planners are uniquely situated to address these problems, as local governments arguably influence the daily life of citizens more than any other level of government.

While climate change and public health are often treated as separate issues, there is a growing acknowledgement that they are highly interrelated, both in their causes and in the effect that climate change will have on public health (Frank, Greenwald, Winkelman, Chapman & Kavage, 2010; Watts et al., 2015; Younger, Morrow-Almelder, Vindigni, & Dannenberg, 2008). In an urban context, transportation habits contribute both to climate change and overweight and obese populations (Younger et al., 2008). In much of North America, the private automobile is the primary mode of transport for many people. This contributes significantly to climate change. In the US, transportation is the largest source of carbon emissions, representing 29% of total emissions (US Environmental Protection Agency, 2019). In Canada, transportation is second only to the oil and gas industry in terms of emissions, representing 24% of total emissions (Environment and Climate Change Canada, 2019). It also means that our cities have been built to accommodate automobiles, which makes active forms of transportation like walking and cycling more difficult. Designing physical activity out of our daily lives has contributed to increasing obesity problems and associated illnesses like heart disease and others (Younger et al.,
Aside from the obvious issue of preventable mortality rates, physical inactivity also costs healthcare systems billions of dollars every year (Ding et al., 2016; Janssen, 2012; Jarrett et al., 2012).

Both issues may also have common solutions. Active transportation, also referred to as active mobility or active travel, is the idea that when we are commuting, going to the store, or meeting friends, we can get there by using our own power. Doing so reduces the need for fossil fuels and allows people to meet their requirements for physical activity (Mueller et al., 2015). Looking through an equity lens, there is also a strong argument to support active transportation. Private automobiles cost thousands of dollars every year in insurance, gas, and maintenance. Communities that are designed for the automobile put pressure on those with low incomes to purchase a car to be able to work and access services. Designing for and normalising active transportation gives people more mobility choices and could save people a substantial amount of money.

Cycling is a particularly promising form of active transportation. It requires no fuel to power, it is faster and more efficient than walking, and can more easily replace trips otherwise taken by car, as one can travel further and carry more on a bike. However, in certain contexts there are significant barriers to cycling for transportation, such as extensive urban sprawl and hilly topography. Electric bicycles, or e-bikes, may be one way to overcome some of the major barriers to cycling. E-bikes are bicycles with electric motors that assist the rider as they pedal the bike. E-bikes have the potential to greatly expand the scope of cycling for transportation, as they make hills and distance easier to overcome.

Evidence suggests that e-bikes are already gaining popularity, especially in European countries (Lee, Loucks, Stewart, Jarvis & Arkenberg, 2019). Sales of e-bikes have been outstripping sales of electric vehicles (EVs) by a considerable margin and are already outselling traditional bicycles in the Netherlands. (Lee et al., 2019; Reid, 2019). The literature on e-bikes largely comes out of countries like the Netherlands, where there is already a high rate of cycling for transport. North America has about a 1% rate of cycling, with Canada cycling at slightly higher rates than the US (Pucher, Buehler, & Seinen, 2011), and a totally different built environment and cultural context than Europe. More research is required to understand e-biking in the Canadian context. This project aims to start to fill
that gap, by examining attitudes towards e-bikes in a mid-sized city in Canada with low levels of cycling and a high dependency on cars.

1.1. Background

Nanaimo is a mid-sized city located on the east coast of Vancouver Island. According to the 2016 Census, it has a population of about 104,936 (Statistics Canada, 2017a). It is connected via ferry to Vancouver and via Highway 19 to Victoria. The City of Nanaimo is located within the boundaries of the Regional District of Nanaimo (RDN).

Prior to European settlement, the Snuneymuxw First Nation, one of the Coast Salish peoples, lived in the area for time immemorial. Europeans first settled in the area in the early 1850s when coal was found in what is now downtown (Leduc, n.d.). Even after the decline of coal mining the mid 20th century, Nanaimo remained a major settlement and economic hub on the island (Artibise & Favrholdt, 2015).

Nanaimo’s urban form is at once unique and a reflection of the larger settlement patterns seen in North America. Its original street grid, designed by George Deverill, is a unique “spider web” pattern radiating from the inner harbour/downtown area (Leduc, n.d.). The pattern was meant to conform better to the bowl-shape of the harbour and surrounding lands, rather than a strict cartesian grid. The areas just adjacent to that are a more traditional street grid. Moving north from downtown, the urban form becomes sprawled and meandering. After Woodgrove Mall opened in 1981 in an otherwise undeveloped area (McGarrigle, 2011), development moved to fill the space between downtown and the mall. This led to the proliferation of strip malls along Highway 19a, the city’s main corridor, with suburban development sprawling out on either side.
Nanaimo is situated in the Coastal Douglas Fir biogeoclimatic zone. With mild, wet winters and moderate, dry summers, it has one of the most temperate climates in Canada (Ministry of Forests, 1999). Its economy has traditionally been resource based, with coal, forestry and lumber production originally fueling the economy. The economy has now diversified, with retail and services playing a role, as well as tourism and education (Artibise & Favrholdt, 2015). Vancouver Island University’s main campus is located in Nanaimo.

Nanaimo is a car-dominated community, with 80.4% of residents using a car, truck, or van as a driver to get to work. This compares to 70.5% of British Columbians. 6% ride in a vehicle as a passenger, 3.85% take public transit, 6% walk, and 1.5% of residents cycle to work. All alternative modes of transportation (public transit, walking, and bicycling) are significantly lower than the BC average (Statistics Canada, 2017b).
Nanaimo currently has minimal cycling infrastructure. There are two multi-use trails, both following the two highways that run through the city. The Parkway Trail runs along Highway 19 (“the parkway”) from North to South. It provides safe cycling off of the highway but is hilly and meandering, meaning it can be an indirect route if commuting. The E&N Trail runs beside Highway 19a (“the old highway”) and also runs roughly north to south. This is a popular route for commuting.

Other than the two trails, there is a combination of signage, painted bike lanes, short trails and cut-throughs between streets and cul-de-sacs, and sharrows (a combination of “share” and “arrow” – typically a painted symbol of a bike with two arrows above, indicating a shared space for bicycles and cars). While the network of cycling infrastructure is far from complete, the city has been slowly but steadily adding more bike routes.

Figure 1.2 Example of a sharrow.
1.1.1. Policy Context

Adopted by Council in 2014, the Nanaimo Transportation Master Plan (TMP) sets out the strategic goals and policy background for transportation in Nanaimo. It supports the city’s Official Community Plan (OCP), planNanaimo. planNanaimo’s specific transportation priority is:

Greater accessibility and more opportunity for safe and convenient movement around the city by transit, cycling, and walking as well has enhanced regional connections (City of Nanaimo, 2008, p.8).

Overall, the OCP and TMP have a goal of increasing sustainable travel mode share from 12% to 24%. Specifically, the TMP sets the goal of increasing bike trips from 1% (3,000 trips per day) to 4% (15,000+ trips per day) by 2041. To support this goal, the TMP sets out specific policies, such as developing and expanding the cycling network and integrating cycling with other modes and initiatives.

The TMP does acknowledge the need for improved cycling infrastructure for people to feel safe and comfortable riding:

Many residents have indicated that they would consider cycling more if the quality of bicycle facilities were improved and the cycling network was expanded to serve more destinations such as Downtown and Vancouver Island University. Similar to walking, different parts of the City have different cycling activity levels, with Central Nanaimo showing the highest levels of current cycling activity and the greatest potential for future expansion (p.49).

It also acknowledges that:

Developing a comprehensive cycling network that covers the entire City and which residents would feel comfortable using is integral to achieve the Plan’s cycling targets (p.49).

The plan goes on to specify the strategic directions and goals, which have a focus on expanding the cycling network as well as education and outreach. Plans for expanding the cycling network are over the short- and long-term.
There is no mention of electric bicycles (e-bikes) in the entire document. The only mention of electric transportation is electric vehicles (EVs), which are mentioned several times, generally in relation to providing vehicle charging stations.

Beyond official planning documents, Nanaimo is an active organizer in Bike to Work Week events (a provincial initiative) and has partnered with the Nanaimo RCMP to promote the use of a mobile bicycle registration app to help prevent bicycle theft (City of Nanaimo, 2019b).

1.2. Research question

Despite Nanaimo’s temperate climate, utilitarian cycling rates remain low. This is likely because of context-specific barriers, such as the sprawled built environment, the lack of cycling-specific infrastructure, the hilly environment, and a “car culture” seen in many North American communities. However, e-bikes have the potential to overcome at least some of the barriers, such as distance and topography. If cultural attachment to the car is strong though, encouraging a mode shift to cycling may be challenging. This research aims to determine if there is any interest in e-biking as transportation in Nanaimo and how the city might encourage a modal shift.

As an initial step in researching e-bike viability in Nanaimo, I am asking the following question:

Can e-biking be a safe, reliable and desirable mode of transportation in Nanaimo?

Three questions will be asked under the overarching question:

1) What are the current perceptions of e-biking in Nanaimo?

2) What are the opportunities and barriers for people to adopt e-biking as a mode of transportation?

3) What e-bike trends are already being seen in Nanaimo?
1.3. Purpose of research

While there is a growing body of research on e-bikes, much of it comes from countries with already high levels of cycling, such as the Netherlands and Denmark. There is some research in the North American context, but very little of has come from Canada. Therefore, this research aims to contribute to filling a research gap on e-bikes in Canada, and specifically in coastal British Columbia. Nanaimo has a low level of cycling (just over 1% of commuters), which reflects the North American average. The city has significant barriers to cycling such as hilly topography and sprawl, but it has yet to be seen if e-bikes can overcome those barriers – or rather, if people perceive that it can.

This research is largely qualitative and aims to determine general attitudes towards e-biking in Nanaimo and what trends can be observed. The findings of the research will inform policy recommendations on how to promote e-biking as a mode of sustainable transportation. While the policy recommendations will be specific to Nanaimo, it is anticipated that many of them could apply in other Canadian cities, especially in coastal BC. Some recommendations will also be aimed at the provincial government, who have the potential to provide incentives for e-bike purchases.

1.4. Outline of document

My project begins with a comprehensive literature review of active transportation and cycling/e-biking research. This includes the benefits of cycling, cycling policy, transportation theory, cultural influences on cycling, uses of e-bikes, benefits of e-bikes, and safety issues surrounding e-bikes.

Next I will describe my methodology for the project, which is a mixed-methods approach. Through a survey of a sampling of Nanaimo adults, I hope to answer what attitudes towards e-bikes exist in Nanaimo, and to gauge potential interest in e-biking. Then, through interviews with owners and managers of stores that sell e-bikes, I hope to see what trends can be seen in Nanaimo and seek expert advice on what Nanaimo could be doing to promote e-biking and cycling.
Chapter 4 summarizes my results and findings. Chapter 5 provides a discussion of the results and how they relate to previous research. It also provides recommendations to both the provincial government and the City of Nanaimo for promoting e-biking as a mode of sustainable transportation. The document will conclude with a summary of the findings and by pointing towards further research needs.
Chapter 2. Literature Review

The literature review will map out relevant research trends associated with cycling and e-biking. The following themes will be discussed: the benefits of cycling as transportation (including for health and climate change), pro-cycling policies, transportation theories, cultural effects on/of cycling, electric bicycle uses, benefits of e-bikes, and safety concerns related to e-bikes.

2.1. Benefits of Cycling

Cycling has seen a growing interest in research since the 1990s with a dramatic increase in research in the last 10 years (e.g. Aldred, Elliott, Woodcock, & Goodman, 2017; Buehler & Dill, 2016; Ogilvie, Egan, Hamilton, & Petticrew, 2004; Pucher & Buehler, 2008; Pucher, Dill & Handy, 2010). Much of the interest is spurred by a realization that motorized vehicle transport has had significant impacts on both environmental and human health (Mueller et al., 2015).

2.1.1. Health Benefits

One of the major implications of automobile-dependent communities is an increase in physical inactivity. This has serious public health and economic implications. Globally, physical inactivity costs approximately $53.8 billion (international dollars) per year, which is considered a conservative estimate (Ding et al., 2016). A study out of the UK estimated that increasing active travel would save the national Health Service (NHS) approximately 17 billion pounds (Jarrett et al., 2012).

Katzmarzyk, Gledhill, & Shephard (2000), and more recently Janssen (2012) estimated the healthcare costs of physical inactivity in Canada, primarily due to 7 associated chronic diseases (coronary artery disease, stroke, hypertension, colon cancer, breast cancer, Type 2 diabetes, and osteoporosis). Janssen (2012) found that inactivity in adults costs $6.8 billion annually, or about 3.8% overall healthcare costs. In their earlier calculation, Katzmarzyk et al. (2012) estimated that Canadians could save $150 million
per year with a reduction of 10% in prevalence of physical inactivity. This represents significant cost savings with a modest reduction in inactivity.

The literature indicates that increasing active travel generally, as well as cycling specifically, would reduce the prevalence of chronic disease and result in healthcare cost savings (Hamer & Chida, 2008; Mueller et al., 2015; Mueller et al., 2018; Oja et al., 2011). In a review of the literature, Oja et al. (2011) found that of 16 studies on cycling, all but 2 showed that cycling provided a health benefit. Cross-sectional, longitudinal, and intervention studies all showed improvements in cardiorespiratory fitness with increased cycling (Oja et al., 2011). Health improvements are most significant in low-fitness adults, but still progressive among medium- and high-fitness adults (Oja et al., 2011). All-cause mortality is estimated to be reduced 20% with less than an hour’s daily moderate-intensity cycling and more than 30% with about 100 minutes of daily cycling (Oja et al., 2011). Hamer & Chida (2008) found similar results, with a curvilinear dose-response relationship between active commuting and benefits.

Mueller et al. (2018) estimated the health impact assessment of increasing cycling networks in European cities. The authors estimated that if all 167 cities examined achieved a cycling mode share of 24.7%, over 10,000 premature deaths would be avoided. This is based on the assumption that the expansion of cycling networks corresponds with increases in cycling in European cities, which has been demonstrated historically (Mueller et al., 2018).

More generally, a health impact assessment of increasing active travel showed a decrease in mortality (Mueller et al., 2015). The health benefits were found to outweigh any risk or cost, regardless of geographical context. The health outcomes benefit older adults more, but traffic safety affected all populations and especially younger ones. The authors estimated that the increase physical activity accounted for at least half of the total health impacts (Mueller et al., 2015). While traffic risk may increase slightly with higher exposure, overall traffic volume should reduce with a modal shift, and therefore risk would be reduced (Mueller et al., 2015).

De Hartog, Boogaard, Mijland & Hoek (2010) examined whether the health benefits of cycling outweigh the risks (primarily increased exposure to traffic and air
pollution). They found that overall, the health benefits were 9 times more than the risks of cycling, with an overall 3-14 month expected gain in life expectancy with switching to cycling (de Hartog et al. 2010). This echoes the findings of Mueller et al. (2015) in that the benefits outweigh the risks, and that while the benefits are most visible in older adults and inactive persons, health improvements can be seen at all fitness levels (de Hartog et al., 2010). Bicycle commuting also seems to add to physical activity levels, rather than replace other types of physical activity performed (Donaire-Gonzalez et al., 2015).

It is worth noting that these studies come primarily from Europe, where cycling levels are generally high. The results may be slightly different in more car-dependent countries; benefits and risks are sensitive to contextual settings (Mueller et al., 2015).

Looking at air pollution specifically, several studies examine if cyclists increase their risk due to increased breathing rates. Tainio et al. (2016) calculated the tipping point (where additional physical activity compared to air pollution would lead to no additional benefits) and the breakeven point (where physical activity will cause adverse effects) for various cities. The authors found that less than 1% of cities have fine particulate matter concentrations high enough that 30 minutes of cycling every day would hit that tipping point (Tainio et al., 2016).

Johansson et al. (2017) and Grabow, Spak, Holloway, Stone, Mednick & Pats (2012) both calculated the specific changes in air pollution if commuters switched from driving to cycling. In Stockholm, if 111,000 people (the estimated number of people with the physical capacity and short enough travel distance to cycle commute) switched to cycling, 63 premature deaths would be saved, which is double the benefits associated with a recently installed congestion tax (Johansson et al., 2017). In a study of the midwestern states of the US, Grabow et al. (2012) found that replacing 50% of short car trips (<8km) with cycling would result in 1,295 fewer deaths per year, including 608 fewer due to improved air quality and 687 fewer due to increased physical activity.

Mueller et al. (2015) note that noise impacts are largely neglected in research on cycling and active travel. At least one study examines noise pollution: Apparicio et al. (2016) found that cyclists’ exposure to both noise and air pollution vary depending on type
of bicycle infrastructure, hours of travel, and weather, with no conclusions about lasting effects.

Cycling and active commuting appear to have positive impacts on psychological well-being as well as physical health. Several studies have shown that cyclists are the most satisfied of all commuting types (Avila-Palencia et al., 2017; Friman, Garling, Ettema, & Olsson, 2017; Gatersleben & Uzzell, 2007; Martin, Goryakin, & Suhrcke, 2014; Willis, Manaugh & El-Geneidy, 2013). Car driving may increase stress through constant concentration, boredom, and social isolation, while cycling has the benefits of the intrinsic enjoyment and relaxation from exercise (Gatersleben & Uzzell, 2007; Martin et al., 2014). Gatersleben & Uzzell (2007) proposed that the four primary commuting types (driving, transit, cycling, and walking) provoke different levels of pleasant feelings and of arousal. Driving is relatively unpleasant and arousing, transit is unpleasant and not arousing, walking is pleasant and not arousing, and cycling is pleasant and arousing. This classification makes cycling the optimum travel type from an affective perspective (Gatersleben & Uzzell, 2007).

Satisfaction with cycling is not constant, however, and contextual factors (weather, the built environment) may affect cyclist satisfaction and well-being. A study from Montreal found that there is a strong relationship between satisfaction and season, with satisfaction being lowest in winter months (Willis et al., 2013).

2.1.2. **Environmental Benefits**

As mentioned in the health section above, a modal shift from cars to bicycles would result in reduced air pollution (Grabow et al., 2012; Johansson et al., 2017). Encouraging more active transportation also has the potential to impact carbon emissions and climate change (e.g. Frank et al., 2010; Neves & Brand, 2019). Theoretically, switching mode share from carbon-emitting vehicles to cycling would result in lower greenhouse gas (GHG) emissions. However, few studies exist that have measured this correlation. Brand, Goodman & Ogilvie (2014) found no statistically significant reduction in GHG emissions with an increase in cycling infrastructure, although the design of the study would not have picked up small changes. Other studies have modelled the potential reduction in GHG
emissions. Neves & Brand (2019) found 41% of car trips had the potential to be easily replaced by cycling, which would result in a 4.5% reduction in GHG emissions per person, per week. In a comprehensive model of the costs and benefits of a modal shift towards cycling, Macmillan, Connor, Witten, Kearns, Rees & Woodward (2014) found that carbon emissions would be lowered and cost savings realized.

Despite a lack of rigorous studies, increasing cycling and active transportation are commonly suggested as policies to address climate change (Frank et al., 2010; Macmillan et al., 2014; Maibach, Steg & Anable, 2009; Watts et al., 2015; Younger, Morrow Almeida, Vindigni & Dannenberg, 2008). Many car trips in North America and Europe are within 5 miles, a distance that is easily cyclable in many cases (Bagloee, Sarvi & Wallace, 2016; de Nazelle, Morton, Jerrett & Crawford-Brown, 2010; Neves & Brand, 2019). There is also an acknowledgement that promoting public health and climate policy have converging goals when trying to reduce demand for vehicle transportation; both of which can be addressed in part by cycling (Frank et al., 2010).

2.2. Cycling policy – how do cities encourage cycling?

There is a wide range of research examining cycling policies in an effort to determine what is successful in getting people to ride.

It is generally agreed that infrastructure is a key component in encouraging cycling, as demonstrated by countries with both adequate infrastructure and high cycling rates (Dill & Handy, 2010; Gossling, 2013; Pucher & Buehler, 2008; Pucher, Handy, Van Wee, & Kroesen, 2014) and countries with relatively low cycling rates (Adam, Jones & te Bommelstroet, 2018; Pucher, Buehler & Seinen, 2011). Countries with high cycling rates such as the Netherlands, Germany, and Denmark have all had federal support for cycling infrastructure and policy, beginning in the 1970s (Pucher & Buehler, 2008). While cycling rates were falling across the industrialized world in second half of the 20th century, these countries made a concerted effort to reform policy to encourage modes of transport other than the car (Pucher & Buehler, 2008). This has resulted in high overall cycling rates, as well as significantly higher cycling rates among women, older age groups, and other groups that cycle significantly less in Northern America and Australia (Garrard, Rose & Kai
Cycling infrastructure is likely such an important factor in cycling rates due to both real and perceived safety (Heinen, van Wee, & Maat, 2010).

In an examination of North American cycling trends, Pucher et al. (2011) found that after a long decline, cycling rates had been growing in the previous decade. While there was no association between city size and cycling rates, the cities that saw the most growth/highest rates in cycling were the ones that had implemented specific policy, with infrastructure as the most common initiative (Pucher et al., 2011). Several other trends emerged, such as low car ownership being associated with higher cycling rates, and a strong preference and need for secure, sheltered bike parking (Pucher et al., 2011; Pucher, Dill & Handy, 2010). Marketing and educational outreach also seem to be important in raising bicycle mode shares, and the greatest gains may be seen by a combination of infrastructure and marketing (Heinen et al., 2010; Lanzendorf & Busch-Geertsema, 2014).

Specific types of bicycle infrastructure may influence cycling rates, but the relationship is unclear and inconsistent (Buehler & Dill, 2016). Generally, protected bike lanes (with a physical barrier between bicycles and cars) and separate bicycle paths are preferred by less experienced riders and women, while on-street cycling is preferred by experienced cyclists (Buehler & Dill, 2016; Heinen et al., 2010). Overall, the research indicates that whole bicycle networks (with continuous and connected facilities) may increase ridership, as cities in both North America and Europe with complete networks have higher cycling rates (Buehler & Dill, 2016; Gossling, 2013; Pucher et al., 2010).

Integration of cycling infrastructure (including parking) with transit operations may also be important in encouraging cycling (Martens, 2007; Pucher & Buehler, 2008; Pucher et al., 2011). The Netherlands provides an example of this, where bike-and-ride policies aimed to solve the problem of accessibility to transit stops and reduce overall travel time (Martens, 2007). Improvements to bike facilities at train stations saw a significant increase in ridership. The Netherlands is unusual in that they have specific bike-and-ride policy at the national level, stemming from the Bicycle Master Plan of 1992. However, since then there has been no comprehensive initiative to promote bike-and-ride at the national level (Martens, 2007).
It is important to note that while there is a fairly extensive body of research on cycling policy, infrastructure, and initiatives, much of the research is incomplete and difficult to draw strong conclusions from. There are very little longitudinal data, studies with control groups, a lack of clear documentation of cycling rates before and after implementation, and few have random samples (Ogilvie et al, 2004; Pucher et al., 2010).

2.3. Transportation theory and policy

In order to understand why people choose to cycle or not, it is helpful to examine traditional theories of transportation mode choice, behaviour, and more recent studies on specific factors that influence mode choice.

Traditionally, transportation mode choice was considered a rational, economic decision (Di & Liu, 2016). In traffic studies, travelers were assumed to choose routes based on minimizing disutility (often distance and/or time) (Di & Liu, 2016). However, it is now agreed that perfect rationality is too simple of a model, and transportation choices are influenced by a range of factors. Habit plays a significant role in choices and behaviours, as it allows for a less elaborate decision-making process (Di & Liu, 2016; Aarts, Verplanken, & van Knippenberg, 1997). Myopia, or the lack of consideration for wider interests or long-term consequences, also plays a role. (Di & Liu, 2016).

As a broad way to understand transportation behaviour, it is useful to use Ajzen’s (1991) Theory of Planning Behaviour. The theory considers an individual’s intention to perform a behaviour as an indicator for whether they perform it or not (Ajzen, 1991). For example, if an individual intends to ride a bicycle to work, they are much more likely to do so than if they do not have that intention. Ajzen sees three determinants of intention: the attitude towards the behaviour, the subjective norm (or social pressure to perform the behaviour or not) and perceived behavioural control (a person’s perception of whether they have the ability to perform the behaviour) (Ajzen, 1991). This broad theory can be used to explain individual choices, but there is also research on specific influences on travel behaviour.
There may be strong cultural and social determinant of transportation choice. Buys & Miller (2011) explore factors influencing transportation mode choice. They found that perceived convenience played a large role in driving versus transit use, even in dense urban neighbourhoods. Additionally, the authors found that family or personal identification with automobile culture influenced decisions, even when there was awareness of the reliability of local transit (Buys & Miller, 2011). This points to a cultural and social determinant of transportation choice, which is supported by additional studies in California and the UK (Aldred & Jungnickel, 2014; Pike & Lubell, 2016). A more detailed review of culture’s effect on cycling is explored later in this review.

Linked to the social influence on transportation choice is that of life events and transitions. Chatterjee, Sherwin & Jain (2013) found that life events and external changes may influence people’s transportation decisions. For example, young adults were more likely to start cycling after changes in educational or employment status or location. Relationship status changes influenced cycling across age groups (Chatterjee et al., 2013). This indicates that providing education and outreach to people to encourage cycling or making sustainable transportation choices could be targeted (for example, new students enrolling in university).

As outlined above, certain policies (such as improving bicycle networks) may influence the decision to cycle (Dill & Handy, 2010; Gossling, 2013; Pucher & Buehler, 2008; Pucher et al., 2014). Workplace policies and environments can also influence active or sustainable transportation mode choices. Hamre & Buehler (2014) found that specific benefits for cycling or walking were correlated with choosing those modes over driving and that providing free parking at work encouraged driving over other modes of transportation.

In addition to habit, cultural, and social influences on transportation choice, the built environment itself may play a role. Winters et al (2010) found that even after controlling for trip distance and demographic factors, the built environment influenced cycling levels. Less hilliness, higher intersection density, fewer highways or arterial roads, higher population density and a lower amount of land used for single-family residential or large commercial all predicted higher cycling levels (Winters et al., 2010). This suggests
that land use and road network design have an influence on peoples’ decision to cycle or not.

2.3.1. Barriers to Cycling

Several studies have examined specific barriers that stop people from cycling. Generally speaking, environmental factors such as feeling unsafe, the weather, and sometimes topography are the largest barriers, but contextual factors like lack of carrying capacity and physical effort are also frequently cited barriers (Fowler, Barrigan, & Pollack, 2017; Garrard, Handy & Dill, 2012; Heinen et al., 2010; Ravensbergen, Buliung, Mendonca, & Garg, 2018; van Bekkum, Williams & Morris, 2011). Hilliness is strongly negatively associated with cycling (Heinen et al., 2010).

While certain barriers are commonly cited amongst a range of ages, genders, and occupations, some are frequently rated as bigger barriers by women (van Bekkum et al., 2011). In a 2011 study, danger on roads, bad weather, and darkness were rated as the biggest barriers to cycling by women, rating all of those higher than men. Women were also more likely to cite carrying belongings, storage at home, the school run, physical effort, expense of buying a bike, and wearing casual clothing as barriers (van Bekkum et al., 2011). Additionally, non-riders are more likely to list more barriers and rate them as more important than people who already cycle (Fowler et al., 2017; van Bekkum et al., 2011).

2.4. Culture and cycling

Differences in cycling levels can be linked to culture, as evidenced by a growing body of research. For example, Stoffers (2012) emphasizes how cycling has been historically entrenched in the Netherlands’ culture. This was influenced by an early utilitarian approach to cycling (as opposed to recreational) and the Dutch royal family publicly adopting/supporting cycling in the 1930s. These factors have embedded cycling into a national culture where cycling is not a conscious choice but merely something that one does to get around (Oosterhuis, 2016; Stoffers, 2012). Conversely, cycling culture in the US took a drastically different path, where early cyclists and cycling organizations
focused on recreation and there were massive conflicts over road space (Oosterhuis, 2016). In addition, the US experienced a heightened automobile craze due to Ford’s manufacturing; the rapid expansion of automobile production and ownership quickly outstripped that of the bicycle. As a result, bicycles became associated with children and recreation and never reached the widespread cultural acceptance that it reached in the Netherlands (Oosterhuis, 2016).

More literature demonstrates the role of local and national culture in the use of bicycles. For example, there is no national identity of cycling in the UK, which has much lower levels of cycling than a country like the Netherlands. However, in local settings cyclists will normalize cycling and identify a local culture of cycling in opposition to the national identity (Aldred & Jungnickel, 2014). Personal or cultural conflicts may also be present between cyclists and motorists in environments where driving is the dominant mode of transportation (Cepeda Zorrilla, Hodgson & Jopson, 2019; McCarthy, 2011). Wild, Woodward, Filed, & MacMillan (2018) found that personal values and political identities play a role in attitudes towards cycling and cycling infrastructure. Those with strong negative emotional reactions to bike lanes often held more conservative values and saw bike infrastructure as a threat to their way of life and to existing entitlements (Wild et al., 2018). In Mexico City and other Latin American cities, bicycling may be seen as linked to low status and income, which in turn deters people from cycling (Cepeda Zorrilla et al., 2019).

Attitudes and norms, which are shaped in various ways by the larger culture, may also affect bicycle commuting. In a comparison between the US city of Davis and the Dutch city of Delft, a positive attitude towards cycling indicated a higher chance of cycling and cycling frequency (Heinen & Handy, 2012). While the reasons participants reported for why they cycle were largely overlapping between American and Dutch participants, more Americans cited the environment as a reason for cycling, indicating different cultural attitudes towards the merits of different types of transportation (Heinen & Handy, 2012). In a survey in the Netherlands, it was found that overall, participants had positive beliefs about cycling to work (such as it being cheap, healthy, relaxing, and having environmental benefits) but did not believe it had benefits to status, time-savings, or as being comfortable (Heinen, Maat & van Wee, 2011).
Ethnic and gender roles seem to play a role in cycling rates and attitudes towards cycling. In interviews with London, UK residents, where cyclists are overwhelmingly white and middle class, perceptions of cycling varied widely among different ethnic groups and between genders (Steinbach, Green, Datta, & Edwards, 2011). For some minorities, cycling may be seen as inappropriate, especially for women. Other women of certain social classes and ethnicities saw cycling as impractical, as they perceived that they could not carry their children with them. Non-cyclists sometimes saw cyclists as sanctimonious, which was echoed by some of the (white) female cyclists acknowledging that cycling was part of an image of being fit and environmentally conscious. Women seem to be especially policed while cycling, whether for religious reasons, for being not feminine enough, for being too feminine, or for participating in a “risky” activity (Steinbach et al., 2011).

2.5. Electric bicycles and new mobilities

Electric bicycles (often referred to as e-bikes) are bicycles that have an electric motor. While e-bikes date back almost as long as mechanical bicycles (Hung & Lim, 2010; Rose, 2012), it wasn’t until the 21st century that they entered the mainstream and saw widespread adoption, mostly due to improvements in battery technology (thus reducing the weight) (Salmeron-Manzano & Manzano-Agugliaro, 2018). “E-bike” can refer to a range of model types, from moped-style electric bikes/scooters where pedalling is not necessary to trigger the motor, to traditional-looking bicycles with an electric motor that gives a boost to the rider while pedalling (Fishman & Cherry, 2016; Rose 2012). The former model is most popular in China, which is the largest producer and has the largest market share of e-bikes in the world (Weinert, Ma, Chaktan & Cherry, 2007). The latter model, or pedal-assist e-bike, is more favoured in European and North American markets, where they are generally classified as bicycles rather than mopeds or scooters (Hung & Lim, 2020). This paper specifically examines the pedal-assist model, and references to e-bikes or electric bicycles refer to that, unless otherwise noted.
While there is a large body of research on e-bikes in China, much of it does not differentiate between the two types of models (Weinert et al., 2007). For this reason, and because of the different cultural and urban context between China and North America, this literature review will focus on the research from European and English-speaking countries.

Overall, it seems that older adults are the early adopters of e-bikes (Johnson & Rose, 2015; Jones et al., 2016; MacArthur, 2014; Peine, van Cooten & Neven, 2017; Seebauer, 2015; Simsekoglu & Klockner, 2019; Wolf & Seebauer, 2014), likely due to the appeal of less effort when riding. The pattern of older adults being the early adopters is an unusual trend in the diffusion of innovations, where young, technophile adults are generally the early adopters (Peine et al., 2017). In the Netherlands, where e-bikes were seen on the market as far back as the 1990s, early e-bikes were primarily used by older (80s and older) adults with handicaps or mobility issues (Peine et al., 2017). However, as designs changed and the technology diffused further, younger people began adopting the e-bike to increase cycling range and reduce sweating; e-bikes are relatively common in the Netherlands now (Peine et al., 2017).

Attitude also appears to play a role in the diffusion of e-bikes, possibly more than age and other demographic features (Haustein & Moller, 2016; Seebauer, 2015). This suggests the potential for education and outreach to have a significant impact on attitudes towards e-bike and a potential change in behaviour.
While many studies have indicated that older adults tend to e-bike more and many focus specifically on that age demographic, there may be some potential for adoption among a younger population (Plazier, Weitkamp & van den Berg, 2017a). A survey of Dutch students after having access to e-bikes for 4-5 weeks resulted in almost unanimous positive experience (Plazier et al, 2017a). However, few students reported being willing to purchase an e-bike. This likely has to do with the access to cheap public transportation and the high cost of e-bikes over regular bicycles (Plazier et al., 2017a). This may have implications for e-bike adoption among younger students in cities/countries with low transit use and low bicycle use, as the e-bike is a cheaper alternative to a car and may be more convenient than transit.

Much of the research in a Western context comes from countries with already levels of cycling as a mode share, especially the Netherlands. In 2015, e-biking accounted for 12% of all distance travelled by cycling in the Netherlands, an equivalent of 1.5 billion kms per year (Jones, Harms & Heinen, 2016). Most riders are older adults, with an average distance covered per trip at 5.5km, which is 2x the average on traditional bicycle (Jones et al., 2016). Many replaced car trips with e-bikes. While reasons for purchasing e-bikes are diverse and subject to complex individual conditions, many reported the reasons of: a sense of decline in physical ability, perceived positive health benefits, and the ability to ride longer distances (Jones et al, 2016).

Evidence from research is mixed on whether e-bike users ride more for recreational or utilitarian purposes, and it seems context-specific (Gordon, 2012; Ling, Cherry, MacArthur & Weinert, 2017; Lopez et al., 2017; MacArthur et al., 2014). Studies from North America, where car travel dominates, e-bikes were primarily used for utilitarian/transportation purposes (Gordon 2012; Ling et al., 2017; Lopez et al., 2017; MacArthur et al., 2014). However, some studies show that users primarily ride for leisure (shopping or recreation) (Wolf & Seebauer, 2014). This may be explained by the cultural context and the study focus on early adopters who are generally older and looking for recreational opportunities (Wolf. & Seebauer, 2014). It is suggested that in countries where cycling is more associated with physical exercise than transportation, e-bikes will have less appeal due to the reduced energy expenditure needed to ride (Simsekoglu & Klockner, 2019).
One criticism of e-bikes as a sustainable mode of transportation is that it will likely replace mechanical bicycle trips rather than car trips (Fyhri & Fearnley, 2015; Kroesen, 2017). Kroesen (2017) examined this in the Netherlands and found mixed results. While e-bike owners did reduce their mechanical bicycle ridership and ownership, and their car ownership remained constant, e-bike owners travel less by car, travel farther than a normal bike, and were more willing to use the e-bike to alternative options (Kroesen, 2017). A similar study in Norway found similar results, where participants cycled more than the control group (Fyrhi & Fearnley, 2015). The effect seemed to be greater for female cyclists, and participants cycled more the longer they had access to the e-bike (Fyhri & Fearnley, 2015).

Some studies have specifically examined the potential for e-bikes to stimulate a shift from car commuting (de Joost et. al, 2018; Edge et al., 2018; Fyhri, Heinen, Fearnley, & Sundfor, 2017). The results from a specific paid incentive in the Netherlands are not strongly conclusive, but generally showed that lower-income, previously car-only families cycled more (perhaps indicating a financial incentive from cost savings), and that couples without children cycled more than those with children and single people (de Joost et al., 2018).

Other intervention studies have shown that willingness to purchase an e-bike goes up after having the chance to use one for a period of time (Cairns et al., 2017; Fyhri et al., 2017). Saving money and mental relaxation were cited as major perceived benefits, while the environment was less of a motivating factor (Fyhri et al., 2017).

Preliminary research indicates that barriers to e-biking are overall similar to barriers to cycling, with some key differences (Nematchoua, Deuse, Cools & Reiter, 2020). For example, topography is one of the most important limitations of cycling, but much less so for e-bikes (Nematchoua et al., 2020). Barriers are overall seen as less important to e-bikers, with the exception of price of purchase and parking (Nematchoua et al., 2020).

While less research on e-bikes exists in a North America context, that body of literature is also growing. A survey of e-bike riders in North America provided support for much of the research from Europe and provided valuable insight into how North Americans use their e-bikes (MacArthur, Dill & Person, 2014). For example, the survey found that
riders where generally male, older than 45, white, educated, and in good health. While most reported cycling at some point before the purchase of an e-bike, only half rode weekly or daily (MarArthur et al. 2014). After purchasing an e-bike, most respondents (including those who did not ride previously) ride weekly or daily. Most respondents had access to a motor vehicle and a license and reported replacing trips by car as a motivation to buy an e-bike. Overall, respondents had positive experiences with their e-bikes and enjoyed the advantages of increased speed and range, riding with less effort, and help with hills (MacArthur et al., 2014).

Ling, Cherry, MacArthur & Weinert (2017) expand on the research in North America in a comparison between e-bike and bicycle users in the US. They found that overall, most e-bike riders were older, used their bikes for utilitarian purposes more than traditional bicycle riders, rode more often and travelled farther distances, and were motivated to buy an e-bike for the assistance of riding uphill and for going longer distances. The authors found that an important predictor of e-bike ownership was being more familiar with e-bikes (Ling et al., 2017). In terms of sustainable transportation decisions, two interesting findings stand out: women were more attracted to buying an e-bike for carrying goods or children; and owners of hybrid-electric vehicles were less interested in purchasing an e-bike (Ling et al, 2017). Finally, those in hilly areas were generally more interested in purchasing e-bikes (Ling et al, 2017).

While e-bike research in the US is slowly expanding, research in a Canadian context is even more sparse. In one study, results confirmed much of what previous studies have found: that e-bikes may replace car trips, are largely utilitarian, and riders find using the bikes enjoyable (Edge, Dean, Cuomo & Keshav, 2018). Weather was seen as a deterrent to completely replacing trips by car with e-bike, especially among those who did not previously cycle (Edge et al., 2017), likely a result of the unique Canadian context of car dependency and adverse winter weather.

A survey of industry stakeholders (manufacturers, retailers, government agencies, and cycling coalitions) on e-bike adoption and policy provides a preliminary look at e-biking in British Columbia (Aono & Bigazzi, 2019). The majority of respondents thought that pedal-assist e-bikes should be regulated like traditional bicycles and generally should be
permitted on all road/trail types except sidewalks (Aono & Bigazzi, 2019). All stakeholders thought that the modal shift to e-bikes would be from transit and automobiles except for government agencies, who generally thought that people would switch from cycling to e-biking. Lack of bicycle facilities, cost of purchase, and fear of theft were thought to be the biggest barriers to e-biking adoption from all stakeholders. Cycling coalitions saw parking/riding infrastructure as the largest barrier, while manufacturers saw theft and weather as the biggest barriers (Aono & Bigazzi, 2019).

2.6. Health benefits of e-bikes

One of the primary criticisms is e-biking is that it is considered “cheating” and that riders do not gain the positive benefits of cycling such as increased physical activity (Mueller et al., 2015). However, much of the evidence suggests that e-bikers enjoy many of the same benefits, and sometimes more.

In a controlled, laboratory environment, it appears that riding an e-bike has the same potential to provide the physical health benefits as cycling (Simons, Van Es, & Hendriksen, 2009). Results from hilly cycle courses also indicate that, while e-bikers expend less energy than conventional cyclists, they still achieve a moderate level of physical activity (Langford, Cherry, Bassett, Fitzhugh. & Dhakai, 2017). A review of the literature indicates that e-cycling, although requiring less energy than cycling, can still achieve moderate, and sometimes vigorous levels of physical activity (Bourne et al., 2018). The intensity of exercise achieved by e-biking does depend on the route, topography, and perceived exertion; because e-bikes are associated with lower perceived exertion, e-biker users may ride for longer distances (Bourne et al., 2018; Sperlich, Zinner, Hebert-Losier, Born & Holmberg, 2012).

The benefits of e-biking are also dependent on what type of transportation they are replacing. E-cycling requires less physical exertion than cycling and more than walking, but drastically reduces the amount of time traveling compared to walking (Bourne et al., 2018). The biggest potential for improving health is if e-biking replaces the use of cars (Bournet et al., 2018).
Evidence also suggests that e-bikes have the potential to increase physical activity for sedentary adults, as it has been reported by participants to be more enjoyable than conventional cycling (Sperlich et al., 2012). One study indicated that e-cycling had a low substitution effect for regular cycling, meaning those who already cycled were less interested in riding e-bikes (Sundfor & Fyhri, 2017). This would result in a net positive effect on public health, if the majority of e-bikers were substituting e-bike travel for motorized travel (Sundfor & Fyhri, 2017).

Not only do e-bikes have the potential to benefit the physical health of riders, but there is a significant mental health benefit as well (Leyland, Spencer, Beale, Jones & van Reekum, 2019). In a study of the cognitive function and well-being in older adults, it indicated that both e-bikers and cyclists had greater positive results than a control group, but the e-cyclists had the highest (Leyland et al., 2019). The suggestion is that the lower exertion allowed riders to enjoy themselves and relax more (Leyland et al., 2019). E-bikes may also reduce some of the stress and unpredictability of conventional cycling, meaning riding an e-bike will still be enjoyable despite a particularly windy day or tiredness (Wild & Woodward, 2019). Moderate intensity activity is also considered the most pleasurable to most people and improves alertness and mood; conventional cycling may increase exertion too much while e-cycling keeps exertion at an optimum level (Wild & Woodward, 2019).

E-bikes have the potential to significantly improve the mobility of people with various types of disabilities (Blumenstein, Zeitlmann, Alves-Pinto, Turova, & Lampe, 2014). For example, e-bikes designed with sensors have the potential to aid youth with cerebral palsy and have problems with space orientation (Blumenstein et al., 2014).

2.7. E-bike safety

E-bike safety is a potential concern, as they are heavier and often faster than mechanical bikes. Much of the literature on safety comes from China, where scooter and motorcycle-style e-bikes are more popular and studies typically do not differentiate between the types of e-bikes when discussing rider behaviour. However, the studies that exist in Western countries indicate some increased risk (Huertas-Leyva, Dozza, &
In general, people on e-bikes ride faster than those on traditional bikes, by an increased speed of about 2.9-5km/hour (Huertas-Leyva et al., 2018; Petzoldt et al., 2017). The increased speed is partly a function of the technology but also a function of the riders’ attitude; e-bikes are seen as fun and riders enjoy going fast (Haustein & Moller, 2016b). The faster speed results in sharper braking and deceleration and requires more reactive movements and maneuvers (Huertas-Leyva et al., 2018). Huertas-Leyva et al. (2018) found that riding an e-bike almost doubled the chance of having to perform an unplanned maneuver in response to conflict.

Despite faster speeds, e-bike riders seem to behave similarly to traditional cyclists in traffic (Petzoldt et al., 2017; Langford, Chen, & Cherry, 2015), with the possible exception of e-bike riders running stale yellow or red lights at slightly higher rate (Schleinitz et al., 2019). However, the faster speeds still increase the risk of conflict, especially at intersections where the risk is double that of traditional bicycles (Petzoldt et al., 2017). This is likely due to a mismatch between their perceived speed (motorists assuming they are on traditional bicycles) and their actual speed (Petzoldt et al., 2017). For example, a motorist turning right at an intersection may not realize how quickly the e-bike rider is traveling and may cut them off or turn into them.

Risky behaviour and risk of incidents seems to vary between demographics, whether on e-bikes or mechanical bikes (Haustein & Moller, 2016; Petzoldt et al., 2017; Schleinitz et al., 2019; Siman-Tov et al., 2018). For example, younger riders and men run more red lights (Schleinitz et al., 2019). While there is no visible link between age and safety incidents, older e-bikers have a higher rate of injury and fatalities, likely due to their increased fragility where if an incident does occur, they are more likely to be seriously injured (Haustein & Moller, 2016). Risk may be highly contextual and even cultural; in Israel, it was found that Arab youth were more at risk of a serious incident than Jewish children, likely due to the difference in cycling conditions in different areas of the country (Siman-Tov et al., 2018).
2.8. Regulation of E-bikes

The regulation of e-bikes varies geographically and can have an impact on their use. An e-bike is considered a bicycle (pedal-assisted) with a motor that cuts off at a certain speed (variously 25km/h in Europe and 32km/h in the US) (Hung & Lim, 2020). To be considered a bicycle rather than a scooter or moped, there is often a motor power limit, ranging from 250 W (Australia) to 500 W (Canada) to 750 W (US) (Hung & Lim, 2020). In Europe and North America, if the e-bikes are within a certain motor power and speed range, they do not require licensing or registration. In China, an e-bike must be lighter than 20kg and have a slower assisted speed than 30km/h to be unlicensed; anything heavier or faster would require a motorcycle license to operate (Hung & Lim 2020). Some areas have banned the use of e-bikes outright, regardless of power, such as Hong Kong (Hung & Lim, 2020).

2.9. Summary

A survey of a broad range of literature suggests that cycling is a sustainable alternative to automobile transportation with major associated health benefits (Mueller et al., 2018; Mueller et al., 2015; Oja et al., 2011; Hamer & Chida, 2008). However, few countries have significant cycling mode shares, and research indicates that safety, infrastructure, perceived convenience, and several contextual factors influence people’s decision to cycle (Fowler et al., 2017; Garrard et al, 2012; Heinen et al., 2010; Ravensbergen et al., 2018; van Beekyn et al., 2011). Culture and attitudes also appear to play a role in the decision about whether to cycling or not (Aldred & Jungnickel, 2014; Cepeda Zorrilla et al., 2019; McCarthy, 2011; Oosterhuis, 2016; Stoffers, 2012).

Pro-cycling policies appear to have a positive effect on cycling rates, as evidenced by countries like the Netherlands, Denmark, and Germany. Intentional and extensive policy led to major infrastructure investment in those countries starting in the 1970s, which has helped create high levels of cycling in those countries (Pucher & Buehler, 2008). Specific cycling-friendly cities in North America have also begun investing in cycling infrastructure, which seems to lead to higher cycling rates (Pucher et al., 2011; Pucher et
Education and promotion also plays a role (Heinen et al., 2010; Lanzendorf & Busch-Geertsema, 2014).

E-bikes, while they have existed for a number of years, have been steadily gaining in popularity through the 2010s. With a small electric motor, they give a boost to riders while they are pedalling. The following summarizes key points from the literature on e-bikes:

- There is a general trend for e-bike users to be older adults, used for both recreation and utilitarian purposes (Johnson & Rose, 2015; Jones et al., 2016; MacArthur, 2014; Peine, van Cooten & Neven, 2017; Seebauer, 2015; Simsekoglu & Klockner, 2019; Wolf & Seebauer, 2014;)

- E-bike users typically ride longer distances and more often than cyclists on mechanical bicycles (Ling et al., 2017)

- E-bike users may replace mechanical bike trips with e-bike trips, but they are also likely to replace car trips and ride longer/more often (Ling et al., 2017)

- Despite requiring less physical effort than mechanical bicycles, several studies suggest that e-bike riders can achieve their daily recommended physical activity levels (Bourne et al., 2018)

- Cyclists are the happiest commuters, but as a sub-group, e-bike riders have the highest reported satisfaction and well-being. This is likely due to e-bikes reducing stress associated with fatigue or physical effort of riding a bicycle (Leyland et al., 2019)

- E-bikes seem to lower the significance of perceived barriers to cycling (Nematchoua et al., 2020)

- Much of the literature on e-bikes comes from European countries where cycling rates are already relatively high; a gap exists in the Canadian context

Based on the literature review, this project aims to contribute to the literature on e-bikes in a Canadian context. It is important for policy-makers to understand attitudes and perceived barriers in order to encourage e-biking in the interest of public health and lowering carbon emissions. The next chapter will outline the research approach and methods.
Chapter 3. Methods

The following chapter will describe the approach and methods used for the research. A mixed-methods, pragmatic approach is used, while Azjen’s (1991) Theory of Planned Behaviour guides the underlying assumptions of the research.

This research project used a mixed-methods approach with both qualitative and quantitative data analysis. The mixed-methods approach is justified because of the goal of presenting a broad picture of current and potential e-biking trends in Nanaimo.

Quantitative data is primarily derived from survey results, but local and regional data is also used for comparative purposes. Qualitative data is derived from survey results where participants were able to enter their own answers. Qualitative data is primarily derived from semi-structured, face-to-face interview results.

The data is synthesized into a set of policy recommendations for the province and for the City of Nanaimo to encourage e-biking specifically and active transportation more generally.

3.1. Theoretical Approach

This research has a grounding in practical application – the results will inform a set of policy recommendations to be presented to the City of Nanaimo. However, the research is influenced by several theoretical underpinnings.

The first is that of the Theory of Planned Behaviour (Ajzen, 1991). This theory guides the analysis of the data, considering the role of intention on a behaviour being performed and the factors that influence the intention. As discussed in the literature review above, the theory posits that the stronger the individual’s intention to perform a given behaviour, the more likely they will actually perform it (Ajzen, 1991). The performance also depends on the availability of requisite opportunities and resources (for example, time, money and skills), but without the intent, the requisite opportunities and resources will not lead to the behaviour.
The intent of the behaviour is influenced by three main factors: attitude towards the behaviour, the subjective norm (or social pressure), and perceived behavioural control. These factors have varying levels of contribution.

![Figure 3.1 Theory of Planned Behaviour (Ajzen, 1991).](image)

Because this research is considering attitudes towards e-bikes, the research is based on the assumption that if people intend to e-bike or to use more active transportation, they are more likely to actually do so.

The overarching structure of the research is a mixed methods approach, which is grounded in a pragmatic worldview (Creswell, 2014). When using a pragmatic approach to research, the researcher is concerned with problem-solving and real-world consequences. (Creswell, 2014). A mixed-methods approach is often selected because a combination of the two is considered to best answer the research question. Pragmatism also considers the social, political, and historical context of the research (Creswell, 2014), which makes it appropriate for exploratory social science research such as this project.
3.2. Collection methods: Survey

The purpose of the survey was to gauge attitudes towards and knowledge of e-bikes in Nanaimo. A non-random convenience sample of City of Nanaimo employees was used. While a random sample of adults in Nanaimo would have provided more rigorous and statistically significant results, logistically it was not possible to attain such a sample. Therefore, City of Nanaimo employees were chosen as a proxy for the larger adult population. The City employs approximately 750 employees, with a range of profession types, ages, and salary ranges.

Participants were recruited with the help of the City’s Human Resources (HR) Department. Nanaimo HR was asked to post a link to the online survey on an internal discussion board, which all employees have access to. HR also sent an email to all department heads, notifying them of the survey and requesting that they notify employees of the survey and the posting. The survey was available to employees for a total of 4 weeks, with the internal posting being refreshed at the 2- and 3-week marks. 4 weeks allowed ample time for employees to complete the survey, even with vacation and time off taken during the summer.

The survey was designed to gauge participants attitudes and openness towards e-bikes. All participants were asked how they currently commute (3+) days a week and how long their commute is. Subsequent questions depended on how participants answered that they commuted: by bicycle, by e-bike, or other (including car, carpooling, walking, and transit). Cyclists were asked about their feelings towards cycling in Nanaimo and their interest in e-bikes. E-bikers were asked about their attitudes towards cycling in Nanaimo and about details of their e-biking experience. Finally, those who neither cycle nor e-bike were asked whether they had previously considered cycling to work, and whether they had any interest in purchasing a e-bike for various reasons. They were also asked what barriers might prevent them from purchasing an e-bike.

The survey was relatively short and could easily be completed within 10 minutes.
3.3. Collection method: Interviews

As a way to expand on themes uncovered during the survey, interviews were conducted with owners and/or managers of bicycle stores in Nanaimo. This was a purposeful sample of all owners/managers in Nanaimo who sold e-bikes. A total of 7 invites were sent, with a total of 4 participants from Nanaimo responding and agreeing to be interviewed. Because of a low response rate in Nanaimo, the sample was expanded to include 2 cycle shops in Victoria, BC. As a larger, more urban city with a higher rate of cycling and more infrastructure, it provides an opportunity to compare/contrast attitudes and trends in Nanaimo versus Victoria.

The interviews were semi-structured and face-to-face. The interviews were designed to address all 3 research questions:

1) What are the current perceptions of e-biking in Nanaimo?

2) What are the opportunities and barriers for people to adopt e-biking as a mode of transportation?

3) What e-bike trends are already being seen in Nanaimo?

The third question was especially relevant to the interviews. Owners/managers of bicycles stores were assumed to have a unique insight into bicycle culture in Nanaimo and would have valuable information about local trends in the market. They were likely to have a good idea of who buys e-bikes and why they buy them. Interview participants were also asked about what they thought the City or the province could do to encourage more cycling and e-biking.

The interviews lasted from 30 to 60 minutes and included prepared questions and the opportunity to further discuss points that participants felt were important. Interviews were audio recorded and transcribed, with participants given the option to retract or edit the transcripts. The interviews were then coded in an Excel spreadsheet and analyzed for emerging themes. In order to protect their privacy, participants are not referred to by their real names in this document.
3.4. Collection method: statistical data

Supporting data, used for comparative purposes with the quantitative data from the survey, was accessed online from a range of sources such as Statistics Canada and the Nanaimo RCMP.

3.5. Significance of findings

While this research aims to contribute to filling the gap in research on e-bikes in the Canadian context, it is also done with the purpose of exploring sustainable transportation in Nanaimo specifically. Nanaimo faces some significant challenges to transitioning to sustainable transportation, such as sprawled urban form and reliance on the automobile. This project takes the pragmatic approach of considering a specific sustainable mode of transport (e-bikes) and how it could be supported in Nanaimo. The findings from the survey and interviews will contribute to policy recommendations to encourage more people to e-bike for transportation in Nanaimo.

3.6. Limitations

The primary limitation of this research is the lack of statistically significant results. Because of the scope of this project, it was not possible to randomly sample the adult population of Nanaimo. While the convenience sample of City employees provides a broad-cross section of the population, one must be cautious of generalizations drawn from the results. The sample notably lacks two important sub-sections of the adult population: seniors/retirees, and vulnerable populations such as the homeless. Both of these populations may provide valuable insight into attitudes towards e-bikes. Seniors/retirees are one of the main demographics that seems to favour e-bikes, while the vulnerable/homeless may value e-bikes as a viable mode of transportation as a much cheaper alternative to owning and driving a car.

Despite these limitations, this research provides important insight into e-biking in Nanaimo. Because of the lack of research on e-bikes in a Canadian context, this research
is exploratory in nature and provides the basis on which to build more research and knowledge on e-biking in sprawled Canadian communities.

3.7. Funding

This research was funded by the Social Sciences and Humanities Research Council of Canada (SSHRC) through a Canada Graduate Scholarship – Master’s. The total funding provided was $17,500.
Chapter 4. Results and Findings

The following chapter summarizes the results from the survey and interviews. The survey results are broken down into the 3 sub-groups of commuters (cyclists, e-bikers, and non-cyclists) and summarizes the demographic data. The interviews were coded and the emerging themes are summarized below.

4.1. Survey Results:

In total, 57 people completed the survey, out of a possible 750 employees. This represents a response rate of 8%. It is noted that for approval from VIU’s Ethics Review Board, all questions had to have the option to skip, so some percentages will not add up to 100%.

4.1.1. Demographics

94.92% of respondents reported having a driver’s license. The bulk of respondents were in the 35-55 age range (64.91%), with 21.05% of respondents between 25-35, 7.02% between 55-65, 5.26% between 18-24, and 1.75% over 65 years of age. Slightly more females (52.63%) than males responded. Household income was largely over $100,000 (45.61%), with 17.54% between $80,000-100,000; 21.05% between $61,000-80,000; and 1 respondent each for $41,000-60,000 and $21,000-40,000. 7 people chose not to answer this question. Finally, respondents were relatively highly educated, with 94.74% having at least a post-secondary certificate or diploma. This is significantly higher than Nanaimo’s general population, where approximately 54% of the population has at least a post-secondary certificate or diploma (Statistics Canada, 2017a). Because the survey results are not statistically significant, and because the sample population is highly educated, it is important not to generalize the results from the survey straight to the general population. Previous research indicates that e-bikes are more popular with more highly educated and more affluent populations, although this does vary geographically (Fishman & Cherry, 2016). Therefore, the sampled population here may be more interested in e-bikes than Nanaimo’s general population.
4.1.2. **Overall commuting habits**

The majority (79.66%) of respondents answered “other” (which included car, transit, and walking) as their main mode of commuting to work. Five people (8.47%) reported e-biking to work, and 7 people (11.86%) reported cycling to work.

![Types of Commuters](image)

**Figure 4.1 Modal Share of Commuters from survey**

Among those that chose “other”, 3 people reported walking (6.5%), 39 people reported driving (84.78%), 2 people reported carpooling (4.35%), and 1 person reported taking transit (2.17%).

An even larger majority (96.61%) answered “other” for their mode for other destinations, such as shopping, visiting friends, going to restaurants, etc, and only 2 people (3.5%) answered that they cycled for this purpose.

Commute distance varied and was relatively evenly split. Most reported traveling 15kms or less to work, with 27% traveling 0-5kms, 23.7% traveling 5-10kms, 30.51% traveling 10-15kms, and 18.64% traveling >16kms.
There was a gender divide in terms of commuting type. Of the 10 total respondents that either cycle or e-bike, only 2 were women. All 5 e-biking respondents were men.

4.1.3. Non-cyclists or e-bikers

The aim of the questions for those who answered “other” was to gauge their attitude and interest in e-biking, and to determine what barriers prevent them from cycling or e-biking.

71.7% of respondents reported owning a bicycle, while 23.91% reported not owning one. When asked if participants had ever considered cycling to work, 52% said yes, and 45.65% said no.

Among the reasons people gave for why they did not ride a bike, the three top selections (each selected by 39% of respondents) were *The roads feel unsafe and I don’t want to be sweaty when I arrive and I live too far away*. *The weather* was the next most common response, with 36.96% of people citing that as a barrier. *There are not enough bike lanes/paths where I need to go, it would take too long, I make multiple stops, and too*
Many hills were all concerns for roughly a quarter of people. Few people responded that they like driving (13%), while only 4.35% of people reported not liking cycling.

![Bar chart showing barriers to cycling to work](image)

**Figure 4.3 Reported barriers to cycling to work**

Almost all respondents (97.83%) had heard of e-bikes, and 76% knew someone who rides one. 70% had not tried riding one, but exactly 50% of respondents had considered purchasing an e-bike.

When specifically asked if, hypothetically, an e-bike allowed participants to ride longer distances with less effort, 60.87% said they were interested in riding one to work. Slightly more respondents (63%) were interested in riding an e-bike to run errands. The interest in e-bike share was less pronounced but still high, with 50% of people responding they would consider using one (the author notes that 6 people did not answer this question [13%], perhaps indicating an answer of “unsure”, which was not a selectable option in the survey).

Specific barriers for purchasing an e-bike were overwhelmingly cost of purchase and risk of theft (58.7% and 50%, respectively). 30% of people thought it would not be able to replace all uses of a motor vehicle, while 21.74% do not feel safe riding a bicycle.
in Nanaimo. 15% of people are not interested at all, and 6.5% of people do not currently feel comfortable riding a bicycle.

![What barriers would prevent you from purchasing and riding an e-bike?](image)

**Figure 4.4 Reported barriers to purchasing and riding an e-bike**

Participants were given an "other" option for the barriers question, with space to write their own response. 2 participants responded that they already own an e-bike, highlighting a limitation of the survey. Participants were initially asked how they commute 3+ days a week, and the subsequent questions are based on how they answered that question. However, some may own an e-bike and not use it to commute to work, or some may use it less than 3 days a work to commute. 2 people cited having children specifically as a barrier. Other answers highlighted lack of storage for bicycles, weighing the cost of purchase with advances in technology, a disability, the ride still being too long, needing a vehicle for work, and the desire for exercise which an e-bike may not provide.
Table 1 “Other” answers for barriers to purchasing an e-bike

<table>
<thead>
<tr>
<th>Reason</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nowhere to store a bicycle</td>
<td>I have considered many times purchasing an ebike. When I last looked a month ago the one that would best meet my needs was around $4,000.00. I look every 3 months to see what ebike technology and pricing may have changed.</td>
</tr>
<tr>
<td>disability (knee injury) so balance issues</td>
<td>I already own an ebike</td>
</tr>
<tr>
<td>Still a longer ride to work</td>
<td>Children</td>
</tr>
<tr>
<td>I need my vehicle for work. I have thought about leaving my vehicle at</td>
<td>If I was to ride a bike I would like to use it as a form of exercise as well as a method of transportation.</td>
</tr>
<tr>
<td>work, but riding would also depend on the weather as I'm not to keen to</td>
<td>maybe wouldn't use enough as I have a child</td>
</tr>
<tr>
<td>come in to work, shower, and get dressed in common locker room.</td>
<td>I have an ebike</td>
</tr>
</tbody>
</table>
Gender Analysis

When separating answers by gender, several trends can be seen. The strongest difference seen was whether participants had previously considered cycling to work. Only 40% of women respondents had considered commuting by bike, while 72.5% men had previously considered cycling. This generally reflects much of the literature from North America and Australia that men cycle at a much higher rate than women (Garrard et al., 2008; Garrard, Handy, & Dill, 2012; Pucher, 2010; Pucher et al., 2011).

The following table summarizes the percentages of women and men, respectively, who selected each potential barrier for why they do not currently cycle.

Table 2: Gender breakdown of barriers to cycling

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t like cycling</td>
<td>3.5%</td>
<td>0%</td>
</tr>
<tr>
<td>I don’t own a bicycle</td>
<td>32%</td>
<td>5%</td>
</tr>
<tr>
<td>I feel inexperienced and nervous to try</td>
<td>28%</td>
<td>0%</td>
</tr>
<tr>
<td>The weather</td>
<td>35%</td>
<td>41%</td>
</tr>
<tr>
<td>Too many hills</td>
<td>28.6%</td>
<td>17.6%</td>
</tr>
<tr>
<td>I make multiple stops (children, groceries, etc.)</td>
<td>28.6%</td>
<td>29%</td>
</tr>
<tr>
<td>I don’t want to be sweaty when I arrive</td>
<td>39.3%</td>
<td>35.3%</td>
</tr>
</tbody>
</table>
Several significant differences stand out. Firstly, every barrier was selected by more women than men with the exception of the weather and the roads feel unsafe. This may suggest that women perceive more barriers to cycling than men do. There is some literature to support this, where a survey showed that 13 of 18 possible barriers had gendered results, with women considering 13 of the barriers more important (van Bekkum, Williams, & Morris, 2011), and a survey in Belgium having similar results (Nematchoua et al., 2020). This helps to explain the vast difference both in the actual number of male vs. female cyclists, and the difference found in this survey between the numbers men and women that have considered cycling to work. However, as this sample was not statistically significant, the results point towards a need for further research into this issue.

Some significant barriers exist for women that do not seem to be barriers for men. The most important one is ownership of a bicycle. Only 1 male participant reported not owning a bicycle, while roughly one third (32%) of female participants reported not owning a bicycle. Owning a bicycle, or at least having access to one, is an obvious and necessary determinant of whether or not a person commutes by bicycle (Handy et al., 2014). This is clearly a significant barrier for many women.

Two barriers were not selected by any men. I don’t like cycling was not selected by any men, and only by 1 (3.5%) woman. This does not seem like a significant barrier to
either gender, and suggests an openness to cycling in general. Some studies have shown that men perceive cycling slightly more positively than women, which this result reflects (Garrard et al., 2012). However, I feel inexperienced/nervous to try was selected by 28% of female respondents and no male respondents. This indicates that more men have either
a) attempted commuting by bike at some point; or b) generally have more confidence/less risk aversion in trying something new. Some literature does support this, suggesting that more men than women are confident cyclists and men are more confident in their ability to fix any malfunctions (Garrard et al., 2012). This is valuable information when trying to encourage more women to cycle, as education and support (such as bicycle mechanics courses and bike-to-work events) could be especially effective.

The only other barrier that saw a drastically different response from men and women is It would take too long. 32% of women cited this as a barrier while 17.6% of men did. With no further details provided, it is difficult to determine the exact reason that this may be. It is possible that women generally have more commitments and pay closer attention to their time. Research indicates that women still disproportionately carry more unpaid, household work, have more complex trip patterns, and tighter time budgets (Garrard et al., 2012). If they have to make multiple stops, or are concerned about getting housework done, they may be more averse to spending slightly longer commuting by bicycle.

It is unexpected that there was little difference between men and women for Too many stops, because the literature generally suggests that women have more complex trips with multiple stops and are more likely to drive children and other family members (Garrard et al., 2012). It is also unexpected that slightly more men than women considered the roads unsafe, as that is one of the most commonly cited reasons that less women than men cycle in non-cycling countries and cities (Garrard et al., 2012). This could be a result of the small sample size, or the self-selection of participants who were generally more interested in cycling.

The following table summarizes the differences in barriers to purchasing an e-bike selected by men and women:
Table 3: Gender breakdown of barriers to purchasing an e-bike

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of purchase</td>
<td>53.6%</td>
<td>70%</td>
</tr>
<tr>
<td>Risk of theft</td>
<td>53.6%</td>
<td>47%</td>
</tr>
<tr>
<td>Not interested</td>
<td>14%</td>
<td>17.6%</td>
</tr>
<tr>
<td>Do not feel comfortable riding a bicycle</td>
<td>10.7%</td>
<td>0%</td>
</tr>
<tr>
<td>Do not feel safe riding a bicycle in Nanaimo</td>
<td>25%</td>
<td>17.7</td>
</tr>
<tr>
<td>Would not be able to replace all uses of a motor vehicle</td>
<td>32.1%</td>
<td>29.4%</td>
</tr>
</tbody>
</table>

There are fewer stark differences in barriers to purchasing an e-bike than in barriers to cycling. The largest difference is *I don’t feel comfortable riding a bicycle*, which echoes the results from the barriers to cycling. No men reported this as a barrier while 10.7% of women did. This again speaks to the need to find ways to make women feel more comfortable riding bicycles.

Interestingly, significantly more men than women thought that the cost of purchase was a barrier to purchasing an e-bike. While a concern for most people, 70% of men versus 53.6% of women listed cost of purchase as a barrier. Despite this, a similar number of men and women thought that *risk of theft* was a barrier, with 53.6% of women and 47% of men thinking so. To the author’s knowledge, no previous studies have examined how the perception of the cost of e-bikes or cycling is different between genders. One possible
explanation is that e-bikes appeal to women more than men, who typically ride longer distances when they do commute to work and are less deterred by physical exercise. Women may see the e-bike as more worth the investment, but more research is needed to see if this is a consistent trend and what explanations there might be.

4.1.4. Cyclists

The questions directed at cyclists aimed to gauge how they felt about cycling in Nanaimo in general, why they cycled, and if they had interest in e-bikes. It is important to note that for both the cyclist and e-biker respondent groups, the sample size was extremely small and therefore unreliable. However, analyzing the data may provide valuable insight to guide future research.

Overall, no cyclists were satisfied with the level of cycling infrastructure in Nanaimo. 28.57% were neutral, 57.14% were unsatisfied, and 14.29% were very unsatisfied. Feelings of safety were somewhat higher, with 42% feeling unsafe, 14.29% feeling neutral, and 42.86% feeling somewhat safe.

An overwhelming majority answered better infrastructure in response to “What policies would you like to see the city implement when it comes to cycling?” 57.14% also selected education and outreach, with 28.57% desiring traffic calming. One respondent filled in the “other” field and suggested adequate and secure bicycle parking in new developments, and showers to accommodate employees who cycle.
57.14% of cyclists had considered purchasing an e-bike, and the same percentage had tried riding one. All cyclists had access to a car. 57.14% of cyclists thought they would cycle more if they had access to an e-bike, with 28.57% disagreeing and 14.29% being unsure.

When asked to select all the reasons participants cycle to work, all of them cited exercise and health as a reason. 85.71% also cited both because it’s enjoyable and because of climate change/the environment. 57.14% did not like driving, 14.29% responded that they can’t drive, and the same number answered that the bus is too slow/unreliable. Two people provided “other” answers: one saying it was more convenient than driving, and the other expanding on the issues with the bus system, infrastructure, and expensive fares.

**Figure 4.5: Desired policies to promote cycling**

Better infrastructure (bike lanes, etc) | Education and outreach | Traffic calming | Nothing | Other
--- | --- | --- | --- | ---
6 | 4 | 2 | 1 | 0

What policies would you like to see the city implement when it comes to cycling?
4.1.5. **E-bikers**

The questions for e-bikers aimed to survey how and why they purchased an e-bike, and how they feel about e-biking in Nanaimo. 5 respondents reported riding an e-bike 3+ days a week. All e-bikers had commutes under 15km and 3 of them had commutes longer than 5km. All e-bikers were male and had at least a post-secondary certificate or diploma. They were generally middle-aged and had higher than average household incomes.

3 of the e-bikers have owned one for over 2 years, while 2 have owned one between 1-2 years. Before purchasing an e-bike, 3 had cycled regularly, 1 had cycled occasionally, and 1 did not cycle at all. It is worth noting that the 3 who had previously...
cycled regularly had shorter commutes (<10km) while the two participants with commutes between 10-15km either did not cycle or only sometimes cycled. 3 e-bikers knew someone who owned an e-bike before purchasing one, and 2 had tried riding one before purchasing one.

All e-biking respondents said that purchasing an e-bike allowed them to replace trips otherwise made by car, and all reported this as a motivation to purchase an e-bike. 4 of them also cited reducing the effort of cycling and it being fun to ride as a factor. 2 e-bikers reported climate change/the environment as a factor, and 1 person reported each of to go on longer bike rides and to maintain physical activity as I age as factors. 3 of the respondents provided “other” responses: 2 people cited not having to worry about parking, and 1 cited to save on the cost of gas.

E-bikers were split on how satisfied they are with cycling infrastructure in Nanaimo: 1 person answered satisfied, 1 person answered neutral, and 1 person answered very unsatisfied, while 2 people answered unsatisfied.

The statement “E-biking has allowed me to make more trips by bicycle” had a mean response of 2.8, with respondents overall disagreeing. “E-biking has allowed me to ride longer distances to my destination” had an arithmetic mean of 3, with neutral agreement. “E-biking is a safe way to get around in Nanaimo” had a mean of 2.2, with overall disagreement. “E-biking is a convenient way to get around Nanaimo” had a mean of 2.4, again with a general disagreement with the statement. These results are somewhat unexpected, as the statement "e-biking has allowed me to ride longer distances to my destination" would expect to see stronger agreement. However, the sample size for this group was so small that we cannot make any strong conclusions from this data.

4.2. Interview Results

A total of 6 interviews were conducted, with 4 participants from Nanaimo and 2 from Victoria. 3 stores sold only e-bikes (2 in Nanaimo and 1 in Victoria) while 3 stores sold both mechanical bikes and e-bikes (2 in Nanaimo, 1 in Victoria).
The interviews were coded to find common themes. The analysis below summarizes those themes from all participants, followed by a comparison between the interviews with Nanaimo participants and Victoria participants.

4.2.1. Themes

A total of 12 themes emerged from the coding process, as well as an additional category, “other”, which holds several comments that did not relate to the other themes.

Sales

All participants agreed that sales of e-bikes have been increasing. Several stores had been selling e-bikes for 10+ years, and had noticed a sharp increase in sales in the last 2-3 years. The degree to which the sales have increased varied between vendors. One participant had not seen a steep increase, because he sold only e-bikes and the competition has been increasing with more stores carrying them. Another participant had a store that sells primarily mountain bikes, and he estimated e-bike sales constituted less than 1% of sales in his shop. Another participant estimated that e-bikes sales make up 10-15% of total sales in the store but noted that 2019 had seen a big jump in e-bike sales. Participants generally estimated that sales would continue to increase in 2020 and beyond.

Power of motor and e-bike components

Some participants discussed the technical details of e-bikes and the differences in motors/batteries, etc. The power and range on motors varies significantly between manufacturers and price points. Most participants mentioned that the more expensive an e-bike, the more powerful the motor. They also mentioned that more powerful motors may be needed for riding in particularly hilly areas (such as Nanaimo), as the weaker ones may not be able to assist you up the hill.

Popular e-bike models

Participants were asked what type/model of e-bike was most popular in their store. Generally, the more popular models seem to be “commuter” style e-bikes or “city bike” style. Participants mentioned that city-style bikes are more upright riding positions, making
them more comfortable especially on longer rides. Participants did acknowledge that it depends on who is buying the bike and what they are buying it for. The store that specialized in mountain bikes did sell some e-mountain bikes but sold even more commuter bikes.

![Figure 4.7: Example of a city/commuter bike with an upright riding position.](https://electricbikereview.com/easy-motion/neo-city/)

Several participants noted that e-cargo bikes were popular with young families with children. Almost all participants also noted that unlike many mechanical bikes sold in North America, e-bikes are more likely to come with fenders, racks, lights, and bells. One participant noted that this was likely manufacturers catching on to the European model:

“In Europe, they’re very practical. But they use their bikes for everything. So there, you know, I guess the manufacturers over there, have realized that, hey we need to equip these with it. Because if we don’t people will buy a different brand” (Participant 2).

The popularity of e-cargo bikes and the trend of e-bikes being sold with all practical components included indicates a more utilitarian focus of e-bikes.
Attitudes

All participants brought up attitudes towards e-bikes before being prompted. Attitudes in general seem to be changing from e-bikes as “cheating” to e-bikes as a sustainable, fun way to travel. Several participants, avid cyclists themselves, admitted their own previous bias against e-bikes, but both said that they have seen the benefit they provide for people and are now enthusiastic about the proliferation of e-bikes. One participant theorized that people who hold negative views of e-bikes may change their minds if they suffer an injury that prevents them from cycling on a mechanical bike. One participant also mentioned that some people hold negative attitudes towards them, but when they test ride them, they end up wanting one.

One participant noted how the stigma attached to e-biking had a negative effect on one customer’s life:

There's some guys who, the one customer in particular, that he used to love riding with his kids. But he can't do it so much anymore, just because he's not as fit as he used to be. And he's had like hip and knee replacements and stuff like this. But he has this stigma in his head that e-bikes are evil and only lazy people ride e-bikes, but he'll go out and ride in the same area as his kids, but he won't ride with his kids, because he's, because he can't keep up. Whereas if he got an E bike, he'd actually probably be able to ride and keep up with them and have a really good time. He just never tried one (Participant 1).

The customer could benefit from riding an e-bike and enjoying time riding with his children, but his view that e-bikes are for “lazy people” has stopped him from even trying one. Education on the benefits of e-bikes and opportunities to test ride them could introduce people with this type of negative attitude to how positive of an influence e-biking can have.

One participant brought up issues of (perceived) safety from other cyclists and pedestrians. E-bikes can travel significantly faster than mechanical bikes, and may ride more quickly than is appropriate for the trail or bike lane they are in. This causes other trail/road users to view them negatively.
Cars, cycling, and culture

Some conflicting attitudes between drivers and cyclists were also brought up. As one participant put it:

A lot of people still say cheating, which is pretty funny, right? Because you’re not racing another bike. I mean, like, if they’re in a car and telling you you’re cheating, and then that doesn’t make sense. Or I ride my mountain bike up 7000 feet up to the top of a mountain and my buddies’ got their bikes in the back of a pickup truck to get up the gravel road, I don't think I'm cheating (Participant 3).

The participants described the attitude of “e-bikes are cheating” as somewhat absurd, especially when expressed by people who are driving. This may be a result of the culture in North America where driving is the norm for transportation and cycling is seen as a recreational activity. If cycling is recreational and for exercise, then e-bikes are viewed as pointless or cheating.

One participant acknowledged that in a car-dominant culture, it can be difficult for drivers to understand the experience of cyclists:

So I guess going back to the Netherlands and stuff where like, all those car drivers are bike riders too, they’re just using car that day, because they’re picking up some gear there, they’ve got an appointment, or something. Whereas here the people [here] don't have the mindset, you know they’re drivers first and foremost. So it's hard to think like a cyclist when you're not a cyclist (Participant 3).

He addresses the difference between somewhere like the Netherlands, where people have often experienced both driving and cycling, and how that allows for more acceptance of cyclists while driving. It helps erase the stigma of cycling and the separation of identities between cyclists and drivers.

Demographics

All participants agreed that the main demographic that is purchasing e-bikes is older adults, describing the range as over 45-50 years old. This finding is supported by the literature. However, all participants also noted that although more customers are over
50, they do sell to people of all ages. Only one store did not see e-bike customers under the age of 30, and their younger customers were generally mountain bikers.

Several demographic trends emerged. First, younger populations generally seem to buy e-bikes for utilitarian purposes: for transportation and to save money. One participant also said the younger customers in his store appear to be not as fit, and perhaps are looking to get healthier. Older customers may purchase for some utilitarian purposes, but primarily for recreational purposes. Some have been lifelong cyclists and want to continue, whereas others want to begin to stay fit/healthy, because they suffered an injury, or because their friends have bought one

Several participants mentioned that it was quite common for a couple to come in to purchase an e-bike for one partner. Then several weeks later, the couple will return because the other partner wants to get one as well.

One participant had several customers that purchased e-bikes because they were not allowed to drive – generally because of DUIs and alcoholism.

Only one participant mentioned gender, and he estimated that it was a 50/50 split between men and women purchasing e-bikes.

Reasons for riding

Participants listed a range of reasons that people buy and ride e-bikes.

As mentioned above, younger people often purchase e-bikes to replace car trips – for commuting, shopping, etc. Older populations tend to purchase for recreational purposes, for errands, as well as for health and recovery from injuries.

Other reasons emerged from the interviews. Saving money on a car appears to be a motivation, especially for younger people. Other people purchase an e-bike to overcome the barriers to cycling on a mechanical bike, such as arriving to work sweaty from the effort:

Yeah, a lot of people it's, "We don't want to show up to work sweaty", or they haven't been riding in a long time, and they want to get back
into it, mobility issues. So they just, you know, they want to get riding, but they just don't have the strength and fitness or they have hip issues or something along those lines (Participant 1).

Many people, especially in the older population, know someone who has purchased an e-bike and are now curious to try one. The older generation also seems to enjoy riding for the social aspect: either they rode mechanical bicycles when they were younger and now need some assist, or they are new to cycling and purchase an e-bike as a way to get out and about and meet friends.

Not many participants mentioned the environment or climate change as a motivator for purchasing an e-bike. When prompted, some participants agreed that customers might mention the environment, but it did not appear to be a strong explicit motivator.

**Customer Satisfaction**

When asked what response participants get from customers after purchasing their e-bike, and how much customers enjoy their e-bike, the answer was universally positive. All participants said that everyone loves their e-bike, regardless of the reason for purchasing one. One participant stated “basically, they try them and they want one” (Participant 2), indicating that the positive feedback begins even before purchase. Just the experience of riding one is positive. Another participant commented that “they lose their minds over it”, and that “if you ride one and don’t have a smile on your face afterwards, you have issues” (Participant 1). These observations and responses indicate a positive and joyful effect of riding an e-bike.

Participants only mentioned negative reactions once prompted, and these were generally minimal. There is somewhat of a learning curve when riding an e-bike for the first time, and it takes some getting used to the feeling of the assist. Some customers take longer to learn, but all stores offered test rides and coaching for learning to ride. Other negative feedback may be related to defective components or, in one case, a brand that was discontinued and replacement parts could no longer be purchased. E-bikes are also heavier than mechanical bikes, which may cause issues for some customers, but one participant commented that with advances in motor and battery technology, there should
continue to be improvements on that front. However, overall negative reactions were minimal and usually due to specific circumstances, rather than a negative reaction to e-biking in general.

**Barriers to purchasing an e-bike**

While customer satisfaction is almost universally positive, it appears there are still major barriers to purchasing an e-bike.

Cost is one of the main barriers. While a mechanical commuting bike may be purchased for anywhere from $100-$500, e-bikes generally start at the $1700 range. To get one with higher quality components that may be more reliable in a hilly city like Nanaimo, an e-bike may cost $3000 or more.

Linked to the high purchase cost is the risk of theft. Almost all participants mentioned customers worrying about locking their e-bikes in public places for fear of theft. One participant mentioned having two customers who had had their e-bikes stolen, but he noted that the bikes had not been locked with high quality locks. Another participant noted that he sometimes borrows his wife’s e-bike but was reluctant to even leave it locked outside of a busy shopping mall for fear of it being stolen. Some participants mentioned that newer and more expensive models have bike tracking technology and more anti-theft features, but these features come at a significant price increase.

Lack of safe infrastructure was mentioned several times as a barrier. Many people are hesitant to ride on roads with cars and feel unsafe doing so. While e-bikes allow people to ride further, one participant pointed out that there is no safe cycling infrastructure between Nanaimo and nearby communities like Parksville and Ladysmith, meaning that the range of where you can ride is effectively restricted.

Two other potential barriers mentioned were weather and range anxiety. The participant who mentioned weather and rain also commented that with good gear, the rain should not be a deterrent. Range anxiety is the fear of running out of battery power while out on a ride. Older riders especially may be nervous about this as they may feel that they
cannot pedal the bike back home on their own. Participants did mention that the rapidly changing technology, and therefore battery range, has somewhat addressed this concern.

**Stories of use**

Some participants knew their customers quite well and recounted stories of use. Generally, these stories indicated how e-bikes had a hugely positive impact on the riders’ life.

For example, one participant had a customer who was overweight and lost 25 lbs within a month of purchasing an e-bike. This person would not have been able to cycle on a mechanical bike, but an e-bike allowed him to get out and get active. Another participant had a customer who bought an e-bike in the early days that they were available, about 10 years ago. The customer was an alcoholic and purchased the e-bike for commuting. However, he loved cycling so much that he eventually bought a hybrid (mechanical) bike and continued to ride more. Eventually he started traveling by bike and doing trips through India, Mexico, and South America and now owns several high-quality road bikes. The participant thought that it was the e-bike’s assistance that allowed this customer to turn his life around:

He started on an e-bike. And that's probably the only reason it got him going because he was probably so out of shape, he wouldn't have been able to handle it. Just like to this guy who is absolutely passionate about cycling and is super fit (Participant 4).

Many participants had customers with various health issues, such as COPD, nerve issues, bad knees, and bad hips, who have been able to stay or get active by riding an e-bike. These customers are as old as being in their 80s.

One participant had a customer who had mountain biked his whole life, and his social network was younger men who mountain bike. He worked as a forestry engineer however and was finding it difficult to ride with his friends after work. Purchasing an e-bike allowed him to continue to socialize with his social network through mountain biking:

A friend of mine, for example, he's my age. And he rides a ton, but he works as a forestry engineer. And at the end of his day, work day, he's [been hiking] around the woods for hours. But mountain biking is a
social time. And he would be trash. He couldn't go for a bike ride and keep up with his friends. He has an e-bike now. And he keeps up the Eco setting. So he's still working. But he's not nearly as trashed. He's riding with his friends, and this sort of thing. And there was the same guy wanted to go do this huge bike ride, like 60 kilometers long with a bunch of really fast dudes, there's no way he would have been able to keep up with all these other guys that are faster than him. He took his e-bike. He had to keep it on the eco setting. Otherwise, you would have drained this battery super quick. So he's out. He's still riding, he's not cheating. But he got to ride with these guys that he doesn't get to ride with very often, and keep up with them, but not getting in their way (Participant 1).

Several participants themselves owned e-bikes and used them for various purposes, both utilitarian and recreational. One participant used an e-cargo bike to transport bikes from his warehouse to the shop, which was faster than driving his truck to do so. Another participant felt that e-biking was important for his health for socialising, and for spending quality time with his wife:

So one of our customers told us about the trail between Ladysmith and Chemainus that just opened a few months ago. And it's beautiful. It's like the Galloping Goose. So on the weekend, well the last two weekends in a row we've gone from Ladysmith, we park at Ladysmith, ride to Chemainus. And then yesterday we went across to Thetis Island. I spent the day on Thetis Island. And then rode it back. We were gone for nine hours. It was an awesome day (Participant 2).

One participant used to take his daughter to school on a cargo bike, and another cycled up Hurricane Ridge in Washington, which has some 5000ft of elevation gain.

**Infrastructure**

Infrastructure and road safety were recurring themes in all interviews. Participants generally felt that more people would cycle (on both mechanical and e-bikes) if there was more cycling infrastructure. There were mixed opinions about whether painted bike lanes, separated bike lanes, or off-street trails were the best option. All participants did acknowledge that people need to feel safe to want to ride, so the type of infrastructure should ultimately make riders feel safe. The difference in opinion on the best type of infrastructure seemed to depend on perceptions of safety among participants. One
participant had been involved in a fairly serious collision with an automobile, and he strongly felt that separated bike lanes and paths were necessary:

Because the cycling infrastructure terrible. And I have an aversion to riding on the road because of having been hit by a vehicle. So these little bike lanes that are separated with a white stripe, and some little bike painted on the road...that's not enough of a barrier for me. Because I, I get hyper aggressive by that, because of bad drivers for a couple different reasons. I have a very minor injury from that accident. And I don't want to be hit again. And I think people a lot of times don't notice cyclists or don't care, because they don't realize they're driving a 2000-pound death machine. Just a simple knock and you can kill someone. But like the people who are driving past us right now, that's not on their mind when they pass a cyclist, because they don't really think about that. And I don't blame them because they might not ride bikes. But you know, every time I ride on the road, I have at least one close encounter. Because someone doesn't see me. They're pulling out, they roll through a stop sign. They've ran a red light. Like it's, it's dicey (Participant 1).

His experience meant that separated bike lanes are the only safe option, because drivers can so easily inadvertently injure cyclists. His comment also echoes the differences in perception between someone who has cycled and someone who has not; he acknowledges that someone who drives a car and has not cycled on roads may not realize the feeling of fear/lack of safety that cyclists feel in traffic.

Another participant noted that painted bike lanes might be favoured by experienced cyclists, but may not feel safe for newer riders, or people riding with children.

I feel like the painted lines in the road are good for people who are already confident cyclists. The protected lanes, whether that's a, you know, on road and protected lane or the multi-use trail, where that really helps of course is people who are not confident cyclists [...] just getting people who are either young, or older, being able to get places on a bike safely. [...] you definitely hear from some people who are cyclists about not liking the protected bike lanes and whatnot and [saying] "you know, I've been riding a bike for 30 years in traffic I don't need to have these bike lanes". You know, that's fine for them. That's not fine for like a 10 year old child who wants to get to school or whatever (Participant 6).

This participant’s quote echoes what the literature suggests, that protected, safe infrastructure encourages those who do not normally cycle (children, older people) to do
so (Heinen et al., 2010). While an experienced cyclist may feel comfortable riding in/with traffic, if a city wants more people, and more diverse people to ride, they need to consider protected infrastructure. The same participant also acknowledged that infrastructure preferences may depend on cycling purpose; recreational cyclists may prefer riding directly on roads because it allows them to go faster:

I find is that like the protected bike lanes are for riding a moderate, a slow or moderate speed or not for riding quickly. I guess that's sort of the kind of, like, conflict with like recreational cyclists and with E bikes, there. One of my friends told me [...] he's you know, into cycling, and visited Europe. I can't remember if it was Copenhagen or Amsterdam and he was like, it's just you know paradisiacal bike place utopia, but then he found cycling super annoying and terrible, because he is used to riding on the street in Toronto, and being able to go really fast. And weave in and out of traffic and that kind of thing. But then he was riding in this super crowded bike lane with tons of people riding at like 10 kilometers an hour (Participant 6).

Participants also noted that the infrastructure in Nanaimo is disconnected and spotty. It can be difficult to ride continuously on cycling infrastructure and the route you might have to take may be indirect:

Well the bike lanes could be a little bit more consistent. A lot of the bike lanes, they'll go along, and then they just end (Participant 2).

 Specific cycling routes and roads in Nanaimo were mentioned. One participant felt that if the E&N corridor was not going to be revived as a passenger train service, it should be repurposed as a cycling/multi-use path up and down the island. He felt this would boost tourism but also be incredibly useful to local residents. Several participants mentioned the Parkway Trail, which runs beside Highway 19. One commented that it is extremely meandering and could add significant time to a commute by bike if riding on the trail rather than on the roads. Another mentioned that the condition of the trail is deteriorating, with tree roots creating bumps in the surface. He suggested that trails near large trees should be finished with something other than paving to avoid the roots and water from damaging the trail. Bowen Road was mentioned several times as being particularly unsafe (by Participants 1, 2, 4) – one participant described it as “suicide”. Another said:
One of the roads I really try to avoid is Bowen Road, because it's very busy. And there's nowhere to go on it [...] it's narrow (Participant 2).

Bowen Road is a main arterial that runs roughly north-south through the mid-town area, with relatively high residential density and many services concentrated along the road.

Figure 4.8: Bowen Road, designed for high speeds.
Source: Google Maps
Several participants mentioned looking to Europe for best practices. Most were aware that cycling rates are much higher in many European countries and felt that Canada could learn from their policies and infrastructure designs.

Only one participant noted potential conflict between e-bikes and other cyclists and/or pedestrians on bike lanes and trails. E-bikes have the potential to cycle much faster than mechanical bikes and maintain that speed. Other cyclists or other trail users may feel those speeds are unsafe, or there may not be enough room to pass. The participant that brought this up noted that a whole separate lane for e-bikes may not be necessary, but that wider lanes might help address this issue.

Other recommendations for promoting e-bike use

There were a range of ideas from participants on how local and provincial governments could encourage e-bike use.
On the provincial level, almost every participant mentioned removing the Provincial Sales Tax (PST) from e-bikes. There is no PST charged on the purchase of mechanical bikes, but currently there is on e-bikes. On a purchase of at least $1500, and likely as much as $3000 or $4000, a tax of 7% is not insignificant. Participants felt that removing PST would be an incentive for purchasing e-bikes.

Participants also felt the province could offer other incentives and credits that could be applied to e-bikes. Currently the government provides $850 towards an e-bike if citizens scrap their car. Participants felt that people should not have to return/scrap their car to get the credit. There was a feeling that the current program may be more for good publicity for the provincial government than for anything else.

One participant had been involved in an initiative with the City of Nelson, where City employees have the option to purchase an e-bike with a loan through their employer, which they pay back in chunks taken from their paycheque. This participant mentioned that he had suggested this idea to Nanaimo Council but there was not much interest.

Almost all participants mentioned education and awareness, which could be applied at a local or a provincial level. Several types of education and awareness were mentioned.

One was promoting the benefits of e-bikes. This could be emphasizing the health benefits, the cost savings when compared to driving, or the efficiency of biking (especially in busier urban areas). One participant felt that putting the benefits into monetary values would help people understand how far-reaching the benefits are. For example, if health care costs go down because people are healthier from cycling, and there are less traffic accidents, that translates into tax savings. "You start saving people money, people will pay attention" (Participant 1).

Participant 1 also felt more education about the safety implications of automobiles is needed. He felt strongly that better, separated bike lanes were needed, but that to get people to support this type of infrastructure, they need to know the consequences of not building it. He had been involved in a crash himself and mentioned several other high-profile crashes between cyclists and automobiles in Nanaimo. He thought that graphic
photos may be a way to drive home the importance of infrastructure for people who do not cycle or have not been involved in crashes.

Participants also felt that universal bicycle education, perhaps provided through the public-school system, would encourage safer interactions between cyclists and drivers. One participant had had bicycle safety lessons when he was in school, which involved the RCMP coming to help and running drills and games with bicycles. Another participant had heard that German elementary schools provide bike courses about riding in traffic and bike control, so everyone learns how to do it. Finally, one participant thought that bike courses aimed at drivers would be helpful. He thought that drivers do not have empathy for those riding bikes on the roads and do not understand that experience and will pass too closely or quickly. He stated that if they “tried cycling in the city for like 10 minutes they might have more sympathy for people who are on a bike” (Participant 6).

Better, more secure places to park and lock bicycles was a recurring theme among participants. Almost all of them mentioned that risk of theft is a big concern for people and commented that Nanaimo especially lacks secure places to park bicycles. One mentioned an app, called Garage 529, where you can register your bike and report it stolen or missing if needed. Other users of the app in your area will be notified and will be on the lookout for your bike. The RCMP can also access information on what bikes have been stolen and can cross-reference this with bicycle that come into their compound. Bike lockers and valet parking at special events were mentioned as possible solutions.

Finally, one participant felt that cities should use bicycle retailers as a resource for planning cycling infrastructure. As a participant from Victoria, he had seen great strides in cycling infrastructure but stated that:

Nobody says, Hey, you guys have a bike shop? What do you think? What are your people telling you? Nobody ever reaches out to us, to say what do you know? (Participant 5).

He felt that he would have had valuable input for the city, based on his detailed knowledge of the cycling community and his conversations with customers.
**General comments about e-bikes**

At various points in all of the interviews, participants spoke generally about the benefits of e-bikes. The positive impact on physical activity came up quite a few times, especially for people who may not be able to cycle on a mechanical bike. All participants mentioned how it opens up a new form of mobility that allows for freedom and exercise.

Many participants mentioned the positive impacts e-bikes have on mental health and well-being:

"You know, part of the good part of the E bikes is riding any bike, people are happy, it's good for your brain, it's good for your balance. And it gets you out, more connected to the community. Like when you go out on your bike, you wave to people, you say hello, you stop for a coffee. In a car, you're in your car, you're stuck in the traffic. Sometimes you're frustrated. With a bike, you can take bike paths, trails, roads, you know, a lot even in this city, there's a lot of different subdivisions that are connected by a trail to the next one. So you can stay off a lot of the main very busy roads. And on a regular bike, that might be a little tougher, because you gotta pedal a lot harder. And, you know, take a longer route" (Participant 2).

The flexibility of e-bikes and controlling how much exercise the rider wants was mentioned:

"I think if we get ever get the right the word out to people, then it is it's beautiful, peaceful choice to get around. And it's easy. And the beautiful thing about these bikes is you can work as hard as you want. Or you can just zip to wherever you want to go. And that's it. It's like I like to ride my bike to work in the morning. I also like coffee in the morning. I don't like to get to work all hot and sweaty. Well I'm on a high level of the assist. Going home, getting my exercise lots of times, I don't even turn it on. I just ride it like a bike" (Participant 5).

Socialising and being able to stop easily to chat with people came up a few times as ways that e-biking contributes to psychological well-being. One participant described e-biking as taking away the anxiety of not being able to make it up the hill or arriving at work without wearing full cycling gear. It allows the rider to control how much effort they put into their ride. It also allows for flexibility in routes, by being able to use cycling trails and cut throughs that are not accessible by cars.
One participant also considered e-bikes, and cycling in general, as a contributor to the local economy. If you are cycling around town for your transportation, you are more likely to stop at the nearby local shops rather than drive further (perhaps to another city) for shopping. He had heard that a dollar spent at a local business gets spent seven times more within the community, rather than leaving.

Some participants did express some concern about speed and safety issues. While the legal limit for e-bikes is 32km/hr, it is possible to purchase faster bikes online or build your own. Participants felt that these bicycles likely need licensing and enforcement. One participant had also heard of e-bike riders crashing at a higher rate than mechanical bicycle riders.

All participants in both Nanaimo and Victoria had seen an increase in e-bike use in the last few years.

4.2.2. Comparing Nanaimo and Victoria participants

While responses from participants in both Nanaimo and Victoria were very similar, and similar themes arose, there were some key differences observed in the responses.

Participants from both cities mentioned that e-bikes are popular with older adults, but respondents in Victoria said the popularity was more widespread among all ages. They brought up younger populations using e-bikes for commuting/transportation sooner and more often than the respondents in Nanaimo. E-bike use in Nanaimo seems to be more recreational than in Victoria, perhaps linked to the demographics that are riding in each city and the general cycling culture present in each city.

Participants from Victoria were also more likely to mention safety and speed. One participant in particular had concerns about shared trails and lanes, where some e-bikes may be going their max speed of 32km/hour or faster. This could be due to the fact that more people in Victoria cycle or use active transportation (Statistics Canada, 2017b) and there is more potential for conflict.
When comparing the stores that sold both mechanical bikes and e-bikes, the Victoria stores had more of a commuting focus in general and a higher estimated percentage of e-bike sales. While this is not a random sample nor a quantitative study, it is worth noting, considering the cycling rates in Victoria compared to Nanaimo and the level of infrastructure both cities have. Victoria has significantly higher cycling rates and more infrastructure. It would appear that Nanaimo has more of a recreational cycling culture.

4.3. Summary

The results of the survey and interview paint a relatively positive picture of e-bikes. Survey results show that while there are barriers to both cycling and e-biking, the majority of people are interested in the idea of commuting by e-bike. E-bikes also seem to overcome some of the perceived barriers to cycling, such as not wanting to be sweaty upon arrival, and living too far away.

Interview results indicate growing sales of e-bikes, which are projected to continue to grow. While the main demographic purchasing e-bikes is older adults, younger people are also showing interest, usually for utilitarian purposes. Customer satisfaction was universally high, with participants indicating that purchasing an e-bike had a clear positive impact on riders’ quality of life.

Based on the results of the research, the following chapter will discuss the implications and answer the research questions. It will also provide policy recommendations to both the provincial government and the City of Nanaimo to encourage e-bike commuting.
Chapter 5. Discussion and Conclusion

This research aimed to answer the question: Can e-biking be a safe, reliable and desirable mode of transportation in Nanaimo? In order to come to a conclusion, the following three questions were asked:

1) What are the current perceptions of e-biking in Nanaimo?

2) What are the opportunities and barriers for people to adopt e-biking as a mode of transportation?

3) What e-bike trends are already being seen in Nanaimo?

The following chapter discusses how the results can answer the research questions. It then provides policy recommendations for the province and for the city to help encourage e-biking as a sustainable mode of transportation.

5.1. What are the current perceptions of e-biking in Nanaimo?

Based on the survey and interview results, it could be said that e-bikes and e-biking is seen positively in Nanaimo. While the results from those who answered that they e-bike on the survey were ultimately too small to draw any strong conclusions, those who sell e-bikes seem to universally hear that their customers love their e-bikes. Whether customers ride for recreation, errands, or commuting, there seems to be an overwhelmingly positive attitude towards e-biking. This generally supports the literature (e.g. Edge et al., 2018; Plazier et al, 2017b)

Amongst those who answered that they cycle to work on the survey, over half said that they thought they would cycle more if they had an e-bike and over half had considered purchasing one. However, much like the results from those who e-bike, the sample size is too small to make many conclusions.
However, the largest group of responders in the survey were those who neither cycled nor e-biked to work (most of whom drove). Of this group, half had previously considered purchasing one and 60% would be interested in riding one for either commuting or running errands. Around 50% responded that they would be interested in an e-bike share program in the city. Considering that only 1% of people currently cycle to work, if 50-60% are interested in pursuing e-biking, that marks 1) a perception that e-biking could overcome barriers to cycling; and 2) that there is a high potential for increasing e-bike ridership within the city.

One more attitude to note is that when the non e-bike and non-cyclist group was asked to select all the reasons that they do not currently cycle, only 13% answered that they like driving and only 4% answered that they do not like cycling. This indicates that despite high levels of driving in Nanaimo, few people see it as an enjoyable mode of transportation. The literature suggests that attitudes towards cycling influence the likelihood of actually doing it (Heinen & Handy, 2012). Because so few people do not enjoy cycling at all, there is opportunity to capitalize on those positive attitudes.

5.2. What are the opportunities and barriers to people to adopt e-biking as a mode of transportation?

A generally positive attitude and openness towards e-biking is an indication that the right policy and education measures could help people adopt e-biking. However, an understanding of what barriers are stopping people from cycling and/or e-biking is required to tailor policy responses to lowering those barriers. Below is a summary of the barriers and opportunities for a modal shift to e-biking.

5.2.1. Barriers

Knowing what barriers prevent people from adopting certain desirable behaviours is important for policymakers. While many people view e-bikes positively, there were some significant barriers to their adoption.
The first barrier is cost of purchase, which 60% of survey respondents chose as one of the barriers to purchasing an e-bike, and many interview participants mentioned. E-bikes are significantly more expensive than a typical commuting bicycle, and for many this could be prohibitively expensive. Starting at around $1700 and ranging up to around $5000 for a typical commuter-style e-bike, this is a significant financial commitment. This barrier suggests a potential for the success of government subsidies, financing options like those that are available for cars, and education on the cost savings of riding an e-bike rather than driving a car. While many perceive e-bikes as expensive, the same people may make loan payments on their cars. An e-bike can be purchased for roughly the cost of a used car, but the subsequent costs are negligible when compared to the insurance and gas costs associated with car ownership. A combination of financial incentives and perceptions of cost savings may trigger a shift to e-biking in some people.

Risk of theft was another deterrent to purchasing an e-bike, evidenced by both the survey results and the interview results. Many interview participants brought up risk of theft independently and emphasized how important a good lock is for storing e-bikes. With such a high cost of purchase and increasing theft rates in Nanaimo (Statistics Canada, 2019), it is understandable that people are concerned about theft. If someone is afraid to leave their e-bike locked outside their place of work, there would be little appeal in purchasing an e-bike for commuting. Looking through Azjen’s (1991) lens of planned behaviour, this would influence both the perceived norms and the perceived behavioural control. A lack of secure bike parking lowers the behavioural control, while also signalling that cycling is not valued or important. Cities need to consider this when considering cycling policies.

A barrier that survey participants cited for both why they do not cycle currently and what is preventing them from e-biking is the lack of cycling infrastructure in Nanaimo and subsequent lack of feeling of safety. Cyclists in the survey also generally rated the cycling infrastructure in Nanaimo poorly. This reflects much of the literature on cycling policies and the effect of cycling infrastructure. Despite a lack of controlled experiments, evidence suggests that building more cycling infrastructure, especially infrastructure that separates cyclists from drivers, results in an increase in ridership.
The weather was cited as a barrier to cycling for 37.8% of non-cyclist/non-e-bike respondents. Interview participants also mentioned the weather as comments they sometimes get from customers as to why they do not want to cycle. However, Nanaimo has a temperate climate which is similar to the Netherlands and Copenhagen, two of the cycling capitals of the world. In those places, people routinely cycle in all types of weather events, including strong winds, rain, and snow. Weather as a barrier is likely a cultural barrier which could potentially be overcome through education and raising the visibility of cycling commuters in all types of weather (thus indicating the “normalcy” of cycling).

Related to weather, maintenance of cycling infrastructure may pose a risk to cyclists, if snow or debris is not cleared from bike lanes and paths. This is something that cities should consider when encouraging cycling.

Finally, perceptions of what can be accomplished on an e-bike compared to with a motor vehicle may be a barrier as evidenced by the survey results. This includes the perception that having children or the need to make multiple stops would make commuting by e-bike unfeasible. This suggests a need for education and outreach to demonstrate the potential utility of e-bikes, including e-cargo bikes, which are designed to carry children, other passengers, and significant loads of cargo.

Figure 5.1 Example of an e-cargo bike
Source: https://yubabikes.com/2019-yuba-electric-cargo-bike-lineup
5.2.2. Opportunities

Two of the top reasons survey participants cited that they do not currently cycle to work are issues that can be addressed by an e-bike. The first is *I live too far away*. The literature consistently demonstrates that people who ride e-bikes ride farther and more often than those who ride regular bicycles (Apostolou et al., 2018; Cairns et al., 2017; Fyrhi & Fearnley, 2015; Haustein & Moller, 2016; Jones et al., 2016; Ling et al., 2017; Plazier et al., 2017). Most people who responded to the survey (over 80%) live 15kms or closer to their place of work, and half live within 10km of work. While 15kms one-way is a daunting bike ride for many people, it is well within range of an e-bike for many fitness levels. Even if cycling with full assist the entire trip, both ways, that distance could easily be done on a full charge of an e-bike. Because e-bikes travel at higher, more consistent speeds than mechanical bikes, it would also shorten a ride that might take 45+ minutes on a mechanical bicycle to 30 minutes or less on an e-bike. This indicates that education may play an important role in changing people’s commuting habits, so that people know how far and how fast e-bikes can go.

One of the other top reasons that survey participants cited for not cycling was *I don’t want to be sweaty when I arrive*. This can also be overcome by the use of e-bikes. While in the Netherlands and in Copenhagen, people ride bicycles in every type of clothing from casual to formal, in Canada cyclists can often be seen in athletic gear. Commuters will typically change when they get to work. In a city with such varied topography and steep hills, this is not surprising. However, e-bikes “flatten hills” by giving enough assist to minimize effort and maximize speed. This would allow many commuters within Nanaimo to make their commute without exerting enough effort to break a heavy sweat.

70% of non-cycling, non e-biking participants had not tried riding an e-bike at the time of taking the survey. This represents an opportunity for creating spaces and events for people to try riding one. Research suggests that people are more likely to purchase an e-bike after having some experience/contact with one (Cairns et al., 2017). Providing people with opportunities to try riding one would increase the chance of having them purchasing one.
One of the primary opportunities for promoting e-bike use is the existing positive attitudes currently seen towards e-bikes and the general interest in them. Because it seems that those who ride e-bikes universally love them, it may be possible to catalyze that energy for marketing and education. The literature suggests that people are more likely to purchase an e-bike if they know someone who already owns/rides one (Popovitch et al., 2014). The literature also indicates that people who have positive view of cycling are more likely to cycle (Heinen et al., 2010). Interview participants also mentioned people coming in and being curious about e-bikes after having a friend show them theirs, or couples buying e-bikes within weeks of one another. There is clearly an interest and curiosity about e-bikes, but it is likely that many people have little knowledge and experience with what the e-bikes can actually do. It would likely spur some increased purchases and use if educational materials were made easily accessible.

5.3. What e-biking trends are already being seen in Nanaimo?

While this research was largely qualitative in nature, and no quantitative e-bike data was gathered, it is possible to draw preliminary conclusions from the research. Through the interviews with e-bike retailers, it is apparent that e-bike sales have been steadily increasing. While still a relatively small proportion of total bicycle sales, most participants estimated that the last several years had seen significant jumps in e-bike sales, and their business projections predicted even more in the near future.

Interview participants also acknowledged that they see an increasing number of people around the city riding e-bikes. One participant suggested that the researcher count bicycles on the E&N Trail; he thought that the number of e-bikes commuting would outweigh the number of people cycling on mechanical bicycles.

As far as demographics go, it appears that e-bikes remain popular primarily with an “older” population, variously described as over 40, over 50, or over 55. Interview participants had customers as old as in their 80s purchasing e-bikes and riding them regularly. Much of this demographic purchases e-bikes for recreational purposes, for
social purposes, and/or for running errands. Often this population also has underlying health motivations – either to stay fit or to get more active.

Commuting by e-bike seems to be more common among younger populations. Interview participants cited the cost of owning and maintaining a car, as well as the cost and hassle of parking as reasons that younger customers seek e-bikes. Some parents with young children also purchase e-cargo-bikes, but this remains a relatively small demographic.

In summary, e-bike sales have been steadily increasing in Nanaimo. While e-bikes remain popular with older people, as supported by the literature, there is a growing market of young people seeking alternatives to driving. There is also an increasing number of people interested generally in e-bikes, but cost and fear of theft may be prohibiting many people from actually purchasing one. Infrastructure remains a barrier for both cycling and e-biking in Nanaimo. Overall, the outlook for e-biking would suggest that rates will continue to increase, especially as technology advances and prices continue to fall.

5.4. Can e-biking be a safe, reliable, and desirable mode of transportation in Nanaimo?

The previous questions demonstrated some of the barriers and opportunities for e-biking as a viable mode of transportation in Nanaimo, what trends are being seen, and what current attitudes can be seen. The answers to these questions generally lead to the answer that yes – e-biking can be a safe, reliable and desirable mode of transportation in Nanaimo, with a few caveats.

Desirable: Overall, attitudes and interest in e-bikes suggests that e-biking is a generally desirable mode of transportation in Nanaimo. With over 50% of respondents indicating previous interest in e-bikes and over 60% indicating current interest in riding an e-bike, e-biking is on the radar of a substantial number of people. Additionally, all interview participants noted that customers enjoy their e-bikes and remain enthusiastic about them. This, in combination with the literature about e-bikes and physical and mental well-being, indicate the e-biking can be a desirable mode of transportation in Nanaimo.
Reliable: This research did not take a deep look into the “reliability” of e-biking, especially in comparison with other modes of transportation such as transit or driving. However, several factors suggest that e-biking can indeed be reliable in Nanaimo. Several e-bikers and cyclists in the survey noted that e-biking/cycling could be more convenient that other modes of transportation, especially by reducing parking stress and avoiding the irregular transit system. One interview participant also noted that bicycles have access to paths, trails, and cut-throughs between streets and cul-de-sacs that cars do not, meaning that the flexibility and freedom of cycling is extensive.

Research suggests that cycling is generally more reliable that driving, in the sense that commuting times are more consistent even with variable influences like traffic (Wild & Woodward, 2019). Cycling is also seen as more reliable than transit (Wild & Woodward, 2019). Again, this project did not look specifically at traffic in Nanaimo and how it impacts either driving or transit, but it is likely that the results from the literature would hold true here.

Safe: Safety is likely a barrier to e-biking being a viable mode of transportation in Nanaimo. Although cycling fatalities are relatively infrequent on Vancouver Island (with the 5-year average being 3 fatalities/year) (ICBC, n.d.), the perception of safety is as important as absolute safety in a person’s decision to commute by bicycle.

All groups of survey participants mentioned street safety or infrastructure in some way; cyclists and e-bikers feel the streets could be safer and there could be more infrastructure, while the roads feeling unsafe was a barrier for many non-cyclists/e-bikers to adopt cycling. All interview participants, when first asked what Nanaimo could do to encourage cycling and e-biking, cited infrastructure as one of the biggest items. Interview participants understood that people need to feel safe to want to cycle, which is borne out in the literature (Heinen et al. 2010; Riggs, 2019).

Nanaimo currently has several multi-use pathways that span north-south across the city, with very little bicycle infrastructure running perpendicular to them. The disconnected nature of the cycling network and the lack of separated/protected bike lanes may be a barrier to more people commuting by bike. In this regard, it would be valuable to look to other cities and countries that have been building cycling infrastructure for many
years. Evidently, the Netherlands and Copenhagen offer excellent examples and innovative design ideas. However, US and Canadian examples may be highly valuable as well. Victoria has been implementing extensive bicycle network planning recently and has the highest cycling rate in Canada with 6.8% of residents commuting by bicycle (Statistics Canada, 2017b).

Linked to safety is also the safety of the e-bike itself; theft was a common theme in both the interviews and the survey. Generally, people do not feel that they can leave their bike outside of their workplace or shopping centre for fear of it being stolen. Nanaimo could improve safety on this front by providing secure, long-term bicycle parking.

Overall, e-biking has the potential to be a viable mode of transportation in Nanaimo. Current e-bikers are overwhelmingly positive about the experience of riding their e-bikes. These e-bikers seem to see an improvement in quality of life from their e-bike in some way – whether in the form of exercise, socializing, or saving money. Sellers of e-bikes report that e-bike sales are steadily increasing year-on-year and are projected to become a significant portion of sales in the near future. Survey participants, as well as potential customers that e-bike sellers encounter, seem to have a general curiosity and interest in e-bikes. This bodes well for transitioning to a low-carbon future. If people are already interested in it and have an intention of purchasing or riding one, incentives and promotions may be more likely to have an effect (Simsekoglu & Klockner, 2019).

5.4.1. Non-transportation potential for e-bikes in Nanaimo

While the potential for e-bikes as a viable mode of transportation in Nanaimo is significant but highly dependent on pro-cycling policies, this study also added to the growing body of research that e-bikes have a positive impact on peoples’ well-being. E-biking as recreation seems to be the dominant use in Nanaimo and has the potential to grow, as e-bikes gain popularity and as the population ages. The resounding opinion of all e-bike retailers interviewed was that customers were happy with their purchases and the e-bikes had positively impacted their well-being. While the aim of this study was to examine transportation/utilitarian potential of e-bikes in Nanaimo, an increase in recreational riding should be considered a positive outcome for its potential health
impacts. Some of the recommendations below, such as improving infrastructure, would benefit those wishing to ride e-bikes recreationally as well as those riding to commute.

5.5. Recommendations to the Province:

Remove PST from sales of e-bikes

In BC, there is no Provincial Sales Tax (PST) charged on the purchase of bicycles, or on the purchase of replacement parts, or on the cost of servicing mechanical bicycles. Exempt bicycles are considered non-motorized. PST is charged on the sale of electric or otherwise motorized bicycles, as well as parts and servicing for those e-bikes. PST is also charged on electric-assist conversion kits (Ministry of Finance, 2016).

Because cost of purchase was the top barrier to purchasing an e-bike in the survey, and because all participants in the interviews mentioned removing PST as a way to incentivise e-bike use, it is justifiable to remove PST from these purchases. E-bikes are significantly more expensive than mechanical bicycles, as are their parts and components. PST is 7%, meaning that on a $3000 e-bike, the PST is $210. That amount of money could buy a used commuting traditional bicycle or accessories for an e-bike such as baskets, a helmet, a good-quality lock, or a trailer. Almost all of the interview participants listed removing PST from e-bikes as a way to incentivise e-biking; clearly it is something that they see come up with customers.

Provide incentives for commuting by bicycle

Another way to address the financial burden of e-bikes is for the government to provide incentives for cycling. Some countries and cities do so for both e-biking and mechanical cycling, such as the Netherlands, France, and Bari, Italy (Ferguson, 2019). Many of these schemes pay a modest amount (around 0.20 euros) per kilometer cycled. Sometimes a country or city will also provide subsidies, with more money being provided for the purchase of an e-bike than a mechanical bicycle. While these incentives typically only cover a fraction of the cost of an e-bike, when considered in combination with the cost savings of cycling rather than driving, it may be incentive enough for some to switch
to e-biking. This recommendation could be applied at a provincial level for all citizens, or at the municipal level, where City employees get paid per kilometer cycled.

**Provide rebates on the purchase of e-bikes**

BC currently has a program called “Scrap-It”, whereby citizens can trade in their vehicles for various incentives. One such incentive is an $850 credit towards the purchase of an e-bike from a participating retailer.

While this program aims to incentivise replacing cars with e-bikes, it is not a viable option for many people in BC. In sprawled suburban communities or in rural areas, an e-bike may be able to replace many car trips but not all of them. This is especially true for families with children or for people who use cars for a specific reason (for example, a truck or van for a business). At best, it will encourage 2-car families to reduce to using 1 car and 1 e-bike.

Rebates should be available for people who wish to purchase an e-bike but who cannot, for various reasons, get rid of their car. Research indicates that even when e-bike owners also own cars, they still replace car trips with their e-bike (Kroesen, 2015). If the provincial government is seeking ways to incentivise greener modes of transportation, then offering rebates to anyone wishing to purchase an e-bike would do so.

If it is not financially feasible to offer every person a rebate on e-bikes, an alternative would be to offer a rebate based on a sliding scale of income. Lower income people get a higher rebate, whereas higher income people get a small or no rebate. This would provide more equitable access to e-bikes. It would also allow those who cannot afford a car or the costs associated with one (insurance, gas, and maintenance) to have access to a form of transportation that offers the freedom and flexibility to rival that offered by a car.

**Work on better bicycle/e-bike integration with transit systems**

BC Transit is the provincial agency that plans and provides transit services for the entire province, excluding Metro Vancouver. They generally work with Regional Districts and municipalities to plan bus routes. Transit is funded through a combination of provincial
funds and local property taxes. In Nanaimo, the Regional District of Nanaimo (RDN) operates the regional bus system.

Integration with transit may provide incentives for more people to take up cycling and riding transit (Pucher & Buehler, 2012). Cycling to transit greatly increases the catchment area beyond what is easily walkable (Pucher & Buehler, 2012). Although transit was not mentioned by survey or interview participants, evidence from countries such as the Netherlands suggests that integration of transit and cycling can be successful (Martens, 2007; Pucher & Buehler, 2012). 39% of Dutch rail commuters ride bicycles to their local train station, while 25% of Danish rail commuters and 20% of Tokyo commuters do so (Pucher & Buehler, 2012). Providing bicycle parking is also a fraction of the price of vehicle parking for the purpose of park-and-ride (Pucher & Buehler, 2012).

Currently, e-bikes are allowed on BC Transit bicycle racks. They must be less than 55 lbs, the wheels must fit in the bike rack, and the battery must be taken off the bike and into the bus with the rider (BC Transit, n.d.). However, most bus bike racks only fit 2-3 bikes at a time, meaning that if more people begin integrating cycling and transit, people and their bikes will be left behind. In the long term, researching and implementing improved bicycle storage on busses is warranted, especially as bicycle and transit ridership increase.

Providing short- and long-term bicycle parking (including charging outlets for e-bikes) at transit exchanges would also encourage more people to combine cycling with transit. The BC Active Transportation Design Guide (2019) provides recommendations for bicycle stations (also called hubs or depots), which are common in Europe and Asia. Usually located at transit exchanges or places of high-density employment or commercial activity, they are fully staffed, highly secure centres for parking bicycles. As a more short-term and cheaper solution, bicycle cages, with users having key-card access, are an easily implementable type of bicycle parking that could be used in a range of transit stops/exchanges (Pucher & Buehler, 2012).
Add cycling and road safety lessons to the public education curriculum

Education and awareness came up several times in the interviews as important for promoting cycling in general. Several participants mentioned either having had cycling and road safety lessons in school here, or having heard of universal cycling and road safety lessons in other countries. Most interview participants mentioned the importance of drivers understanding cyclists and having more empathy for others on the road.

Universal primary school cycling education would 1) Ensure that all children learn how to ride a bicycle, regardless of their socio-economic position and family situation; and 2) Ensure that even those children who do not grow up to cycle regularly have some understanding of what it feels like to cycle on the roads. Ideally, it would also foster a more positive view of cycling in general. While this research did not address drivers’ (potentially negative) attitude towards cyclists themselves, the literature suggests that this can be something that discourages cycling (McCarthy, 2011). Fostering empathy and understanding between road users at a young age may prevent later conflict and negative views about cycling.
Early education could also help address the gender gap in cycling rates and attitudes. In North America, cycling rates amongst women is drastically lower than amongst men; in countries with high cycling rates, there is usually gender parity (Garrard et al., 2008; Pucher & Buehler, 2008). This research also indicated some significant differences in perceptions of cycling between genders, with women more likely to feel inexperienced or uncomfortable riding a bike. Educating all children could help reduce this gap by teaching young girls the skills needed to be confident cyclists.

The course could be modelled after what is available in the Netherlands. While not a universal, many schools begin introducing bicycles to preschool age children, by teaching them on pushbikes. Around the age of 10, children take cycling skills courses, and complete a written exam at around age 12. They must also complete a practical exam at around the same age, where they cycle on designates routes. The children are given a certificate at the end of the course (Roberts, 2018). While not a legal requirement like passing a driving test, programs like this ensure that all children gain some road safety literacy, learn how to ride a bicycle, and are encouraged to feel confident riding on the streets. Other countries and cities provide bicycle safety education to school-age children which can provide guidelines, such as Odense, Denmark (Handy, Heinen & Krizek, 2012).

5.6. Recommendations for the City of Nanaimo:

Provide safe, secure, and convenient bicycle parking

Risk of theft was tied as one of the biggest reasons survey participant hesitated to purchase an e-bike, and the literature suggests that commuters highly value secure bicycle parking (Heinen et al., 2010). Nanaimo’s crime rates have been increasing since 2015, with 2018 having the highest rate of theft in a 5-year period (Statistics Canada, 2019), meaning that respondents’ fears are not unfounded. Through personal observation, there is a lack of secure bicycle parking around Nanaimo. Shopping and commercial areas may have racks outdoors, but they are usually small and often uncovered and many smaller strip malls have no racks. Vancouver Island University (VIU) and several other locations have bike lockers, but such secure bike storage is uncommon.
Nanaimo does include bicycle parking requirements in their Parking Bylaw (Bylaw No. 7266), with requirements for both short-term and long-term bicycle parking spaces in new developments. This is an excellent first step but does not address the buildings and infrastructure that already exist around the city.

A first step in providing secure bicycle parking would be at transit hubs and commercial centres around the city. As previously mentioned, the Netherlands and several other European countries have seen considerable success with the integration of bicycle parking and transit stations (Martens, 2007; Pucher & Buehler, 2012). In a sprawled city like Nanaimo, getting to the nearest transit stop or station may be too far to walk to, which makes taking transit unfeasible or undesirable. Cycling or riding an e-bike may lower that barrier. Most of the transit hubs in Nanaimo are also either commercial hubs or employment hubs, meaning that both transit riders and those using the area for work or shopping could make use of the bicycle parking.

Both short term parking and long-term parking should be provided. Nanaimo’s Parking Bylaw defines long term bicycle parking as “secure, weather-protected bicycle
parking facility used to accommodate long-term parking, such as for residents or employees within a building or covered compound with lockable doors” (City of Nanaimo, 2018). Short term parking is defined as “short-term bicycle facility that is accessible to visitors and located near the building entrance” (City of Nanaimo, 2018).

Beyond the City’s parking bylaw, there are numerous sources to find best practices for bicycle parking. Despite best practices for most cycling infrastructure coming from Amsterdam and Copenhagen, e-bikes have different requirements from the “casual” parking culture in those places (Larsen, 2017). Most people in those cities ride cheap bicycles and use minimal locks and have experienced bicycle theft (Larsen, 2017). European countries often have excellent long-term bicycle parking (especially located near transit stations) but their short-term parking is often minimal and does not always use best practices. Supporting e-bikes will require higher quality short-term parking standards.

The City of Victoria has several policy documents that guide the requirements for and design of bicycle parking in the city. For example, their Bicycle Parking Strategy (2011) outlines best practices, current demands, and design guidelines for on- and off-street bicycle parking. Some general guiding principles for on-street (short-term) bicycle parking are:

- Safety and security
- Theft-resistant and firmly anchored
- Convenience and accessibility
- Visibility and lighting
- Avoiding conflicts with pedestrians and vehicles
- Quality of design and aesthetics

Specifically, short-term racks should support the bicycles, allow U-locks, be flexible in the size/shape of bicycle they can accommodate, be made of materials that will not damage the bicycles, be attractive, be simple and intuitive to use, and be space and cost effective. Victoria recommends U-racks, post and ring racks, and coat hanger or spiral racks. Racks to avoid include wheelbender racks, comb racks, or wave racks (City of Victoria, 2011). In the context of e-bikes, U-racks and post and ring racks are likely the best options, as they provide the most flexibility for the generally larger and heavier frames
of e-bikes. Racks are the most cost-effective way to drastically increase the immediate supply of bicycle parking, so prioritizing these is an easy first step in providing more bicycle parking.

The British Columbia government recently released an Active Transportation Design Guide (2019), which is another useful resource for bicycle parking guidelines. The document’s guiding principles echo those of the City of Victoria: convenience, safety and secure, functional, accessible, and good aesthetics. The guide also has recommendations for non-traditional bicycles, which are especially useful in the context of parking for e-bikes. Their recommendations for racks to avoid are relevant for e-bikes. Some common racks such as wave and coathanger are advised against, as they limit the type and number of bicycles that can be accommodated.
Figure 5.4: Bicycle racks to avoid (Ministry of Transportation and Infrastructure, 2019)

While it may be beyond the City’s capacity to immediately install bicycle racks at all commercial centres, Nanaimo may consider adopting a program that Portland has developed. There, businesses can request that a bicycle rack be installed outside their shop. As long as the proposed space meets certain guidelines, the city will then install one or two, free of charge. Any additional rack costs $150 (City of Portland, n.d.).
**Prioritize completing an AAA cycle network**

All interview participants from Nanaimo commented on the lack of infrastructure in Nanaimo and its disconnected network. All participants from both cities thought that infrastructure was one of the best ways to encourage more cycling. It is important for riders to feel safe, which encourages more diverse populations to start riding (such as women and children). Additionally, 39% of survey participants cited “The roads feel unsafe” as one of the reasons they do not ride. The responses from both the survey and the interviews are supported by the literature, which indicates infrastructure is one of the best ways to encourage more cycling (Pucher & Buehler, 2008; Gossling, 2013; Handy et al., 2014; Pucher et al., 2010). Clearly, this is a need that the city needs to address.

As discussed previously in this paper, Nanaimo’s Transportation Master Plan (2014) does acknowledge the need for improved safe infrastructure. The TMP includes short- and long-term cycling network expansion plans.

![Figure 5.5: Nanaimo’s planned short-term cycling network (City of Nanaimo, 2014)](image)
Figure 5.6: Nanaimo’s planned long-term cycling network (City of Nanaimo 2014)

The plan is an excellent skeleton for improving the cycling network, but lacks some specificity, timelines, and budget considerations.

Although it uses language like making cycling more “safe” and “comfortable”, there are no specifics about what that might look like. The City could consider using the AAA (All Ages and Abilities) Cycling Network framework. AAA infrastructure aims to create infrastructure that is comfortable for all ages, at any level of cycling, to use. Someone with their 6-year-old child should feel as comfortable as an avid road cyclist. The City of Victoria has used this language to frame their cycling network and to justify the sometimes-contentious separated bike lanes that they are installing. Removing cyclists from motor vehicle traffic is the only way to make cycling feel safe on busy thoroughfares.

Nanaimo should adopt a AAA framework for their cycling infrastructure and provide more protected bike lanes. While they have been making progress on some of their TMP goals like increasing the number of painted bike lanes and wayfinding signs, much of these actions will not have a significant impact on those nervous about cycling on the roads.
Prioritize bicycle infrastructure in budget

Highly relevant to completing a AAA network of bike lanes is prioritizing infrastructure in the City’s budget. While Nanaimo has decent policy regarding active transportation priorities and cycling infrastructure, none of the visions included in the TMP will become a reality without budgeting for it.

If finding funding for cycling infrastructure is an issue, Nanaimo should look to other cities for how they funded infrastructure. For example, the City of Victoria funded their recent AAA infrastructure through the Federal Gas Tax Funding, as well as the Provincial Bike BC program, Trans Canada Trail Foundation, and the Federation of Canadian Municipalities (City of Victoria, 2019).

There is incentive for Nanaimo to contribute more funds to the development of cycling infrastructure. In April of 2019, City Council passed a motion declaring a climate emergency. The motion included steps to address climate change such as:

- The creation of a reserve fund used to support projects, plans and initiatives that reduce the City’s CO2 emissions.

- An update to the City’s Community Sustainability Action Plan, including the framework, strategies, actions and implementation.

- Correspondence sent to the Regional District of Nanaimo requesting the addition of 20,000 annual public transit hours.

- Correspondence sent to the provincial Minister of Environment and Climate Change Strategic requesting the province reinstate the production of the Community Energy and Emissions Inventory Reports or dedicate grant funding to be used for their creation.

(City of Nanaimo, 2019).

While the original motion did not include any mention of cycling or active transportation infrastructure, promoting cycling would arguably apply to the concept of a climate emergency. Getting people out of their cars and using more sustainable modes of transportation is a way to quickly reduce carbon emissions from transportation. Because of Nanaimo’s disconnected cycling network, it will take a significant investment of planning
and financial commitment to make a complete network. This can be justified considering Nanaimos acknowledgement of a climate emergency.

**Add e-bike specific objectives to the Transportation Master Plan**

While Nanaimo’s TMP provides a good basis for guiding visions and objectives for active transportation, the 2014 document does not mention e-bikes anywhere. This research demonstrates a strong interest from citizens of Nanaimo in e-biking, and the City should actively pursue that. Additions to the TMP could include several of the other recommendations in this report, such as explicitly pursuing a AAA Cycling Network, focusing on providing better/more bicycle parking and storage facilities, especially in transit hubs and commercial areas, and pursuing a feasibility study for an e-bike share program.

**Play an active role in Bike to Work Week/Go by Bike Week**

Several interview participants specifically mentioned events aimed at promoting commuting by bicycle. In BC, there are various iterations of it. The largest is GoByBike Week, formerly Bike to Work Week, usually held in early June. Individuals and teams can sign up and track the kilometers they cycle during the week. There are generally “celebration stations” throughout communities, where commuters can stop and enter in draws and often partake in free snacks or drinks. There is a grand prize draw at the end of the week for a cycling trip somewhere around the world. Other iterations are similar and try to encourage those who do not regularly cycle to do so for the week.

GoByBike Week is organized by GoByBike BC Society. They secure resources and funding to deliver events across the province. The organization was founded in 1995 in Victoria, and their first event had approximately 500 participants. By 2018, the number of participants across the province reached more than 50,000 and the events now include a Bike to School event (GoByBike BC Society, 2019).

Despite the City of Nanaimo playing an active role in the organization of GoByBike events, interview participants who brought up these events felt that in Nanaimo, momentum has stopped and the events were floundering. Participants thought that the City could play a larger role in reactivating and promoting the events. More advertising on
the city’s part and efforts to increase visibility could play a role in dispersing information and raising awareness. Generally, interview participants felt that education and awareness were important, but often were not sure of what role the City might play on that front. Bike to Work events could be one such avenue to promote education. A combination of infrastructure investment and education/promotion/marketing seem to provide the largest gains in cycling modal share, so GoByBike week and other marketing would be highly valuable in Nanaimo (Heinen et al., 2010).

**Consider a feasibility study for an e-bike share program**

While the focus of this research was not to consider the feasibility of a bike-share program in Nanaimo, the results suggest that a bike share program that offered e-bikes could be a viable venture. Interest in e-bikes is generally high in Nanaimo yet cost of purchase and risk of theft are deterring people from purchasing one. An e-bike share provides an opportunity for people to try and use e-bikes for commuting, errands, or recreation without the financial commitment of purchasing one. Results from the survey suggest that there is high interest specifically in e-bike share, with 50% of non-cyclists/e-bikers indicating interest. While the survey is not statistically significant, the amount of preliminary interest warrants a closer look at the possibility.

E-bike share programs can take various forms and many factors need to be considered. Will it be publicly or entirely privately-funded? Will the bicycles have docking stations or will they be dockless? Where should the docking stations be? Should the program only be available in certain areas of the city? A feasibility study would answer these questions and point to whether such a program would be viable. Many cities in North America have pursued bike-shares to varying degrees of success. These can be used as case studies to determine what might or might not work in Nanaimo.

**Consider employee incentives for purchasing e-bikes and cycling to work**

While drawing conclusive ideas about Nanaimo’s population from the survey results is not possible, the results do indicate a strong interest in e-bikes from City employees. Cost of purchase was one of the largest barriers to purchasing one. One interview participant had been involved in another municipality’s efforts to encourage e-biking. That municipality had a program where employees could purchase an e-bike with
a “loan” from the City, which was then repaid by directly deducting payments from the employee’s paycheque.

The City of Nanaimo should consider such an incentive program, which might be the difference between someone thinking about an e-bike and actually purchasing one (Heinen et al., 2010). While an incentive program would only benefit employees of the City (a relatively small proportion of the entire city’s population), the literature suggests that this could have a domino effect through the employees’ social networks (Rogers, 1995). The literature suggests that people are more likely to pursue e-biking when they know someone that owns one (Seebauer, 2015). Therefore, expanding the network of people that own and ride e-bikes would indirectly contribute to a snowball effect. It would also start normalizing e-biking/cycling as a viable mode of transportation. Cyclists are not very visible in Nanaimo because the cycling rate is so low. This may create a cyclical effect, where people do not see cyclists, and therefore do not consider cycling as a mode of transportation, and therefore do not consider cycling themselves. Raising that visibility would help normalize the idea of cycling for transportation. The survey results indicate that City of Nanaimo employees are open and interested in e-bikes, so an incentive program could help increase uptake.

An e-bike loan/incentive program may fit within city policies not directly related to transportation. For example, reducing emissions from the organization itself or promoting better public health/more physical activity could help justify the program. The program is also ultimately cost-neutral, as the employees end up paying the full cost of the e-bike over time.

*Purchase a municipal e-bike fleet for employees to use for work-related travel*

With similar justifications as the previous recommendation, purchasing an e-bike fleet to be used by employees for meetings and other work-related travel would allow them to try out and experience e-bikes without committing to purchase one themselves. It could fit positively with the City’s climate change and sustainability goals, by reducing the carbon emissions of the organization.
Consult with bicycle store owners as part of public consultation on cycling initiatives

This research demonstrated that owners and managers of stores that sell bicycles/e-bikes are a rich resource on all things cycling. While interviews with e-bikers themselves would provide more depth and insight into the current experience of individuals e-biking in Nanaimo, bicycle store owners hear from a wide range of customers and have a better idea of what general trends can be seen. They can provide insight into sales trends, demographics trends, how people use their e-bikes, and what people think of infrastructure. Many are often cyclists themselves and can offer their personal experiences of cycling in Nanaimo.

The City should consider bicycle store owners/managers as stakeholders in any future consultation on cycling network improvements or general cycling initiatives. Nanaimo’s cycling advocacy group, the Greater Nanaimo Cycling Coalition (GNCC), has been largely inactive for a number of years. Volunteer organizations such as the GNCC can be hugely instrumental in promoting cycling and transportation issues, but like all volunteer organizations, they may suffer from instability over the long-term. Bicycle stores are more consistent, and the owners/managers have valuable insight to offer. One of the interview participants from Victoria felt strongly that store owners should be consulted in the planning of cycling infrastructure for this very reason.

Bicycle store owners can also provide access to the wider cycling community when a volunteer advocacy group does not exist. Several owners seemed to know their customers quite well and were actively involved in Nanaimo’s cycling community. When the City is looking to consult with those who use cycling infrastructure, bicycle store owners could easily aide in the recruitment of that population.

5.7. Limitations

As mentioned in section 3.5, the survey results are not representative of Nanaimo’s population. The response rate was lower than expected, meaning that even generalizing to the City of Nanaimo’s entire employee population is not entirely possible. Furthermore, in examining the demographic results of the survey, it is hard to generalize about any age
group or income bracket even within the sample, as the number of people falling into each group is so small. The respondents trended on the wealthier side (with almost half having a household income over $100,000) and most people having some kind of post-secondary education.

Finally, while the survey was available to all staff at the City, there was likely some self-selection bias from those who chose to take the survey. People who chose to take the survey could have been more likely to be interested in cycling and e-bikes than those who did not. Also, because the questions were based on commuting habits, those who own an e-bike but do not ride it to work were not represented in the “e-biker” portion of the survey.

However, as a preliminary form of research, the survey still holds value in comparing results to other e-bike/cycling research and in pointing towards future research needs.

The interview results are also not quantitative or statistically significant in any way. However, using selected informants can provide valuable insight into trends and help build a knowledge base from which to do more research.

5.8. Future Research Needs

This project provides a preliminary look at e-biking trends and potential in Nanaimo. However, there remains a substantial gap in e-bike research in Canada. While this project is valuable in the context of coastal British Columbia, other parts of Canada have drastically different political, geographic, cultural, and climatic conditions. More conservative areas and communities with harsher weather may not demonstrate the same interest in e-biking as those on the mild BC coast; it is therefore not possible to generalize the results from this research to the rest of Canada.

Similar research with a larger sample size would be highly valuable. The main limitation of this research was the small, limited, and homogenous sample for the survey. A larger, more diverse sample would give more robust data on attitudes and perceptions
of e-biking, while more specialized research on important user groups, like young families/mothers or those with low income, would be highly valuable. A more detailed gender analysis of cycling and e-biking in Nanaimo is warranted, as the survey demonstrated some significant differences in perceived barriers between men and women.

The survey results indicated a strong interest in an e-bike share program. Further research on this topic would be valuable. A more detailed analysis of potential rider interest, financial feasibility and an analysis of where to place docking stations are all warranted.

Should the province or the City offer financial incentives, it would be highly valuable to study the impacts of these incentives to see what impact they have on purchases of e-bikes and on cycling rates in the city. This would add to a small but growing body of literature that looks at how government and workplace incentives influences transportation mode choice.

5.9. Conclusion

Like many cities in North America, Nanaimo has a sprawled development pattern and is a highly car-dependent community. This transportation reality has implications on both local and global levels. Globally, private transportation is a significant contributor to carbon emissions and climate change. Locally, it contributes to air pollution, environmental degradation through sprawl, and has public health implications for inactivity and obesity. Car-centric communities are also inherently inequitable; owning and operating a car is expensive, sometimes prohibitively so. Others cannot drive for various physical or medical reasons. Car-centric communities often marginalize all other forms of transportation in favour of the automobile.

These problems are complex, as are transportation decisions and planning, and require myriad responses. However, one part of the solution may be promoting e-biking. While cycling is often as efficient as automobiles in urban areas, sprawled and hilly environments may discourage the widespread adoption seen in some European
countries. E-bikes are a way to overcome those barriers, where an electric motor enables the rider to ride for longer and faster than they otherwise would be able to.

The literature suggests that e-bike sales are growing rapidly, that many people are adopting e-bikes, and that e-biking has many of the same health benefits as cycling. Generally, e-bikes are more popular with older (55+) populations, likely because they think they need the assist and the high cost of purchase may be prohibitive to younger riders. Research indicates that while less effort is needed to ride an e-bike, e-bikers ride for longer and more often than cyclists, resulting in the same net gain in physical benefits (Jones et al., 2016). Psychological benefits are also apparent, especially in older populations (Leyland et al., 2019). It appears that when people own both an e-bike and a car, they replace at least some car trips with their e-bike (Kroesen, 2017).

However, much of the research on e-bikes comes from European countries, where cycling levels are already high. Several studies from the US have emerged and echo the same findings as Europe, but very little research exists in the Canadian context. This project aimed to contribute to filling that gap. Europe’s built environment is drastically different than much of Canada, with transit and pedestrian/cycling infrastructure much more developed in most cities in Europe (Handy et al., 2012). Assuming that attitudes and responses to e-bikes in Canada will replicate those seen in Europe is not entirely realistic considering the different contexts. Therefore, this project aimed to gather, in general terms, data on what trends are being seen in Nanaimo and how open people are to the idea of e-biking as transportation.

This research aimed to answer the question “Can e-biking be a safe, reliable and desirable mode of transportation in Nanaimo?”. To answer this question, this research looked at current attitudes towards e-biking, current trends in e-biking, and what barriers and opportunities exist in getting people to switch from driving to e-biking. A mixed-methods approach was used, with a survey of City of Nanaimo employees exploring perceptions of e-biking and interviews with e-bike vendors exploring Nanaimo’s e-biking trends.

Through the research, it is evident that there is growing interest in e-biking in Nanaimo. Sales have been steadily increasing and the majority of survey participants
showed interest in e-biking. However, several barriers suggest why more people have not already pursued e-biking. Cost of purchase was the largest deterrent, with risk of theft closely following. Uncertainty about the possibility of replacing car trips with an e-bike was a concern for about one third of respondents. Infrastructure/safety on roads was consistently raised as an issue by all survey groups and by all interview participants.

Many of these barriers can be addressed by provincial and local policies. On a provincial level, improving the financial incentives for purchasing an e-bike could be improved. Removing PST from e-bike sales and improving rebates may help incentivise e-bike purchases. On a local level, improving infrastructure, including cycling networks and parking facilities, would help normalize cycling and encourage more people to shift their transportation habits.

Despite the limitations of this study (such as a small sample size and lack of quantitative data), it contributes to a growing body of research that indicates that policy can directly impact peoples’ transportation decisions. Nanaimo’s planning and development has consistently favoured automobile travel, to the detriment of walking, cycling, and transit. It will take intentional policy decisions to begin to balance the transportation system in Nanaimo.

These policies are increasingly urgent. Immediate action is needed to curb carbon emissions and avoid catastrophic climate change. This has been acknowledged by the City through the declaration of a Climate Emergency. The benefits of e-biking are widespread for both environmental health and public health and e-bikes offer a viable alternative to many trips by car. Nanaimo, and all cities, should be actively pursuing policies and incentives to encourage e-biking and other modes of sustainable transportation.

5.10. Epilogue

During the writing of this project, the City of Nanaimo has been progressing on their cycling policy and budgeting. A new council and mayor were elected in the fall of
2018, and there has been a significant shift in transportation priorities. Below is a summary of updates at the time of writing.

In the draft budget for 2020, the City proposes $10,979,250 for their Transportation Infrastructure Program (City of Nanaimo, 2019a). While this includes all types of transportation infrastructure, several major projects to be undertaken include a “complete street” upgrade to Metral Corridor and improving cycling amenities off Bowen Rd, Comox Rd, and Boxwood Rd. Specifically, the City has proposed $2,338,000 on cycling amenities in 2020 and $8,597,000 in 2021. This is a major increase from previous budgets, with total planned spending on cycling from 2020-2024 at over $12 million, while the previous 5-year budget plan allocated $5 million for cycling (City of Nanaimo, 2019a).

Also included in the Draft Financial Plan (2020-2024) is Active Transportation Education and Marketing. The City proposes spending $25,000 in 2020 and increasing gradually to $35,000 in the years 2022-2024 (City of Nanaimo, 2019a).

The city is also undertaking work on an active and sustainable transportation master plan. Although no official announcement or engagement has begun, work will likely commence in 2020.

These developments indicate a new political will to encourage more sustainable modes of transport, which bodes well for cycling infrastructure. E-bikes will be an essential part of a sustainable transportation system, but only if policy creates conditions that make them a desirable and convenient way to move around the city.
References


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Heinen, E., Maat, K., & van Wee, B. (2011). The role of attitudes toward characteristics of bicycle commuting on the choice to cycle to work over various distances. Transportation Research Part D, 16, 102-109. 10.1016/j.trd.2010.08.010


Appendix A.

Survey Questions

My name is Eleni Gibson and I am a student in the Master of Community Planning Program at Vancouver Island University (VIU). The following survey is part of my Master's thesis research about transportation and electric bicycles (e-bikes) in Nanaimo. The survey will ask questions about your commuting habits and your attitudes towards cycling and e-biking.

All responses are completely anonymous and will not be linked you or your identity to in any way. The data collected will be securely stored and destroyed after the research is complete. You may exit the survey at any time, in which case none of the data provided will be save. Once you click "submit" at the end of the survey, you will not be able to retract your responses, but the data will not be linked to you personally.

By clicking "continue", you agree to the above terms.

How do you primarily commute to work (3+ days a week)? Choose one of the following answers

- Other (car, transit, walking)
- E-bike
- Bicycle

How do you usually get to other destinations (shopping, friends, restaurants, etc)? Choose one of the following answers

- Bicycle
- E-bike
- Other (driving, walking, transit, etc)

How long is your commute to work? Choose one of the following answers

- 0-5km
• 5-10kms
• 10-15kms
• 16+ kms

Do you have a valid driver's license?

Yes/No

IF ANSWERED “OTHER” FOR FIRST QUESTION

How do you typically get to work/school? Choose one of the following answers

• Walking
• Transit
• Driving
• Carpooling
• Other

Do you own a bicycle?

Yes/no

Have you ever considered cycling to work?

Yes/No

What specific barriers are stopping you from cycling to work? (Check all that apply). Please check at least one item.

• The roads feel unsafe
• There are not enough bike lanes/paths where I need to go
• I like driving
• It would take too long
• I live too far away
• I am out of shape
• I don’t want to be sweaty when I arrive
• I make multiple stops (children, groceries, etc.) and a bicycle would be difficult to accommodate this
• Too many hills
• The weather
• I feel inexperienced and am nervous to try
• I don’t like cycling
- I don’t own a bike
- I can’t ride a bike

Do you have any knowledge/heard of e-bikes?

Yes/No

Do you know anyone who rides an e-bike?

Yes/No

Have you ever tried riding an e-bike?

Yes/No

Have you ever considered purchasing an e-bike?

Yes/No

If an electric bike allowed you to ride longer distances with less physical exertion, would you be interested in riding an e-bike to commute to work?

Yes/No

If an electric bike allowed you to ride longer distances with less physical exertion, would you be interested in riding an e-bike to run errands?

Yes/No

Would you consider using an e-bike share if one was available in Nanaimo? (An e-bike share is a program where a fleet of e-bikes can be rented for short-term use around the city)

Yes/No
What barriers would prevent you from purchasing and riding an e-bike? Choose one of the following answers

- Cost or purchase
- Risk of theft
- Not interested
- Do not feel comfortable riding a bicycle
- Do not feel safe riding in Nanaimo

IF ANSWERED “BICYCLE” TO FIRST QUESTION

Are you satisfied with the level of infrastructure (bike lanes, separated paths, beg buttons at crossings, etc.) available in Nanaimo? Choose one of the following answers

- Very satisfied
- Satisfied
- Neutral
- Unsatisfied
- Very unsatisfied

Do you feel safe cycling in Nanaimo? Choose one of the following answers

- Very safe
- Somewhat safe
- Neutral
- Not safe
- Very unsafe

What policies would you like to see the city implement when it comes to cycling? Check all that apply

- Better infrastructure (bike lanes, etc)
- Education and outreach
- Traffic calming
- Nothing

Have you ever considered purchasing an electric bike (e-bike)?

Yes/no
Have you ever tried an e-bike?

Yes/No

Do you own a car/have access to one?

Yes/No

Would you cycle more if you had access to an e-bike? Choose one of the following answers

- Yes
- No
- Unsure

Why do you cycle to work? (check all that apply)

- To save money/because it's cheap
- Climate change/the environment
- I enjoy it
- I don't like driving
- I can't drive
- The bus is too slow/unreliable
- For exercise
- Other:

What is the biggest reason you cycle to work? Choose one of the following answers

- To save money/because it's cheap
- Climate change/the environment
- I enjoy it/it's fun
- I don't like driving
- I can't drive
- The bus is too slow/unreliable
- For exercise
- Other
IF ANSWERED “E-BIKE” TO THE FIRST QUESTION

How long have you owned an e-bike? Choose one of the following answers

- Less than 6 months
- 6 months to a year
- 1-2 years
- 2+ years

Did you cycle on a regular bike before purchasing an e-bike? Choose one of the following answers

- Yes
- No
- Sometimes

Did you know someone who owned an e-bike before purchasing yours?

Yes/no

Did you try riding an e-bike before you bought one?

Yes/no

Did purchasing an e-bike allow you to replace trips otherwise made by car?

Yes/no

What factors influenced you to purchase an e-bike? Select all that apply. Check all that apply

- To reduce the effort of cycling
- To replace trips by car
- Climate change/environmental concerns
- It’s fun to ride
- To go on longer bike rides
- To maintain physical activity as I age
- Other:
Are you satisfied with the level of infrastructure (bike lanes, separated paths, beg buttons at crossings, etc.) available in Nanaimo? Choose one of the following answers

- Very satisfied
- Satisfied
- Neutral
- Unsatisfied
- Very Unsatisfied

How much do you agree with the following statements? (1 is strongly disagree, 3 is neutral, and 5 is strongly agree)

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<thead>
<tr>
<th>Statement</th>
<th>1</th>
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<tbody>
<tr>
<td>E-biking has allowed me to make more trips by bicycle</td>
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<tr>
<td>E-biking has allowed me to ride longer distances to my destination.</td>
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<td>E-biking is a safe way to get around in Nanaimo</td>
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<tr>
<td>E-biking is a convenient way to get around Nanaimo</td>
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</table>
ALL RESPONDENTS WILL BE ASKED:

How old are you? Choose one of the following answers

- 18-24
- 25-35
- 35-55
- 55+

What is your gender? Choose one of the following answers

- Male
- Female
- Other
- Other:

What is your annual household income? Choose one of the following answers

- $0-20,000
- $21,000-40,000
- $41,000-60,000
- $61,000-80,000
- $80,000-100,000
- $100,000+

What is the highest level of education you have completed? Choose one of the following answers

- Some high school
- High school diploma
- Post-secondary certificate or diploma (1-2 yrs)
- Bachelor's Degree
- Graduate diploma
- Master's Degree
- PhD
Appendix B.

Interview Questions

How do e-bike sales compare to traditional bicycle sales (can be a rough percentage of total bikes sold)?

Have sales been increasing over the last 5 years?

Can you describe the main demographic that purchases e-bikes? Do you see any trends?

What reasons to customers give for purchasing e-bikes?

- Health? Environment?
- Save money (replace car)?
- Fun?
- Other?

What types of trips are people using their e-bikes for?

- Work?
- Errands?
- Recreation?

Have you heard about how satisfied customers are with their e-bikes?

- What are they satisfied with?
- If not satisfied, why?

What models/types of e-bikes are most popular?

Do people become more interested in purchasing an e-bike after trying one and/or knowing someone with one?
Do you see e-bikes as significantly reducing barriers to utilitarian cycling?

Have you seen an increase in people commuting by e-bike?

What negative attitudes towards e-bikes do you know of?

How can the city of Nanaimo encourage commuting by e-bike (and by bicycle in general)?

Any other observations about e-bikes in Nanaimo/BC?