Electric Vehicle Adoption in Growing Canadian Cities: Assessing Barriers to Electric Vehicle Adoption in the City of Kamloops

by:

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Abstract

Greenhouse gas emissions from transportation are a significant contributor to climate change. An effective method of reducing these transportation emissions is to electrify transportation. Local governments are creating electric vehicle policies to increase electric vehicle adoption in their communities. The City of Kamloops released their *EV Strategy* to encourage local electric vehicle uptake in 2020 but encountered barriers to local electric vehicle adoption such as a lack of charging infrastructure, a hesitancy to new technology, and the high prices of EVs. There is no significant research on EV adoption and barriers within a smaller city, regional hub, or Canadian context. To address this, I conducted a content analysis, literature review, and key informant interviews with six stakeholder groups in Kamloops to assess the perceived barriers to EV adoption. My research compares the perceived barriers within the context of Kamloops and provides policy solutions to the City of Kamloops to overcome these barriers and reduce transportation emissions. The City should continue to prioritize EV adoption through public education campaigns, encourage the building of charging stations, and focus on densification for an overall reduction of emissions and to provide convenient places for EV drivers to charge their vehicles.

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Abbreviations

BC	British Columbia
BEV	Battery-Powered Electric Vehicle
CAFC	Company Average Fuel Consumption
CAFE	Corporate Average Fuel Economy
CCAP	Community Climate Action Plan
EV	Electric Vehicles
GHG	Greenhouse Gas
HOV	High Occupancy Vehicle (Lane)
ICE	Internal Combustible Engine
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LCFS	Low Carbon Fuel Standard
MSRP	Manufacturer's Suggested Retail Price
MURBs	Multi-Unit Residential Building
NDC	Nationally Determined Contribution
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
SUV	Sport Utility Vehicle
UNFCCC	United Nations Framework Convention on Climate Change
ZEV	Zero Emission Vehicle

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Chapter One – Introduction

Political, economic, and ecological agendas are now concentrated around climate change (Held & Roger, 2018). Climate scientists agree that if global warming is left uncontrolled, it will have negative irreversible effects on the Earth (Held & Roger, 2018). Globalization, urbanization, and industrialization since the post-industrial era are increasing the carbon emissions into Earth's atmosphere through increased human produced greenhouse gas (GHG) emissions (Peter, 2018). Climate change has been linked with (but is not limited to): Arctic warming, increases in extreme weather events, decreasing food and water security, and negative health impacts (Mora, Spirandelli, Franklin, Lynham, Kantar, Miles, Smith, Freel, Moy, Louis & Barba, 2018). To prevent further heating of the Earth's atmosphere, radical policy action is needed to reduce human created GHG emissions (Davis, Ahiduzzaman & Kumar, 2018).

The transportation industry is a key contributor of GHG emissions. In 2017, it accounted for 18% of global GHG emissions from internal combustible engine (ICE) vehicles (Melton, Axsen & Moawad, 2020). Transportation is the second largest GHG emitting sector in Canada and the largest emitter within the province of British Columbia (BC) (Davis, Ahiduzzaman & Kumar, 2018). Passenger or light-duty vehicles contributed 11% of Canada's total GHG emissions in 2017 (Milovanoff, Posen, Saville & Maclean, 2020). In BC, 27% of BC's total GHG emissions in 2020 were from road transportation (including light-duty gasoline trucks and vehicles, motorcycles, and heavy-duty trucks and vehicles) (Province of British Columbia, 2020). Studies show that government policy measures are crucial for reducing transportation emissions (Poudenx, 2008; Bjerkan, Bjørge & Babri, 2021). An effective transportation emission reduction policy is to shift vehicles onto the electrical grid to reduce fossil fuel consumption (providing the region has access to clean electrical energy) (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019).

While research shows that national policies are impactful on EV markets, municipal EV adoption policies can significantly encourage EV adoption as they are customized to local conditions (Bjerkan, Bjørge & Babri, 2021). To increase EV uptake, 16 local governments in BC have created EV strategies – the City of Burnaby, City of Coquitlam, City of Kamloops, City of Kelowna, City of Nelson, City of New Westminster, City of North Vancouver, District of North Vancouver, City of Port Coquitlam, City of Port Moody, City of Richmond, District of Saanich, District of Squamish, City of Surrey, City of Vancouver, and the District of West Vancouver (Plug In BC, 2021). These strategies include targets to add and increase local accessibility to charging infrastructure, and to support local EV uptake (Plug In BC, 2021).

There is significant research on EV uptake in major cities internationally (Jin & Slowik, 2017; Wappelhorst, Hall, Nicholas & Lutsey, 2020; see also Section 2.1), but gaps in the literature are evident on Canadian cities, smaller cities, cities that serve as regional hubs, and communities outside of major city centers (e.g., the Lower Mainland or the Greater Toronto Area). I aim to address these gaps with a case study on the City of Kamloops, a growing city in British Columbia, Canada, that serves as a regional hub for the many communities surrounding it. The City of Kamloops released a comprehensive EV adoption strategy, the *Electric Vehicle and E-Bike Strategy* (*EV Strategy)* with AES Engineering in 2020 (AES Engineering, 2020; City of Kamloops, 2020). My research examines the City's *EV Strategy*, assesses local barriers, and provides policy recommendations for the City of Kamloops to overcome those barriers.

This research aims to answer two questions:

1) What are the perceived barriers to EV uptake in Kamloops?
2) What municipal policy solutions can be used to overcome these barriers?

Within the literature, 'negative factors, constraints, and challenges' related to EV transitions are addressed as 'barriers' (Berkeley, Bailey, Jones & Jarvis, 2017). Barriers can be defined as anything that prohibits, limits, or constrains the active implementation of EV uptake (Berkeley, Bailey, Jones & Jarvis, 2017). From the literature, I identify potential barriers to the implementation of the City of Kamloops' EV policy including outfitting homes, buildings, and workplaces with charging stations, vehicle preference barriers, and community reaction to the EV policy. These barriers were compared to perceived barriers proposed by my interview participants and analyzed to provide policy recommendations for the City of Kamloops to encourage local EV adoption. I also assess policy solutions in the literature from other cities for encouraging EV adoption and asked interview participants to provide suggestions on local policy measures to reduce barriers and expedite EV uptake.

1.1 Thesis Outline

To answer my research questions, this thesis contains six chapters. The first chapter introduces my research topic and my research questions. The second reviews relevant literature on climate change, zero-emission vehicles, and electric vehicle transitions. The third chapter describes the case study of the City of Kamloops. Chapter Four discusses my research methodology and methods. Chapter Five explains my research findings and Chapter Six discusses my results and concludes with my policy recommendations for EV adoption.

Chapter Two – Literature Review

To understand the background of my research questions, my literature review has four sections. It begins with an overview of GHG emissions, climate change, and transportation emissions. Second, it assesses provincial and municipal policies, strategies, and plans that address GHG transportation emissions in BC. Third, it identifies potential barriers to the electrification of transportation in municipalities. The closing section explores potential solutions to overcome these barriers by analyzing policies from different regions and municipalities within Canada and internationally.

2.1 International and Canadian Response to Climate Change

Climate change has been at the forefront of economic, political, and societal discourse since the late 1980s; stemming from a heightened awareness of human impacts on the environment (Held & Roger, 2018). The Earth's atmosphere has increased in temperature by 1.1°C from pre-industrial times (Jackson, Friedlingstein, Andrew, Canadell, Le Quéré & Peters, 2019). Increases in the release of GHG emissions through human activities contribute to the warming of the Earth's atmosphere and result in climate-related impacts on human and natural systems such as extreme weather (for example - increases in temperature and weather-related events like hurricanes, droughts, and cyclones), food insecurity, and rising sea levels resulting in the displacement of communities (Intergovernmental Panel on Climate Change, 2018).

According to the United States Environmental Protection Agency, GHG emissions are contributing to global warming (2020). GHGs trap and retain heat which increases the temperature of the Earth (United States Environmental Protection Agency, 2020). GHG emissions are comprised of carbon dioxide (CO_2), methane, nitrous oxide, and 'F-gases' such as

hydrofluorocarbons and sulfur hexafluoride (Crippa, Oreggioni, Guizzardi, Muntean, Schaaf, Lo Vullo, Solazzo, Monforti-Ferrario, Olivier & Vignati, 2019).

International organizations like the United Nations (UN) recognize mitigating climate change impacts and risks is a key component of development. International climate response began in 1988 with the founding of the International Panel on Climate Change (IPCC), a body of the UN that collects and analyzes scientific data on climate change, and continued with the UN Framework Convention on Climate Change (UNFCCC). The UNFCC had 197 countries agree in 1994 to acknowledge climate change and create global climate objectives (United Nations, 1992; Finus & Pintassilgo, 2013; Held & Roger, 2018).

Public and political confidence in international climate agreements began with the success of the Montreal Protocol in 1987, an international agreement to phase out ozone-depleting substances to protect the ozone layer (Held & Roger, 2018; United States Department of State, n.d.). The Kyoto Protocol, the following international climate agreement to cap emissions signed in 1997 by thirty-eight countries, was deemed a failure by critics as it was only binding to developed countries (United Nations, 2021). When it became apparent obligations could not be met, countries like Canada abandoned the agreement and left the treaty (United Nations, 2021). Reports such as the Stern Report, an environmental economic report commissioned by the United Kingdom government, and IPCC reports like the IPCC's Climate Change Assessment Reports, were already calling for more radical action beyond the Kyoto Protocol (Held & Roger, 2018).

Another attempt at international climate obligations occurred at the Copenhagen Summit in 2009. The Copenhagen Accord encouraged voluntary participation and unlike the Kyoto Protocol, in which each agreed party set their own targets (up to 5°C reduction from pre-industrial times),

Copenhagen set a long-term target to limit global warming and temperature increases to 2°C above pre-industrial levels (Held & Roger, 2018). While the agreement of the 2°C target would be the starting point for the Paris Agreement, the Copenhagen Accord was heavily critiqued and deemed a failure by many climate science and political activists due to its voluntary and non-binding nature (Bodansky, 2016).

The Paris Agreement, signed in 2015 and ratified in 2016, is the most recent global agreement on climate action (Bodansky, 2016). It is an amalgamation of the Kyoto and Copenhagen agreements with 196 countries signed on to limit global warming to 2°C (preferably 1.5°C) from pre-industrial levels in this legally binding agreement (Bodansky, 2016; Held & Roger, 2018). The Paris Agreement encourages states to aim well below the obligatory 2°C target and to peak global emissions as soon as possible to begin a rapid emissions reduction (Bodansky, 2016). Each country creates its own 'Nationally Determined Contribution' (NDC) – a customized plan with targets to reduce national GHG emissions (Government of Canada, 2022a).

Canada signed and ratified the Paris Agreement and was applauded for legislating carbon pricing and creating various long-term strategies and policies like the 'Mid-Century Long-Term Low-GHG Development Strategy' (Koasidis, Karamaneas, Nikas, Neofytou, Hermansen, Vaillancourt & Doukas, 2020). To meet the 2°C Paris target, Canada's NDC initial target to reduce emissions by 30% from 2005 levels was updated in 2021 to reduce emissions by 40-45% economy-wide by 2030 (Koasidis, Karamaneas, Nikas, Neofytou, Hermansen, Vaillancourt & Doukas, 2020; Government of Canada, 2022a). The Government of Canada set a target to achieve a net-zero economy by 2050 and created multiple policy instruments to achieve this (Razi & Dincer, 2022).

Canada has been criticized by the international community as the federal government continues to subsidize oil exploration and production (Koasidis, Karamaneas, Nikas, Neofytou, Hermansen, Vaillancourt & Doukas, 2020). In the last thirty years, Canada had the largest emission increase of the G7 nations (Doğan, Chu, Ghosh, Truong & Balsalobre-Lorente, 2022). Despite having a relatively small population, Canada is the 11th biggest GHG emitter in the world due to oil and electricity production; ranking in the top 10 oil consumers and within the top five oil producers in the world with 10% of the global supply of oil (Gibson, Péloffy, Horen Greenford, Doelle, Matthews, Holz & Grenier, 2019; Koasidis, Karamaneas, Nikas, Neofytou, Hermansen, Vaillancourt & Doukas, 2020). The Government of Canada proposed *Bill C-12*, "An Act respecting transparency and accountability in Canada's efforts to achieve net-zero greenhouse gas emissions by the year 2050", in 2020 to legally bind government actions with carbon-reduction targets. The *Bill* received Royal Assent in June 2021 (Bill C-12, 2021, p.1; Kéry, Mullins & Wigle, 2021).

2.2 Policies, Strategies, and Plans to Reduce Transportation GHG Emissions in BC and Canada

The Paris Agreement does not target specific industries for emission reduction objectives but relies on a 'bottom-up' approach aiming to reflect versus drive national policy (Bodansky, 2016). Globally, power generation has been the largest GHG emitting sector with transportation as the second largest emitter (Koasidis, Karamaneas, Nikas, Neofytou, Hermansen, Vaillancourt & Doukas, 2020). Transportation consumes 57% of total global oil production and accounts for 37% of international CO^2 emissions (2021) (Koasidis, Karamaneas, Nikas, Neofytou, Hermansen, Vaillancourt & Doukas, 2020; International Energy Agency, 2023). Between 2000 and 2018, transportation emissions increased by 27% in Canada (Razi & Dincer, 2022). As of 2017, there

are twenty-four million passenger or 'light-duty' vehicles on the road in Canada, which emit 86 megatons of CO_2, and consume 37 billion liters of petroleum (Milovanoff, Posen, Saville & MacLean, 2020). Canadian GHG emissions from passenger vehicles increased by 9.3% and passenger vehicle activity (measured by kilometers driven) increased by 17% from 2005 to 2018 (Government of Canada, 2021).

Studies indicate strong internal policy is a requirement to effectively reduce transportation emissions (Wolbertus, Kroesen, van den Hoed & Chorus, 2018; Singh, Walsh & Goodfield, 2021; Axsen, Hardman & Jenn, 2022). Policies aimed at reducing transport GHG emissions can be separated into two groups: 'demand-focused' and 'supply-focused'. Demand-focused policies encourage and incentivize consumers to purchase an EV (e.g., reducing the ticket price of EVs) (Sykes & Axsen, 2017). These can include purchasing incentives and building charging infrastructure (Melton, Axsen & Goldberg, 2017; Axsen, Hardman & Jenn, 2022). Supply-focused policies concentrate on requirements and regulations for automakers to develop and market EVs and reduce carbon emissions with their vehicles (Melton, Axsen & Goldberg, 2017; Lepitzki & Axsen, 2018; Axsen, Hardman & Jenn, 2022). Supply-focused policies include Zero-Emission Vehicle (ZEV) mandates, low-carbon fuel standards, and carbon taxes (Melton, Axsen & Goldberg, 2017). Regions like Norway chose to pursue a primarily demand-focused policy program, while the State of California took a strong supply-focused policy approach (Sykes & Axsen, 2017; Melton, Axsen & Moawad, 2020). Both have seen success in their reduction of GHG emissions from transportation (Sykes & Axsen, 2017; Melton, Axsen & Moawad, 2020).

Canada and BC adopted several demand- and supply-side policies to address transportation emissions. The Government of Canada implemented a low-carbon fuel standard 'The Clean Fuel Standard', in 2020 to reduce the carbon intensity of fuels over time. They also implemented the

'Company Average Fuel Consumption' (CAFC) (or CAFE – Corporate Average Fuel Economy in the United States) requiring automakers to reduce the GHG emissions produced by vehicles (Long, Axsen & Kitt, 2020). BC began to include policies to address climate change in 2007 and was the first region in North America to introduce a carbon tax in 2008 (Newell & Robinson, 2018). The provincial government added the *Renewable and Low Carbon Fuel Requirement* in 2009 (based on the Californian model) to require fossil fuel suppliers to reduce the lifecycle GHG emissions of fuels (Lepitzki & Axsen, 2018). This LCFS in BC limits the average carbon intensity of fuels and requires the GHG intensity in fossil fuels to be reduced by 10% from 2013 levels (Talebian, Herrera, Tran & Mérida, 2018). This requirement is met by blending ethanol in gasoline (at a current rate of 7.4% ethanol in gasoline and 5.7% in diesel as of 2014) (Province of British Columbia, 2019).

From 2007 to 2016, the population of BC grew by 11% and BC's economy grew by 19%, resulting in a 14.6% increase in emissions from the transportation sector during the same period (Province of British Columbia, 2018). The transportation sector in BC has seen the largest annual emissions increase of all sectors in the past ten years (Province of British Columbia, 2021). There is a direct link between transportation emissions and population growth, and as BC's population is anticipated to continue to grow, the necessity for policies to decrease GHG emissions in transportation intensifies (Newell & Robinson, 2018).

Through various energy simulations and modeling to estimate GHG reduction policies, the strongest reduction of transportation GHG emissions is by electrifying transportation (Sykes & Axsen, 2017; Talebian, Herrera, Tran & Mérida, 2018). To stabilize global carbon dioxide at 450 parts per million (ppm), the International Energy Agency (IEA) recommends that 40% of new passenger vehicle sales be plug-in electric vehicles by 2040 (Melton, Axsen & Goldberg, 2017).

Most recently the IEA has suggested ZEVs sales may need to be 100% of all new passenger vehicle sales between 2030-2035 to reach net zero emissions (in addition to other "technological and behavior changes") (Axsen, Hardman & Jenn, 2022, p.7553). The addition of vehicles onto the electrical grid can reduce the reliance on fossil fuels and decrease GHG emissions (dependent on the source of electrical generation) (Wu & Zhang, 2017; Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019a). In a country like China that uses primarily thermal energy (burning coal), an EV transition would just transfer the emissions saved from transportation to power production (Wu & Zhang, 2017). Despite this, studies show that EVs powered by thermal or diesel-generated electricity can still be more efficient and produce less carbon dioxide emissions than ICE vehicles (Requia, Mohamed, Higgins, Arain & Ferguson, 2018; Nimesh, Sharma, Reddy & Goswami, 2020).

Canada created ambitious targets to transition passenger vehicles to EVs domestically, including requiring at least 30% of passenger vehicle sales to be EVs by 2030 (Axsen, Hardman & Jenn, 2022.) The Trudeau administration increased the federal *ZEV Mandate* targets to require all new light-duty vehicles sold within the country to be ZEV by 2035, down from 2040 (the original target set in 2021) (Government of Canada, 2021). The three provinces of BC, Quebec, and Ontario all have various EV adoption policies in place, and account for 95% of Canadian EV sales (Singh, Walsh & Goodfield, 2021). Quebec and BC are the only provinces with ZEV mandates currently (2022) (Long, Axsen & Kitt, 2020; Pembina Institute, 2022.).

The BC government passed two major pieces of climate legislation – the *Climate Change Accountability Act*, which sets an emission reduction target of 40% by 2030, 60% by 2040, and

100% by 2050 (compared to 2007 GHG emission levels), and the *Zero-Emission Vehicle Act*[1] (a ZEV Mandate) (Razi & Dincer, 2022). The ZEV Mandate was introduced in 2019 as part of the Province's *CleanBC* plan to reduce emissions in BC by 40% by 2030 and initially required all new passenger vehicles purchased in BC to be zero-emissions (hybrid or fully electric) by 2040 (CleanBC, n.d.; Province of British Columbia, 2018; Province of British Columbia, 2021). The CleanBC Plan was updated in April 2022 to accelerate the *ZEV Act* targets to have all light-duty vehicle sales to 100% zero-emission by 2035 (Province of British Columbia, 2018; Province of British Columbia, 2021).

A transition to electric vehicles (EVs) could reduce GHG emissions from passenger vehicles by 45-98% from current levels depending on the electricity supply (Azarafshar & Vermeulen, 2020). BC is a prime region to electrify transportation due to its large amount of renewable energy; hydropower produces 91% of generated electricity with the remainder comprising biomass (6%), natural gas (2%), and oil and wind (1%) (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019b; Atabaki, Bagheri & Aryanpur, 2023). Therefore, adding vehicles onto the electrical grid is a clean option to reduce GHG emissions (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019b).

Studies show that demand-focused policies such as rebates and financial incentives have been proven to increase EV adoption (Srivastava, Kumar, Chakraborty, Mateen & Narayanamurthy, 2022). One study found that EV market shares increase by 5-8% for every $1,000.00 CAD (on average) available in rebates (Azarafshar & Vermeulen, 2020). The federal government has allocated funding of $2.4 billion in incentives for consumers to buy an EV

[1] The *ZEV Act* was released in 2018 as part of the BC Government's *CleanBC* plan.

(Government of Canada, 2022b). This includes the iZEV program that offers up to $5,000.00 in rebates to potential eligible EV buyers (at point of sale) (Government of Canada, 2022b; Razi & Dincer, 2022). The BC 'Provincial Go Electric Passenger Vehicle Rebate' provides up to $4,000 (this applies to new vehicles and is varied with income levels) (Razi & Dincer, 2022; Plug-in BC, 2022). EVs made up 17% of new light-duty vehicle sales in BC in the first quarter of 2022 (Province of British Columbia, 2022). As of 2021, 13% of new passenger vehicles sold in the province were zero emission (BC Hydro, 2022). Battery-powered EVs (BEVs) sales were more than double that of BEV sales in BC (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019b).

There are restrictions on the provincial subsidies, including income requirements and MSRP (Manufacturer's Suggested Retail Price) cap limits (Go Electric BC, n.d.). An individual must make less than $80,000 to acquire the full rebate amount of $2,000 for PHEVs with an 85-kilometer or less range or $4,000 for BEVs or long-range PHEVs (more than 85 kilometers). The rebate reduces as the income level increases (Go Electric BC, n.d.). The BC government released a statement citing these income restrictions were put in place for "ensuring they [the rebates] are going to people who need them the most", and that more than 90% of BC residents are eligible for the EV rebates based on the 2020 income tax return (Province of British Columbia, 2022). Additionally, vehicles are restricted with their MSRP; the provincial rebate does not apply to vehicles above an MSRP of $55,000, and larger vehicles (listed as station wagons, mini-vans, SUVs, pick-up trucks) above $70,000 (Go Electric BC, n.d.).

While financial subsidies have been proven to encourage EV adoption, the literature suggests these rebates should be coupled with funding and building charging infrastructure (Azarafshar & Vermeulen, 2020). As of 2023, there are 2,399 Level 2 (L2) and 720 Level 3 (L3)

charging stations available to the public within the province, majority of which are 'Level 2' (Primary), with some 'Level 1' (Opportunity), and 'Level 3' (Fast) availability (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019b; Province of British Columbia, 2023a). As part of the BC government's 'BC's Electric Highway' plan, the government has a target of installing 10,000 public EV charging stations on highways by 2030 (Province of British Columbia, 2023b).

BC currently has one of the highest rates of EV adoption in North America with 13% of new light-duty vehicles being ZEV vehicles (Province of British Columbia, 2021). While this is substantial, the BC EV market is still in the 'early adopter' stage of EV adoption. The consumer timeline of EV uptake begins with innovators (2.5% of the market), then early adopters (13.5 %), early majority (34%), and then finally, the late majority (50%) (Torkey & Abdelgawad, 2022). A BC study offered insight to mid-stage EV adopters: they tend to share similarities as being "less environmentally inclined or having lower incomes" (de Rubens, 2019). They also have a higher chance of preferring PHEVs versus full electric vehicles and have relatively low EV knowledge (de Rubens, 2019). The majority of EVs are registered in the Lower Mainland (59,918 out of a total of 79,587), while the Thompson-Okanagan has 4,092 EVs registered (Province of British Columbia, 2021). Local government action in cities, regional districts, towns, and villages is needed to encourage higher EV uptake throughout the province into the majority (34-50%) stages.

2.3 Municipal Programs for EVs and Reducing Transport GHG Emissions

Municipalities provide local services, set regulations, meet local needs, and improve the lives of their constituents (Union of British Columbia Municipalities, 2023). Cities can reduce building and transportation emissions by creating policies impacting local infrastructure and transportation (Organization for Economic Cooperation and Development & Bloomberg Philanthropies, 2014). Municipal climate action strategies increased in recent years as

communities work to fill perceived gaps in federal and provincial climate mitigation policies (Jost, Dale, Newell & Robinson, 2020). Communities are evaluating the "physical, ecological, and societal changes [resulting from climate change]…with the rate of change determined by a set of social, cultural, political, environmental (human-made or natural), and economic conditions" to create their municipal climate mitigation strategies (Jost, Dale, Newell & Robinson, 2020, p.411).

Cities contribute a significant amount of emissions. Internationally, it is estimated cities contribute 75% of global carbon dioxide emissions through transportation and construction emissions (some of the largest emitting sectors) (United Nations, n.d.). Select cities have pursued strong emission reduction initiatives and participated in the C40 Cities, an international network of city mayors addressing climate change through emissions reduction policies to match the Paris Accord target of limiting global warming to 1.5°C (C40 Cities, 2023). Cities join the C40 by creating and implementing climate action plans (C40 Cities, 2023). Toronto, Vancouver, and Montreal are the three Canadian cities that are currently part of the C40 network (C40 Cities, 2023). Los Angeles, Seattle, Barcelona, Vancouver, Milan, Quito, Cape Town, and Auckland all expressed an intention to prohibit diesel and gasoline-powered vehicles from sections of cities (sometimes referred to as 'no-emission' zones') by 2030 (Pereirinha, González, Carrilero, Anseán, Alonso & Viera, 2018).

Municipalities have a unique opportunity to create policies that are adapted and tailored to meet local conditions (Egnér & Trosvik, 2018). Through formal and informal roles, local governments can encourage EV adoption through policy instruments; studies have found that support by local governments can increase adoption (Palm & Backman, 2017; Roth, Bahr, Kloo & Wisell, 2021). These can include changing building regulations (ex. requiring developments to be EV-ready), parking restrictions (EV-parking only), public education campaigns to educate the

public on the benefits of EVs and reduce misconceptions and myths, encouraging and/or building local public charging infrastructure, and obtaining their own EV fleet to visually show support for EVs (Sierzchula, Bakker, Maat & Van Wee, 2014; Mersky, Sprei, Samaras & Qian, 2016; Egnér & Trosvik, 2018; Wolbertus, Kroesen, van den Hoed & Chorus, 2018; Melton, Axsen & Moawad, 2020; Roth, Bahr, Kloo & Wisell, 2021). These policies can be supported provincially, for example with the inclusion of EV-ready clauses in municipal building codes (i.e., mandatory parking for EVs and requiring EV-ready charging accessibility) (Melton, Axsen & Moawad, 2020).

2.4 Barriers to the Electrification of Transportation

Barriers to electrifying transportation are anticipated to occur as municipalities prepare for ZEV transitions. Consumers are hesitant to transition to electric vehicles as they (EVs) are still perceived as new technology (Sierzchula, Bakker, Maat & Van Wee, 2014). Literature suggests that barriers include high purchase prices, limited access to efficient charging infrastructure, range limitations and anxiety, long charging periods, and a lack of knowledge of EVs (Palm & Backman, 2017; Engel, Hensley, Knupfer & Sahdev, 2018; Abotalebi, Scott & Ferguson, 2019; Adoba & Dioha, 2021). EV uptake barriers[2] can be separated into three major categories: consumer hesitation, a lack of charging infrastructure, and institutional barriers (Palm & Backman, 2017; Engel, Hensley, Knupfer & Sahdev, 2018; Broadbent, Drozdzewski & Metternicht, 2018; Abotalebi, Scott & Ferguson, 2019; Adoba & Dioha, 2021).

2.4.1 Barriers: Consumer Hesitation

Studies have linked consumer hesitancy to a lack of knowledge or understanding of EVs and low visibility of convenient charging infrastructure (Palm & Backman, 2017). Psychological

[2] That can be addressed by municipal policy (e.g., building charging infrastructure) versus barriers that cannot be address by municipal policy (such as manufacturing environmental regulations, reducing cost of vehicles, etc.).

and social factors are emphasized in the EV adoption literature as important to consider when assessing uptake (White, Carrel, Shi & Sintov, 2022). According to the current literature, if the social norms of a population suit EV ownership (i.e., high prioritization of lower emission living and environmental consciousness, low concern over range anxiety/charging, vehicle preferences matching EVs available), this can significantly increase the chances of EV adoption (White, Carrel, Shi & Sintov, 2022). Consumers may be enticed to buy EVs from having a higher environmental consciousness, increasing EV affordability, and education on the reduced fuel and maintenance costs (Axsen, Cairns, Dusyk & Goldberg, 2018).

Potential EV customers are apprehensive EVs will not fit with their lifestyle as a viable and convenient transportation option. These apprehensions are due to concerns over range anxiety, access to charging infrastructure, vehicle charging time, vehicle cost, and doubt of new technology (Broadbent, Drozdzewski & Metternicht, 2018). A study conducted in the UK found "economic uncertainty" was a large sociological barrier for consumers (Berkeley, Jarvis & Jones, 2018, p.11). Berkeley, Jarvis, and Jones describe "economic uncertainty" as the high purchase price of EVs with uncertainty regarding maintenance, charging, and re-sell value anxiety (2018, p.11). While consumer awareness is increasing, knowledge of EVs has been low in North America (Melton, Axsen & Moawad, 2020).

2.4.2 Barriers: Lack of Charging Opportunities

Convenient access to multiple charging stations positively impacts EV adoption (Egnér & Trosvik, 2018; Jia & Chen, 2021). Access to a consistent charging option, such as home or workplace charging, is imperative for EV uptake and reducing range anxiety (Broadbent, Drozdzewski & Metternicht, 2018; Funke, Sprei, Gnann & Plötz, 2019). Home charging is vital to encourage large-scale EV adoption as studies show that 80-90% of charging occurs in the home

(Lopez-Behar, Tran, Froese, Mayaud, Herrera & Merida, 2019b). A 2018 study conducted in BC found that six in ten surveyed individuals were reluctant to purchase an EV because they did not think there was adequate charging infrastructure in BC (Adoba & Dioha, 2021). Funke, Sprei, Gnann & Plötz found that "public charging infrastructure is not built due to more PEVs (plug-in electric vehicles) [on the road], but PEV[3] sales increase due to more public charging infrastructure" (2019, p.6). This has been referred to in the literature as the "chicken and egg" problem: potential EV consumers are waiting for more available charging infrastructure, but potential infrastructure providers are waiting to see more EVs and charging demand (Harrison & Thiel, 2017, p.166; Miele, Axsen, Wolinetz, Maine & Long, 2020a, p.2; Liu, Sun, Zheng & Huang, 2021, p.50).

There are four main EV charging locations: (1) home charging, (2) workplace, (3) public charging station, and (4) travel corridors (Hardman, Jenn, Tal, Axsen, Beard, Daina, Figenbaum, Jakobsson, Jochem, Kinnear, Plotz, Pontes, Refa, Sprei, Turrentine & Witkamp, 2018). The majority of EV charging takes place in the home (between 75-80%), with workplaces as the second most popular charging location (Greene, Kontou, Borlaug, Brooker & Muratori, 2020). It is key to prioritize access to home charging with any government policy (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019b; AES Engineering, 2020). Home charging reduces the psychological barrier of having to wait to charge when driving around as EV drivers can plug their vehicles in overnight to have full batteries (Hardman, Jenn, Tal, Axsen, Beard, Daina, Figenbaum, Jakobsson, Jochem, Kinnear, Plötz, Pontes, Refa, Sprei, Turrentine & Witkamp, 2018). While access to home charging is imperative for EV uptake, public charging is also important to support drivers should they need it and to reduce range anxiety (Hardman, Jenn, Tal, Axsen, Beard, Daina,

[3] EV literature can refer to EVs (both BEVs and PHEVs) as PEVs as they both plug-in versus non-plug-in electric vehicles (hybrids).

Figenbaum, Jakobsson, Jochem, Kinnear, Plötz, Pontes, Refa, Sprei, Turrentine & Witkamp, 2018).

Barriers relating to charging opportunities include long charging times (e.g., lines to charge EVs in public charging stations), a lack of convenient public charging opportunities, and limitations on vehicle range (Deb, Tammi, Kalita & Mahanta, 2018; Abotalebi, Scott & Ferguson, 2019; Adoba & Dioha, 2021). The lack of charging opportunities or concern over where to charge is called 'range anxiety'; defined by White, Carrel, Shi, and Sintov (2022, p.2), as "a stressful experience of a present or anticipated range situation, whereby the range resources and personal resources available to effectively manage the situation (e.g., increase available range) are perceived to be insufficient". Range anxiety can reduce the incentive to purchase an EV if potential EV buyers perceive the vehicle as insufficient to drive long distances and that travel may be inhibited (Maybury, Corcoran & Cipcigan, 2022).

Consumers are hesitant to purchase EVs until there is perceived stability and ample charging opportunities (Deb, Tammi, Kalita & Mahanta, 2018; Miele, Axsen, Wolinetz, Maine & Long, 2020a). Currently, there are limited public charging stations in Canada – as of 2019, Canada had 290 public charging stations per million residents compared to Norway's 1,700 charging stations per million residents in 2018 (Melton, Axsen & Moawad, 2020). Studies have shown that high-power charging infrastructure along major travel routes is necessary for long-distance trips with EVs and to reduce range anxiety (Funke, Sprei, Gnann & Plötz, 2019).

2.4.2.a Infrastructure Barriers – Implementing Charging in Existing Homes and MURBs

A survey completed in 2013 demonstrated that only a third of those surveyed with interest in purchasing ZEVs had access to home charging options in Canada (Melton, Axsen & Moawad, 2020). The Canadian government has implemented multiple policies and funding to encourage the

building of charging stations in homes (Razi & Dincer, 2022). However, barriers such as the high cost of (charging) unit installation, safety, cost of retrofitting existing electric units, and lack of electricity to meet demand within the building add difficulties to home charging access (Deb, Tammi, Kalita & Mahanta, 2018).

One of the few Canadian studies produced on EV home charging difficulties in multi-unit residential buildings was conducted by Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida (2019a). They found that in Canada, construction rates for multi-unit residential buildings (MURBs), defined as residential buildings with three or more units, have surpassed those of single-family homes since the 2008 recession. MURBs make up 28.6% of households within BC and are anticipated to account for 66-69% of new construction within the 2018-2020 period. Urban migration has encouraged densification planning, and because most of the population in BC lives in metropolitan areas, 70% of the passenger vehicles that can be replaced with EVs are concentrated in these regions (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019a).

MURBs can be particularly difficult for EV charging due to insufficient charging opportunities (Baldwin, Myers & O'Boyle, 2020). There are four major issues with EV charging and MURBs – electrical/building restrictions, installation of charging infrastructure, parking availability, and building resident consensus (strata council must have 75% approval in a vote regarding strata items) (Lopez-Behar, Tran, Froese, Mayaud, Herrera & Merida, 2019a). Depending on the age of the structure, the building itself may not be able to accommodate additional electric demand from EVs and may require expensive electric upgrades such as a new distribution system (Baldwin, Myers & O'Boyle, 2020). There can be difficulties with billing electricity usage and charging only EV owners for electrical use versus billing all the buildings'

tenants (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019a). Additionally, for strata council approval, the building must be assessed for its electrical capacity (to match the increased electrical demand from EVs) (Csonka, Havas, Csaba & Földes, 2020). There is also a question of where to put EV parking as it must be close to electrical outlets, and how many spots to build for current and/or future EV owners.

It is significantly more expensive to retrofit (ensure electrical load capacity and/or add charging stations) an existing MURB than to rough-in the electrical capacity upon development; the City of Kamloops ran a cost study with AES Engineering with an example MURB in Kamloops after the building community spoke of their concern regarding affordability and off-loading costs to consumers (City of Kamloops, 2021). The cost analysis found that requiring 100% of parking to be EV-ready at the time of construction would be $930 to $1,550 per parking stall versus a future retrofit of parking would be three or more times that cost (depending on the electrical requirements etc. of the building) (City of Kamloops, 2021).

2.4.3 Barriers: Institutional

Institutional barriers include a lack of government focus, ineffective policies, and limited spending on EV adoption (Broadbent, Drozdzewski & Metternicht, 2018). Local governments may be hesitant to spend money on policies that are perceived as funding high-income earners (i.e., those who can afford new vehicles and EVs) or may not have the funds or interest in prioritizing EV adoption (e.g., preferencing spending on social programs, infrastructure projects, etc., that will have a more reaching impact to all members of the community) (Hardman, Fleming, Khare & Ramadan, 2021; Cannon, Chu, Natekal & Waaland, 2023). The conflict of balancing policy support for EV adoption and climate change policies with other local government priorities (e.g., social justice spending) is identified as the “development conflict (between planning for social

justice and environmental protection", and "the resource conflict (between planning for economic growth and environmental protection" (Agyeman & Evans, 2003, p.37). For all EV adoption policies, equity will need to be prioritized to address these conflicts (Baldwin, Myers & O'Boyle, 2020; Hardman, Fleming, Khare & Ramadan, 2021).

2.4.4 Barriers: Additional and General

The literature identifies additional barriers to EV adoption including affordability issues (with the high purchase price of EVs), technology (e.g., vehicle range), vehicle preference, raw material supply and ethical mining practices, and EV availability (Abotalebi, Scott & Ferguson, 2019; Melton, Axsen & Moawad, 2020; Jones, Nguyen-Tien & Elliott, 2023). Local government policy cannot currently address these issues due to a lack of funding, resources, or barriers that are out of municipal jurisdiction. Therefore, I will not address them throughout my research.

2.5 Municipal Policy to Overcome Barriers

Successful EV adoption relies heavily on public policies and EV uptake is typically low in areas lacking EV strategies (Brückmann, Willibald & Blanco, 2021). Studies prove the importance of EV policies in impacting consumer vehicle preference and EV demand (Kester, Noel, de Rubens & Sovacool, 2018). Cities have significant opportunities to reduce local emissions by setting regulations such as zoning bylaws or implementing planning tools to encourage climate change resilience (Guyadeen, Thistlethwaite & Henstra, 2019; Song & Potoglou, 2020). Literature suggests municipal policies include a mix of private/public charging station installation, traffic regulations, and financial measures to positively attributed to increased EV adoption (Anderson, 2019; Held & Gerrits, 2019; Rietmann & Lieven, 2019).

2.5.1 Non-Monetary Policies: Increasing EV Visibility, Public Education

Literature shows that public policy can increase environmental awareness and potentially increase EV demand (Driscoll, Lyons, Mariuzzo & Tol, 2013). Policy can reduce misconceptions and encourage a change of culture (such as ICE truck preference) by incorporating climate change and its impacts into policy discussions (Haddadian, Khodayar & Shahidehpour, 2015). Policies such as public education campaigns and an EV fleet procurement plan can also encourage local EV adoption (Haddadian, Khodayar & Shahidehpour, 2015).

Increasing EV visibility is necessary to reduce consumer reluctance and improve EV cognitive status (for example - technology hesitation, behavioral changes, range anxiety) (Song & Potoglou, 2020). Non-monetary policies benefit from being deployed at a more local (versus national) level as regional authorities better understand the local context (Song & Potoglou, 2020). A study conducted in 17 cities by Kester, Noel, de Rubens and Sovacool regarding EV uptake in Scandinavian countries (Iceland, Finland, Denmark, Sweden, and Norway) found that non-monetary incentives provided an "immediate emotive response" from interview participants while suggesting these policies would increase EV visibility and consumer awareness among the general public (2018, p. 725).

HOV/bus lane access, priority parking, and EV fleets are discernable tools for municipalities to visually showcase the benefits of EV ownership (Bakker & Trip, 2013; Silvia & Krause, 2016; Kester, Noel, de Rubens & Sovacool, 2018; Anderson, 2019). HOV/bus lane access and priority parking reduce wait time in traffic and increase better parking opportunities while being more cost-effective (as a policy) than subsidizing EV purchases (Anderson, 2019; Egnér & Trosvik, 2018). A public procurement policy of EVs, an EV fleet, can increase EV awareness and show local drivers that EVs can be used in the community successfully (Haddadian, Khodayar &

Shahidehpour, 2015; Anderson, 2019). Public procurement of EVs (or encouraging an EV fleet by companies in the community) may energize local EV demand by increasing EV visibility, stimulating a second-hand EV market, and reducing misconceptions about EVs (displaying the ease of EV ownership, etc.) (Silvia & Krause, 2016).

2.5.1.a Public Education Campaigns

To encourage EV awareness, local governments can host outreach programs and awareness campaigns to educate the public on the benefits of EVs and dispel myths or consumer hesitations (Jin & Slovik, 2017). Public education campaigns include EV general information, charging station locations, cost comparison of vehicles, EV incentives available, and model availability. Public education campaigns can also reduce the perceived barrier of unaffordability and the high cost of EVs. While the price of new EVs remains higher than ICE vehicles, there have been studies conducted in Canada to prove that EV ownership is cheaper than owning and operating an ICE vehicle. A 2017 study conducted in the Greater Toronto area found EV owners save $1900 on average on fuel and maintenance costs annually (Abotalebi, Scott & Ferguson, 2019).

Misinformation on EVs can be categorized into four categories: EV performance (range, etc.), EV supply and/or market availability (model availability), charging infrastructure, and general EV technology (Singh, Walsh & Goodfield, 2021). Public education campaigns can educate those who have not been following EV technology and may be unaware of EVs and their benefits (Axsen, Cairns, Dusyk & Goldberg, 2018). Public events such as a 'Ride and Drive', which showcases EVs to the public and allows the public to experience driving an electric vehicle, EV public fleets, *EV Strategies* and *Plans*, consumer awareness campaigns, and working with local dealerships to showcase local EVs available, are all tools municipalities may use to further educate and encourage local EV ownership (Bakker & Trip, 2013; Jin & Slovik, 2017).

2.5.2 Funded Policies: Charging Infrastructure:

To reduce concerns about EV charging, increasing access to charging opportunities is suggested as one of the strongest policy options for encouraging EV adoption (Mersky, Sprei, Samaras & Qian, 2016; Liu, Sun, Zheng & Huang, 2021). Distance to charging opportunities is a significant factor in consumer consideration for EVs; therefore, access to home charging should be prioritized in EV policy (Mukherjee & Ryan, 2020). Home charging access is increased by subsidizing home charging station installation and updating building codes and standards to require new developments to be 'EV-ready' (either with electrical capacity for Level 2 charging or with provided charging stations) (Lopez-Behar, Tran, Mayaud, Froese, Herrera & Merida, 2019b; Mukherjee & Ryan, 2020).

In areas with few access points to public charging, local governments can intervene to encourage, and/or build charging infrastructure to expand a charging network (Mukherjee & Ryan, 2020). As discussed by Kumar, Chakraborty & Mandal (2021), there can be multiple models for charging station installation via different installers: (1) EV manufacturer installs their infrastructure independently; (2) local governments install charging stations and potentially provide a subsidy for EV drivers; or (3) a government invests in charging station installation independently (Kumar, Chakraborty & Mandal, 2021). The article found when there is government involvement either by providing a subsidy for EV manufacturers to install charging station infrastructure or independently installing government-sponsored charging stations, they (governments) are the most effective for "maximum EV demand and market share" increase (p.1).

Public infrastructure typically is built as a response to demand (Maia, Teicher & Meyboom, 2015). While municipal installation of charging station infrastructure would increase local charging opportunities, installing charging infrastructure is capital-intensive (Kumar, Chakraborty

& Mandal, 2021). Governments can build their own charging infrastructure or work through a public-private partnership with a charging station provider (Bakker & Trip, 2013). Charging stations can be built in existing parking spaces at convenient locations (i.e., shopping malls and public parking areas) or near residential areas to provide a charging opportunity for those who do not have access to home charging (Bakker & Trip, 2013). Local governments can be hesitant to invest in building public charging infrastructure (versus a partnership with a charging station operator) from the high initial investment costs, uncertainty with revenue, and electricity prices among other issues (Dwyer, Moutou, Nagrath, Wyndham, McIntosh & Chapman, 2021).

A policy addressing MURBs is suggested in the literature to encourage EV adoption as it can reduce confusion and hesitation of EV infrastructure installation due to cost, etc. (Lopez-Behar, Tran, Froese, Mayaud, Herrera & Merida, 2019a). As there are additional difficulties installing charging infrastructure in existing MURB, local policy can help strata councils, residents, and landlords to navigate cost, retrofitting, and maintenance, and create recommendations on parking and charging station installation (Lopez-Behar, Tran, Froese, Mayaud, Herrera & Merida, 2019a).

2.5.3 Subsidies and Funding Restrictions

If funding is available, cities can provide subsidies or tax breaks for EV buyers (dependent on the location of the city and legislation around subsidy provisions) (Bakker & Trip, 2013). While subsidies may be expensive for cities, the purchase price of EVs is still considered one of the largest barriers to EV adoption, so reducing costs may entice potential buyers (Kester, Noel, de Rubens & Sovacool, 2018). While municipalities with climate policies can significantly increase the introduction of EVs locally (Anderson, 2019), municipalities can have competing municipal priorities (refer to Section 2.5.3) and may be restricted with their revenues (Ryser, Halseth, Markey

& Young, 2022). Many local governments in BC are now required to become more "entrepreneurial" with funding sources to finance these types of municipal projects (Ryser, Halseth, Markey & Young, 2022, p.1).

A study conducted with three municipalities in BC (Prince George, Campbell River, and Revelstoke) found that while the three cities created climate policy and projects to reduce emissions, they did not always have the funding or resources to attach to policies or projects despite provincial or federal help (e.g., funding for climate change policy creation) (Jost, Dale, Newell & Robinson, 2020). As local authorities may not be able to allocate significant resources to EV adoption (capital for subsidies, etc.), regional studies and local policies are suggested to "build a better understanding of best practices" for encouraging EV adoption (Kester, Noel, de Rubens & Sovacool, 2018, p.720).

Chapter Three – Case Study: City of Kamloops

This chapter provides context for my case study on the City of Kamloops and their transportation emissions and policies. Kamloops is a growing city in Canada with higher-than-average emissions due to their reliance on personal vehicles for transportation. I analyzed content through online resources and literature on Kamloops, their emissions, and emission reduction plans. My research links provincial climate change policies and strategies (including transportation emission reduction plans) and the City of Kamloops' *EV Strategy*.

3.1 The City of Kamloops

The City of Kamloops is in south-central BC in the North Thompson Valley region (as seen in the purple circle in Map 1 below). The city lies west of Shuswap Lake where the North and South Thompson Rivers meet. Kamloops is a regional center for the Thompson-Nicola Regional District, an area spanning 44,449 square kilometers (Thompson-Nicola Regional District, n.d.). Incorporated in 1893, it is now the second largest city in Interior BC (after Kelowna) and the 12th largest city in BC (HelloBC, 2021; Statistics Canada, 2023a). According to the 2021 Statistics Canada census, the city has a population of 97,902 people, up 8.4% from 2016 (2016 population: 90,280) (Statistics Canada, 2023a). Kamloops is in the top five fastest-growing urban centers in Canada with a population growth rate of 10% from 2016 to 2021 (Statistics Canada, 2022).

Map 1: City of Kamloops, BC

Map 1 Source: https://geology.com/canada/british-columbia.shtml

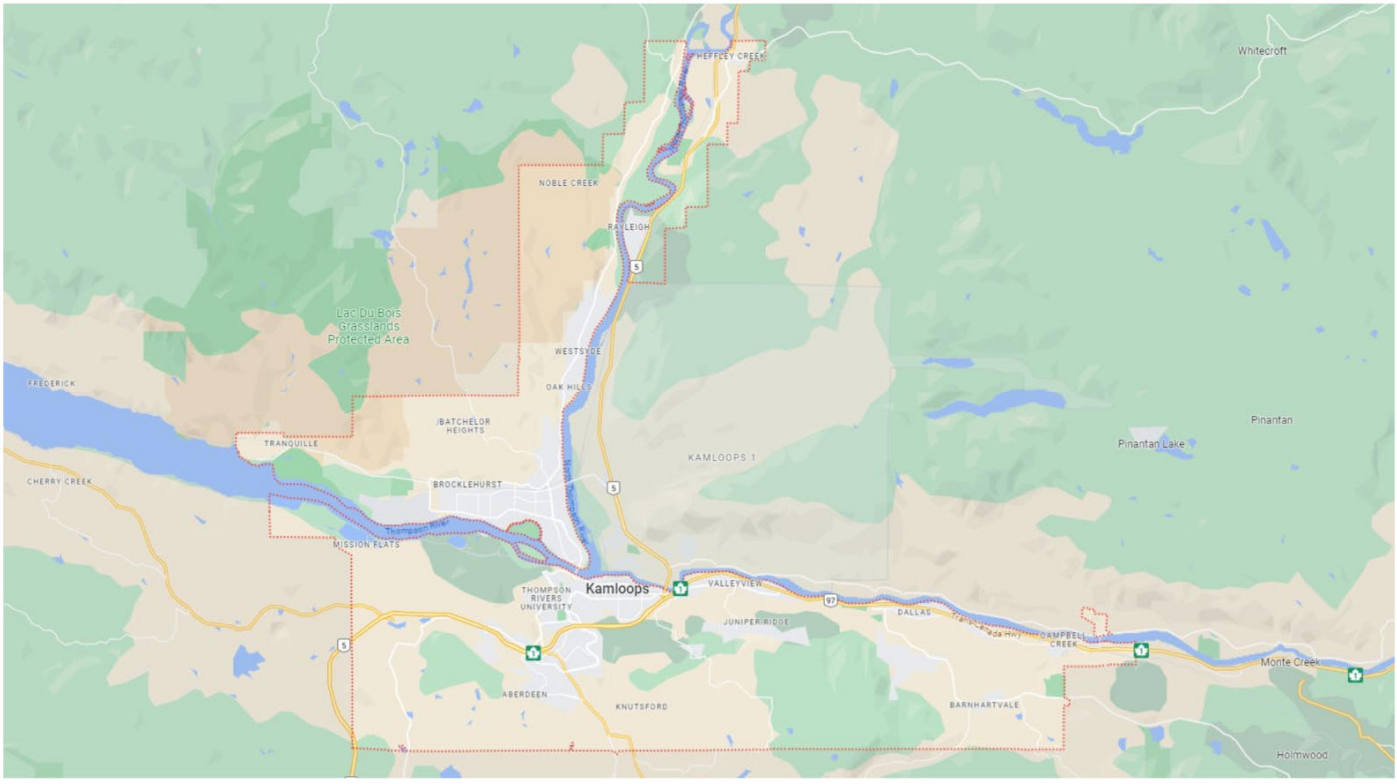
There is low population density in Kamloops despite the growing population compared to the top four most populated cities in BC (see Chart 1) (Statistics Canada, 2023a; Statistics Canada, 2023b; Statistics Canada, 2023c; Statistics Canada, 2023d; Statistics Canada, 2023e; Statistics Canada, 2023f). The boundary of Kamloops is large with a land area of approximately 299.5 square kilometers (see Map 2). Land use constraints include "steep slopes, environmentally sensitive and riparian areas, silt bluffs, floodplains, and provincial Agricultural Land Reserve [creating land development restrictions]" (City of Kamloops, 2018, n.p.). Kamloops has a desert climate, at 1,131 feet above sea level (Baugh, 2010). It is distant from other major city centers: 355 kilometers from

Vancouver, 620 kilometers from Calgary, and 167 kilometers from the closest major city of Kelowna (Baugh, 2010; Google Maps, accessed February 19, 2023). Kamloops itself has multiple hills within the city and is surrounded by local mountains (Baugh, 2010).

Chart 1: Comparing Kamloops' population density with the highest population cities of BC.

City	Population	Population Density
Kamloops	97,902	328.6
Vancouver	662,248	5,749.9
Surrey	568,322	1,797.9
Burnaby	249,125	2,750.7
Richmond	209,937	1,629.0

Map 2: City of Kamloops' boundary



Source: https://www.google.com/maps/place/Kamloops,+BC/@50.7380608,-120.2843763,11.5z/data=!4m6!3m5!1s0x537e2cd33d0d3b31:0xd23e96aa9a6945e7!8m2!3d50.674522!4d-120.3272675!16zL20vMDF3ajE3?entry=ttu

3.2 City of Kamloops Emissions and *EV Strategy* Creation

The City of Kamloops began environmental sustainability planning in 2010 with the Sustainable Kamloops Plan, creating a foundation to develop management tools for climate action (City of Kamloops, 2010). The *Community Climate Action Plan* (CCAP) was developed in 2017 with a city-wide emission inventory analysis, and the City expanded its climate policies to include the *EV Strategy* as it was developed in 2020 and 2021 (City of Kamloops, 2021). The City applied for partial funding to create both the *CCAP* (Municipal Climate Innovation Program) and the *EV Strategy* (BC Hydro) (Participant D1). The City of Kamloops released a request for proposals (a municipal bidding process for contracts, etc.); AES Engineering won the bid and created the City's *EV and E-Bike Strategy* (Participant D1; AES Engineering, 2020). The *EV Strategy* was developed from December 2019 to May 2020 over four stages: (1) Background Research and Best Practices Review, (2) EV Charging Infrastructure Analysis, (3) Public & Stakeholder Engagement, and (4) Strategy Development (City of Kamloops, 2020).

The City introduced a 0.35% Climate Action Levy to civic taxation in 2022 to allow the municipal government to accumulate capital into specific funds for climate projects (City of Kamloops, 2022). The funds from the Climate Action Levy "will be used to implement the municipal-and-community based climate action initiatives prioritized in the *Community Climate Action Plan* (CCAP)" (City of Kamloops, 2022, p.9). These initiatives include targeting reducing emissions in buildings, transportation, and the community, and building local climate resilience (City of Kamloops, 2022). Since the release of the *EV Strategy,* City Council decided not to allocate any funds to the *Strategy* and its targets specifically, and instead pool all funding into the *Community Climate Action Plan* (Participant D1; City of Kamloops, 2021).

Local government support is imperative to ensure a smooth and rapid EV transition. While the City is aware it must create an EV adoption policy that does not appear to be subsidizing the wealthy, prioritizing emission reduction strategies and EV adoption will benefit all Kamloops' residents. The increasing problems of climate change (e.g., extreme heat, forest fires) will continue to impact Kamloops. Issues such as insurance will rapidly increase the affordability barrier. For example, in May 2023, the leading home insurance company in California, State Farm General Insurance Company, stopped offering home insurance to new developments in the State of California citing the risk was too high due to wildfires (Sarkissian, 2023). The company released this statement:

> State Farm General Insurance Company made this decision due to historic increases in construction costs outpacing inflation, rapidly growing catastrophe exposure, and a challenging reinsurance market. (Sarkissian, 2023)

Extreme weather and wildfire risk are anticipated to grow in BC due to climate change (Labossière & McGee, 2017; Coogan, Aftergood & Flannigan, 2022). Kamloops is at high exposure to damage from climate change due to its dry climate and forest fuel build-up[4].

3.2.1 EV Adoption: Public Engagement

The City conducted community engagement activities such as online surveys, in-person community engagement, and a workshop with the Canadian Home Builders' Association to assess public and stakeholder feedback (City of Kamloops, 2020). Through the 'Let's Talk Kamloops' campaign which included an online page for residents to provide feedback, 676 residents answered three surveys open from January 24 to February 28, 2020 (City of Kamloops, 2020). The surveys targeted three categories of residents: (1) the general public, (2) developers, homebuilders, and

[4] Kamloops has a high forest-fuel build up due to the pine beetle devastation on the local forests between 2005-2008 which had a high mortality on conifer trees in and around Kamloops. This leads to a higher wildfire risk as it results in forests comprised of dead trees (Labossière & McGee, 2017; Coogan, Aftergood & Flannigan, 2022).

realtors, and (3) businesses and institutions (City of Kamloops, 2020). Each survey asked participants about their ideas for EV and E-Bike uptake and assessed residents' knowledge and familiarity with EVs and charging infrastructure (City of Kamloops, 2020).

Of the 615 residents who responded to the online general public survey, 14% of respondents currently own and drive EVs, 78% are not EV owners but are strongly considering or plan to purchase an EV for their next vehicle, and 22% said that they are unlikely or have no intention of purchasing an EV in the future (City of Kamloops, 2020). When responding to challenges with EV ownership, the majority of survey participants indicated the high purchase cost of EVs was the main barrier to EV ownership (68%) with limited driving range as another key barrier (45%) (City of Kamloops, 2020).

From the surveys conducted and based on the interview responses from City employees and elected officials, community reaction to the *EV Strategy* can be separated into three categories: 1) supports the City's *Strategy*, 2) apathetic to EVs and EV transition policy, and 3) resistant to the City's *EV Strategy*. As one City employee mentioned: EVs only account for 2% of vehicles owned in Kamloops; therefore, 98% of residents are not impacted by EV policies, and have little or no interest in EVs (Participant D2)[5].

3.2.1 City of Kamloops EV Action

The City created the *EV Strategy* with AES Engineering to include various EV priorities and objectives. These included requiring parking in new developments to be EV-ready, EV fleets, and building charging infrastructure, among others. For requiring EV parking, the City initially had a goal of "100% of parking in new developments to be EV-ready" for residential developments

[5] See Chapter Four regarding interview participant lists.

in their *EV Strategy* (AES Engineering, 2020, p.11). Participants spoke of the lack of current parking availability in Kamloops, and their concern that the initial goal of requiring 100% of parking in new developments to be EV-ready[6] would exacerbate the parking issue in a high driving intensity (relying primarily on personal vehicles for travel) city (Participant D8, Participant A2). After conducting further public engagement meetings, the Sustainability team and City Council changed this goal and passed an amendment to the zoning bylaw:

> Beginning January 1, 2023, one parking stall per dwelling unit must be EV-ready[7] at the time of construction for all new single-family, single-family with a secondary suite, two-family, and multi-family residential developments. (City of Kamloops, 2022)

This update to the zoning bylaw was to accommodate drivers who may not be able to afford or were not interested in purchasing EVs at this time.

Within the City's *EV Strategy* – the City lists three targets to reduce GHG emissions from the City fleet and facilities. These include: (AES Engineering, 2020).

- By 2030, reduce fleet GHG emissions by 40% below peak levels,
- By 2050, reduce fleet GHG emissions by 100%, and
- By 2025, provide workplace EV charging for any City employee who requires it.

Some of the related Actions plans include adopting a "Electric First" Procurement policy[8], and a "Green Fleet Plan"[9]. These require prioritization of EVs over ICE vehicles in the City's procurement policy and the creation of an assessment plan to evaluate opportunities to transition

[6] A goal within the *EV Strategy* requires a percentage of commercial and institutional parking spaces to be EV-ready. Representatives from the City said they were prioritizing home charging in new developments before commercial EV charging as most EV charging takes place in the home.
[7] "EV-ready" is defined as: "a parking space must be constructed in proximity to a pre-wired electrical circuit that is capable of supplying power to a Level 2 EV charger" (City of Kamloops, 2022, n.p.).
[8] A carbon price of $150 per tonne of CO2e (adjusted for inflation) be recommended to use to assess life cycle GHG and air pollution costs (AES Engineer, 2020, *EV Strategy).*
[9] Fleet assessment plan to evaluate opportunities for electrifying city fleet vehicles to "reduce emissions and optimize fleet life cycle costs." (AES Engineer, 2020, *EV Strategy*, p.16).

current ICE vehicles to EVs (AES Engineering, 2020). Within the City's Vehicle Fleets, they own 14 EVs out of 125 light-duty vehicles and five EVs out of 137 for medium-duty vehicles (Participant D1). When a vehicle needs to be replaced or purchased, an analysis is undertaken to see if an EV can be a viable option (AES Engineering, 2020). The City purchased one of the first Nissan Leafs with logos promoting EVs in Kamloops in 2015 through a partnership with a local Nissan dealership (Participant D1 & Participant D6). The City worked to gain media attention for EVs with the Leaf, and the vehicle was brought to local sporting and public events and driven locally to raise EV awareness (Participant D1).

3.3 Electrification of Transportation

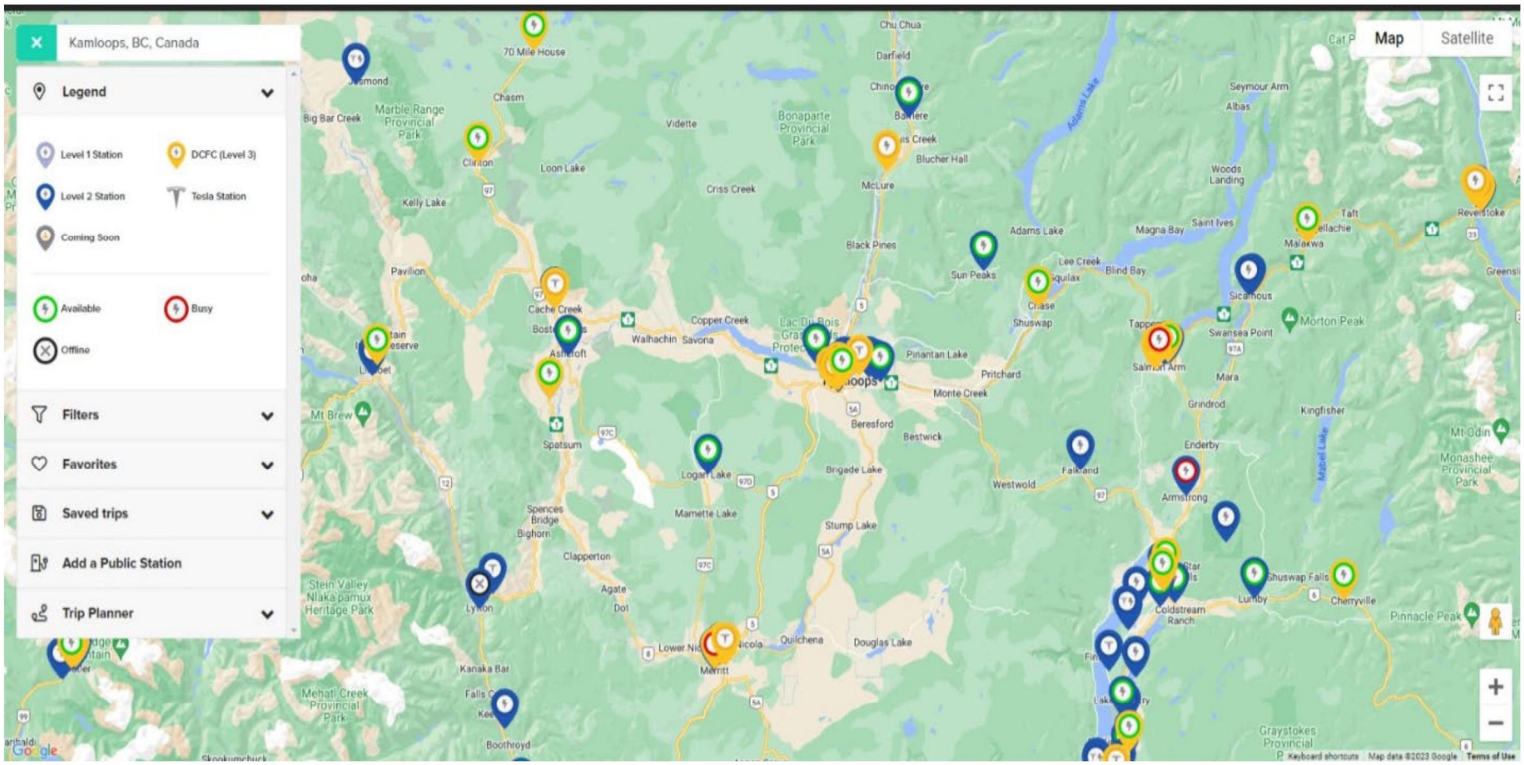
I chose to research the electrification of transportation as transitioning to EVs has the largest GHG reduction rate of all transportation-related policies (Sykes & Axsen, 2017). There is a direct correlation between population growth and GHG emissions from transportation (Newell & Robinson, 2018). A significant portion of the Kamloops population (80%) lives in single-family households, duplexes, or townhouses (AES Engineering, 2020). This implies that the urban density required to replace car ownership with public transportation routes is missing (see Section 3.1.2) (AES Engineering, 2020). Of the 39,915 dwellings in Kamloops surveyed in the 2021 Canadian census, the number one dwelling type was single-detached houses (20,080 dwellings) and apartments with less than five stories were the second most common dwelling type (6,585 dwellings) (Statistics Canada, 2023a).

Kamloops is a "car-intensive community" with 88% of trips occurring by vehicle (City of Kamloops, 2021). On-road transportation in Kamloops contributed to 66% of their total GHG emissions in 2017 (City of Kamloops, 2021). Therefore, reducing GHG emissions from passenger vehicles is imperative to reduce total GHG emissions. As of 2019, Kamloops has higher personal

vehicle ownership rates (1.9 vehicles per household) than the Canadian average (1.5) (City of Kamloops, 2021). Kamloops still has a small EV market locally with only 4% of local passenger vehicles registered as EVs[10]. However, this is a 600% increase from 2017 vehicle registrations (City of Kamloops, 2022). There are currently 41 public charging stations located in Kamloops (as of 2023) with 27 Level 2 chargers and 14 Level 3 chargers (CFJC Today, 2022; Charge Hub, 2023a). Of these 41 charging stations, 75% of them offer free charging for vehicles (CFJC Today, 2022; Charge Hub, 2023a). The charging stations are concentrated in central and eastern Kamloops with little to no charging opportunities upon leaving the city for around 50 kilometers in all directions (Charge Hub, 2023b). Charging stations in Kamloops and the surrounding area are indicated in Map 3, and charging stations in Kamloops are seen in Map 4 (Charge Hub, 2023b).

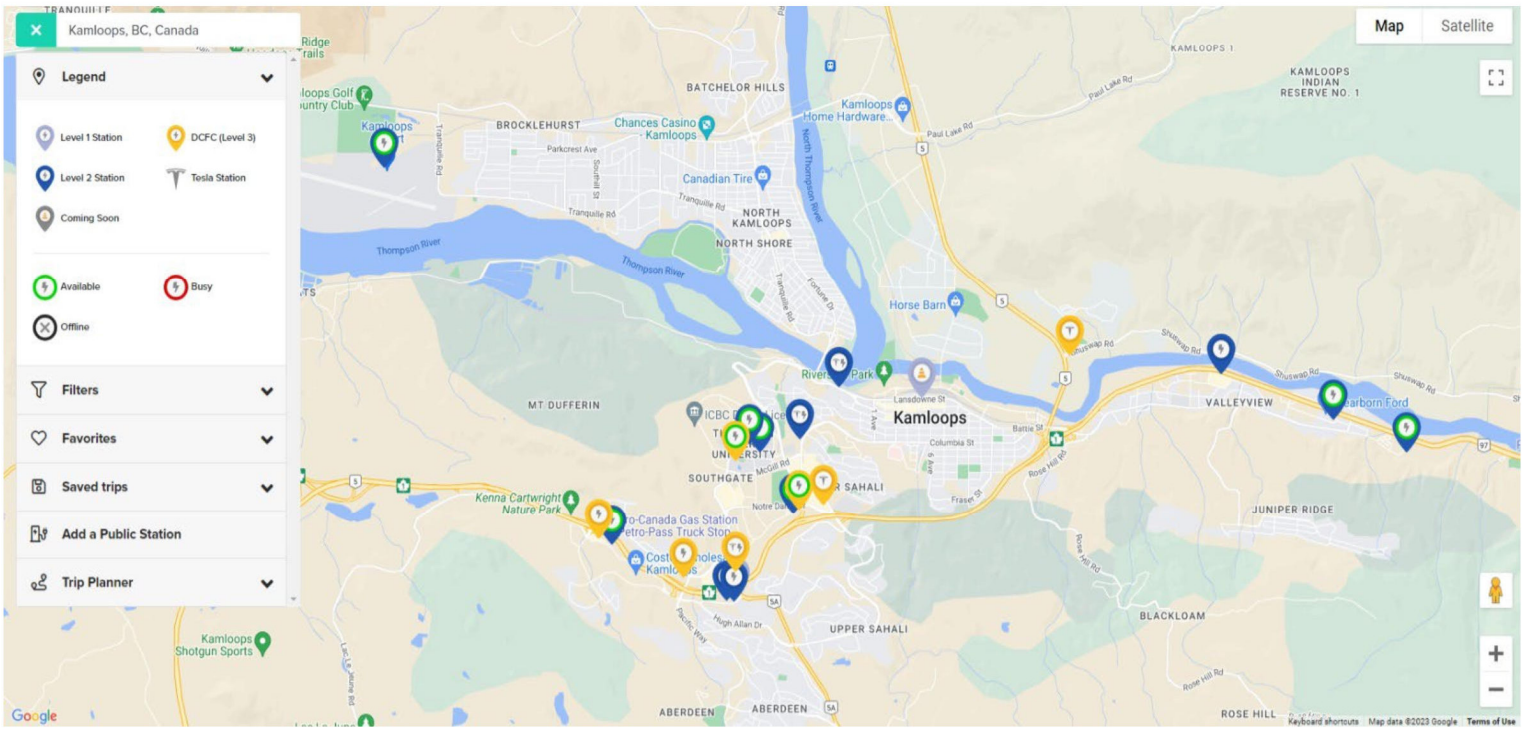
[10] Despite a higher percentage within the City of Kamloops survey, it can be assumed (and was discussed by Community interview participants) that potential or current EV owners, or people that prioritize personal emission reductions might have responded at a higher level due to vested interest.

Map 3: Charging Stations in Kamloops and the surrounding area



Map 3 Source**:** https://chargehub.com/en/Charging-Stations-Map.html

Map 4: Charging Stations in Kamloops



Map 4 Source**:** https://chargehub.com/en/Charging-Stations-Map.html

3.4 Study Limitations

My research exclusively looked at battery-powered electric vehicles (BEVs) – plug-in or hybrid vehicles, and I did not assess hydrogen fuel cell vehicles. Certain solutions and barriers provided by participants such as high purchase prices, or environmental or social degradation from EV manufacturing (for example, mining and/or EV production) are acknowledged but not discussed as municipal policy has little to no jurisdiction over these. There is difficulty in electrifying freight or commercial transportation due to charging time and battery range, so I focused on passenger vehicles for my research (Talebian, Herrera, Tran & Mérida, 2018).

Chapter Four – Methodology

To examine the policy context for EV adoption, I undertook a policy and document analysis with a focus on the City of Kamloops' *Electric Vehicle and E-Bike Strategy.* Second, I conducted qualitative interviews to hear the opinions and experiences of people in different sectors of the community to explore the barriers to local EV adoption.

4.1 Methodology – Qualitative Research

Qualitative research is a form of social science research that concentrates on understanding human experiences within different conceptual frameworks (Winchester & Rofe, 2016). This research style emphasizes participants' experiences through an "interpretive paradigm", by exploring the subject's experience within the research questions (Starman, 2013, p. 30). It relies on inductive approaches to assess the different ways people interpret situations and experiences (Mohajan, 2018). The goal of qualitative research is to "describe and interpret issues or phenomena systematically from the point of view of the individual or population studied…" (Mohajan, 2018, p.2). Qualitative research involves active interaction with a sample population in a semi-controlled environment (Sogunro, 2002). This style of research encompasses two fundamental aspects: social structures and individual experiences (Winchester & Rofe, 2016). As my research assesses both social structures (i.e., government, policy, economics) and individual experience (e.g., community perspective), this type of research is appropriate to answer my research questions.

While there are many benefits to qualitative research, there can be weaknesses in this form of research due to the interpretative nature of the methodology (Choy, 2014). Qualitative research can create new theories and ideas through open-ended inquiries and the understanding of social behaviors; however, there can be no verifiable result due to the subjective nature of the research (Choy, 2014). The researcher in qualitative research is the "first informer", implying they are the

ones to obtain all the information for the research (Abdullah & Raman, 2001, p.123). Therefore, if the researcher is inexperienced or conducts research methods incorrectly, the data may not be interpreted correctly and may provide inaccurate results (Abdullah & Raman, 2001).

4.1.1 Case Study Approach

For my proposed research, I selected Kamloops as a single case study. A single case study examines a singular unit and can help researchers better understand the research issue at hand (Baxter, 2016). Case study research requires the intensive study of a selected aspect (such as the City of Kamloops and EV transitions) to understand the relationships, issues, and reactions involved with the broader question (EV and EET) (Baxter, 2016). To answer my first research question, I chose a case study method to gain insight into decision-making with EV transition strategies and policies. A case study method tries to "illuminate a decision in a set of decisions: why they were taken, how they were implemented, and with what result" (Yin, 2003, p.12). Using a case study as a research method typically gives the researcher freedom to design the research within the case study (Meyer, 2001). While this can have negative repercussions due to the 'loose' method design, "it allows tailoring the design and data collection procedures to the research questions" (Meyer, 2001, p. 330).

To contextualize my case study on Kamloops, I examined BC's policies and strategies on climate change and EV transitions (see Section 2.3), and then focused on the City of Kamloops' *EV Strategy*. My research is idiographic as it emphasizes one phenomenon in detail out of a larger context (Baxter, 2016). It is also an 'embedded' case study. While it is a single case (one municipality and one topic), I assessed multiple sub-units within the case such as government and community decision-making processes, and community impact and reaction (Baxter, 2016).

I chose Kamloops as my case study as it is moderately populated with a growing population, serves as a regional center, and is not geographically close to other urban areas, so it must rely on its own strategies for EV uptake. There is currently (as of 2023) little research on EV policy and Canadian cities, smaller cities, or cities that serve as regional hubs for areas. For example, the majority of the literature and research on EV transitions in BC focus on the Lower Mainland, where 49% of the population in BC lives. Fewer studies have been conducted on regional centers that are relatively isolated from other large urban centers (Wang, Zhang, Bi & Clift, 2020). As Kamloops and other communities continue to grow in Canada, more research will be needed to better understand these contexts with EV transitions.

The *EV Strategy* created by the City of Kamloops was also one of the more progressive EV adoption plans when it was first released. The City hired AES Engineering to create an *Electric Vehicle and E-Bike Strategy* to address and reduce GHG emissions from passenger vehicles (City of Kamloops, 2018). I consider this *Strategy* progressive compared to other municipal EV plans as the City included pilot projects such as retrofitting existing homes and buildings with charging infrastructure (City of Kamloops, 2018).

A single case study is helpful to gain extensive knowledge of EV transitions with municipalities – such as policies, decision-making processes, and perceived barriers. Single case studies can be used to generalize research theories, which can be tested through other types of research methods (Starman, 2013). While theory generalizations from single case studies can occur, "a case study cannot provide reliable information about the broader class, but it may be useful in the preliminary stages of an investigation since it provides hypotheses" (Flyvbjerg, 2006, p. 2).

I believe the City of Kamloops may be an effective representative case study as other municipalities in BC share similar populations, economies, and geographic placement such as Prince George and Kelowna. Transportation is also the number one GHG emitter within both those cities (Kathuria, 2021; City of Kelowna, 2023). While these municipalities are working towards addressing transportation emissions, they do not have EV strategies or policies in place (as of January 2023). There are vulnerabilities in choosing a single case study. These can include a lack of replicable results to other cases, and the potential for researchers to focus more on the individual subunits versus the larger issue at stake (Yin, 2003; Baxter & Jack, 2008). I attempted to mitigate these risks by having a strong literature review and content analysis of other municipal policies, plans, and strategies for EV transitions.

4.2 Methods

This section describes and elaborates on the methods used in my research. All methods are primarily qualitative, and include data collection through key informant interviews, a data analysis of content (policies, strategies, plans for EV transitions), and a narrative analysis of interview data. I discuss the ethical considerations of my interviewing process, and how I attempted to triangulate my data to ensure reliability, rigor, and validity.

4.2.1 Data Collection

To gain insight into the decision-making process and creation of the *EV Strategy* in Kamloops, I conducted 41 semi-structured interviews with key informants. Semi-structured interviews were chosen for their flexibility with participants to maintain a flow of conversation while also allowing the interviewer to have prepared questions to guide the interview (Galleta, 2013). My key informant interviews were categorized into six stakeholder groups. The six

stakeholder groups I created are based on the five stakeholder groups established by the City of Kamloops during their community engagement sessions on local EV adoption (compare Table 1

and Table 2). The City of Kamloops held community engagement sessions to hear public input on EVs and published their engagement information online (City of Kamloops, 2020). This information is publicly available in the form of a community engagement summary on the City's website. The stakeholder groups I created were: Businesses Associations, Local Government and Institutions, Passenger Vehicle Dealerships, EV Charging station owners, Real Estate/Construction, and Community Groups and Associations (see Table 2). Key informants were selected due to their professional (potential) proximity to local EV adoption.

Table 1: City of Kamloops' "Let's Talk" Stakeholder Groups

Stakeholder Engagement Categories: City of Kamloops				
Business Groups	Businesses	Community Groups and Associations	Industry Members	City, Institutions, and Government Agencies

Table 2: My Research's Stakeholder Groups and Interview Numbers per Group

Stakeholder Interview Categories for Barriers to Adoption					
Business Associations	Real Estate/Construction Associations	Community Groups and Associations	Local Government and Institutions	Passenger Vehicle Dealerships	EV Charging Stations
Participants Interviewed per Stakeholder Group					
(4)	(5)	(6)	(9)	(10)	(7)

4.2.1.a Key Informant Interviews

The interview process is a goal-oriented discussion to gain information including opinions, thoughts, and perspectives from an interviewee in a controlled environment (Gubrium, Holstein, Marvasti & McKinney, 2012). Interviews were used to address knowledge gaps in the preparation of EV strategies and policies, and to assess how a community reacts to those implemented policies

(Dunn, 2016). A key informant is considered different than an 'informant' due to their position and connection to the research (Bryman & Burgess, 1999). They are separate from other members of the community and have a more 'elite' status in the research due to their potential knowledge of and "information rich connection to the research topic" (Lokot, 2021, p. 3). Key informants can be helpful in developing the parameters of the research questions (Tremblay, 1957). Tremblay describes five criteria for key informant selection: (1) position in community, (2) knowledge of topic, (3) willingness to participate, (4) communication, and (5) impartiality (Tremblay, 1957). I chose each key informant based on their position to, and knowledge of, Kamloops' EV adoption and policy. Communication levels and impartiality varied among participants.

The community position of interviewees influences the opinion of interview participants and key informant expertise can be helpful in policy-related research to gain insight into community decision-making and behavior (Houston & Sudman, 1975; Lokot, 2021). Key informants can also benefit shorter, time-limited research (e.g., a graduate thesis project) due to the (hypothetical) reliability of the informant's information versus building up trust and a relationship with participants to have them speak openly (Lokot, 2021). Key informants for my research comprised of senior staff members of the City of Kamloops, AES Engineering, leaders of community associations, business and real estate organizations, sales managers of Passenger Vehicle Dealerships, and EV charging station owners. Each individual, company, and group were selected due to their position and potential knowledge of EV transitions within Kamloops.

I prepared an interview guide prior to my research ethics application and relied on this to assist me in my interviews (see Appendix B). The guide included an outline of general questions relevant to my research questions and pertinent to the participants. The questions in the 'open-ended' interview guide were mostly 'primary' questions to initiate discussions and open

conversation on that topic (Dunn, 2016). I added supplementary follow-up questions and pre-written or assigned prompts to each primary question to facilitate additional discussion (Dunn, 2016). Questions included "What do you think are the barriers to EV adoption in Kamloops," "Why do you think EV adoption is slower in Kamloops than other municipalities", and "What do you think can be done to increase EV uptake in Kamloops?". I asked general questions to each interview participant to gain a better understanding of the consensus on EV adoption locally. Key informant interviews provide insight into community relations, dynamics, and reactions. While key informants are considered to provide insider information to a research topic, as they are the opinions of those interviewed; the reliability of the answers provided should be triangulated with other sources of data such as literature reviews, content analysis, and general population interviews (Lokot, 2021). Interview guides were edited and tailored for each interview and stakeholder group.

4.2.1.b Sample Groups

As I am the sole researcher on this project, I contacted larger stakeholder groups to reduce the number of interviews required (i.e., contacting Kamloops Uptown Business Association versus contacting individual businesses). I contacted municipal employees via their public emails on the City of Kamloops website and approached larger stakeholder groups via the City's public engagement campaigns on EV transitions (City of Kamloops, 2020). The stakeholder group listing via the City of Kamloops included business groups, industry members, and community groups and associations (City of Kamloops, 2020). This can be seen in Table 1. I referenced this list and conducted internet searches and used charging station phone applications such as ChargePoint for my interview participant selections. I also conducted interviews with organizations, businesses, or associations in the community that I believe will or have been directly impacted by the *EV Strategy*. These interviews are categorized into six sample groups – Business Associations, Real

Estate/Construction Associations, Community Groups and Associations, Local Government and Institutions, Passenger Vehicle Dealerships, and EV Charging Station Owners. These groups can be seen in Table 2. The targeted groups the City engaged with for the creation of the *Strategy* are the basis of the sample groups, as well as interviewing other stakeholders such as Passenger Vehicle Dealerships and EV Charging Station Owners to assess local EV demand (City of Kamloops, 2020).

I interviewed each community category to assess their knowledge of the City's plans for EV transitions (including the *EV Strategy)*, their thoughts on EV adoption in Kamloops (i.e., uptake, community reaction), and the impact EV adoption and/or the *Strategy* will have on them. There is variety in the number of interviews conducted in each category due to the following reasons: limited number of associations/groups (business and community organizations/associations), poor response from potential participants, and a higher number of participants in certain categories (passenger vehicle dealerships and EV charging stations). There are more quotes with some stakeholder groups than others – I conducted a significant number of interviews over the phone at the same time I called to inquire and request an interview. No recording device was set up in time to capture a quote accurately, and their words are paraphrased.

Some stakeholder groups were asked specific sets of questions:

Business Associations:

- Thoughts on City prioritization of EV adoption.
- Local consumer EV interest.
- Interest among business owners of installing or adding additional charging stations.

Real Estate/Construction Association:

- Consumer interest in EV charging station installation in developments.
- City requirements for EV charging installation in new developments.
- Costs of EV charging station installation.

Community Groups and Associations:

- Interviewed about their collaboration with the City with local EV adoption.
- Thoughts on municipal encouragement of EV adoption, and the *EV Strategy.*
- Engagement with the community regarding EVs, community response to EVs, and their involvement or contributions to EV transitions in Kamloops.

Local Government and Institutions:

- Individual involvement with the creation of the *EV Strategy.*
- Thoughts on the City's prioritization of EV transitions and plans to reduce transportation GHG emissions.
- How plans were created, sustainability planning process.

Passenger Vehicle Dealerships:

- Available EVs at the dealership.
- Consumer interest in EVs.
- Trends in vehicle sales at the dealerships.
- Maintenance capacity.

EV Charging Stations Providers:

- EV charging station usage.
- Charging station maintenance.
- The choice of which EV charging station company to select and why.
- Whether they would add more charging stations in the future.
- This group was the only group not asked about barriers or solutions to EV uptake in Kamloops as they were contacted solely to assess public charging station usage, and whether or not charging station owners would be interested in installing more.

4.2.1.c Ethical Considerations

The UNBC Research Ethics Board (REB) approved this research on July 27, 2021 (Appendix A). The research is of 'minimal risk' following the definition in the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans, as the magnitude of possible harm to participants is limited. I did not ask participants to speak on sensitive or vulnerable related topics and were only asked their opinions and thoughts on subjects from a professional perspective. I informed participants at the beginning of the interview that should they not feel comfortable answering interview questions, or if they were no longer comfortable participating, all materials

pertaining to them and their involvement with this research would be destroyed. Each participant received and signed a consent form and research information sheet prior to the interview, and oral consent was requested at the start of the interviews. The research was discussed with the participants at the start of each interview, and I asked participants at the beginning and end of the interview if they had any questions or anything they would like to add.

Upon completion of the interview, I compiled interview notes and sent them back to the participant to allow them to add or remove anything. Participants were given a time frame of around two weeks (with extensions if needed) to return the compiled interview notes. If notes were not returned within the allocated time, I contacted participants to ensure they approved the interview notes. I continued to assess an 'ethical checklist' prior to any publication to confirm I reviewed and followed the Tri-Council and UNBC's REB recommendations that no harm will come to any participants; the research participants fully understood my research and their participation; and privacy and anonymity of participants are ensured (Bryman & Teevan, 2005).

I practiced critical reflexivity by consistently scrutinizing myself, my actions, and my research to establish ethical research conduct (Bryman & Teevan, 2005). Within the interviews, the researcher is considered a "positioned subject", and must be aware of their behavior and speech to their subjects (Baxter & Eyles, 1997, p.505). I reviewed each interview upon completion to certify my interviewing style and questions are appropriate, clear, and concise, and adjusted myself accordingly if I felt otherwise.

4.2.2 Data Analysis

Qualitative research can produce rich descriptions but can be overwhelming due to the reliance on written materials (such as interview transcripts or documents) (Bryman & Teevan, 2005). Data analysis consists of examining and categorizing research data to uncover patterns and

meanings (Yin, 2003; Kohlbacher, 2006). My data analysis comprises of two main sections: a content analysis of policies, strategies, plans, etc. related to EV transitions, and a narrative analysis of interviews. The content analysis was completed to gain a better understanding of EV transitions within the context of BC and municipalities such as Kamloops, and the narrative analysis added an additional social layer to better understand people's experiences (Syed & Nelson, 2015).

I used grounded theory, defined as "theory derived from systematically gathered data, arising through the research process", to analyze the research data (Bryman & Teevan, 2005**,** p.284). A tool of grounded theory is coding, which involves processing raw data into a standardized framework (Bryman & Teevan, 2005; Kohlbacher, 2006). Within this framework, the researcher can reduce the data into key codes to identify common themes, patterns, and ideas (Cope, 2014). Codes are keywords that reduce the interview data and reflect the essence of the text (Syed & Nelson, 2015). I chose grounded theory and coding as a method to analyze the narrative data collected to assess themes, codes, ideas, and opinions from participants on EV adoption, barriers, and solutions to EV uptake. The data analysis software Delve was utilized to keep all the transcripts/codes etc. in one place versus physically going over each transcript in paper copy. I have two categories of interview data – transcripts from the online interviews over Zoom, and compiled notes from phone conversations with participants who wanted to do the interview immediately upon my calling them. I contacted all participants to set up a Zoom meeting to allow a recording of the meeting.

Adding all interview data (i.e., transcripts, interview notes) to Delve for analysis, I began by reading the interview data to familiarize myself with the initial general ideas from the

interviews. I created two Excel sheets to use as my codebook[11] prior to Round One of data analysis (Cope, 2014; Belotto, 2018). I organized the narrative data analysis on an Excel sheet with the different stakeholder groups – Business Associations, Real Estate/Construction Associations, Community Groups, Local Government and Institutions, Passenger Vehicle Dealerships, and EV Charging Stations. I created three columns– one for each round of analysis, and each stakeholder group and their participants were copied into each column. This was to confirm the interview data for each participant was analyzed three times. For Round One of my narrative data analyses, I read over my interview data for any themes/ideas to begin my codebook. My initial codes are more general and listed in Appendix A: Round One Codes.

In my second round of coding, I colour-coded common themes for example - barriers/challenges, municipal policies, and EV interest/resistance - to visually identify patterns and consistencies in categorizing the codes. I added new codes to my codebook into the stakeholder categories as new themes emerged, and then reverted to 'focused coding'. Focused coding is the exploration of ideas, concepts, and themes in greater detail (O'Reilly, 2012). I wrote memos as I reviewed data during the focused coding stages to label phenomena and new ideas (O'Reilly, 2012). I then added these memos to the Excel sheet under each stakeholder category and within the individual interview transcript section. Appendix A: Round Two Codes lists the additional codes from the second round of analysis.

The next step was to link codes, themes, and memos to elaborate ideas and refine my coding process (O'Reilly, 2012). I created the second Excel sheet with my research questions, and relevant codes and quotes were added under each question as I reviewed the interview data. I started to

[11] A codebook - an organizational structure that allowed me to have a comprehensive analysis of the data.

'test' the codes to see which codes or themes were not relevant to my research, and to identify any bias I might have added (such as preference for EVs). I sub-categorized the codes into larger categories under the two research questions to add a richer interpretation of the data and tested the patterns emerging with the common themes (Belotto, 2018). This included, for example, categorizing certain codes under barriers (i.e., rural culture, larger vehicle preference, topography), and other codes under solutions (i.e., free parking, promotion, education). Codes that were more specific were categorized under larger themes (for example – EV supply, supply chain issues, hybrids, trends, maintenance, and benefits were all categorized under 'EV Sales').

For the third round of data analysis, I gave the codes their final test to see their relevance to the research questions. I added the last codes in the third round after marking them during the second analysis round as being potentially relevant to the research (Appendix A: Round Three Codes). At the end of the third round, codes were re-colour-coordinated and organized again under sub-categories. These sub-categories and their codes were arranged under each research question to show what themes and patterns had emerged from the interview data, and what was relevant to the questions.

4.2.3 Rigor, Validity, Reliability, Triangulation

4.2.3.a Rigor

As qualitative research is subjective and inductive-based, rigor is key to ensure good research practices and results (Baxter & Eyles, 1997). Rigor in research implies validity, objectivity, and honesty (Baxter & Eyles, 1997). Four criteria are used to verify rigor in qualitative research: "credibility, transferability, dependability, and confirmability" (Maher, Hadfield, Hutchings & de Eyto, 2018, p. 3). Credibility refers to the correct depiction of interview data, while transferability implies the research findings can be transferred to a different circumstance

(Maher, Hadfield, Hutchings & de Eyto, 2018). Dependability requires the explanation of the interviews/method process to be clear and concise enough so that it provides readers with trust in the results, and confirmability refers to acknowledging researcher bias within the research (Maher, Hadfield, Hutchings & de Eyto, 2018).

To ensure rigor and demonstrate the competency and integrity of my research, my supervisor and Laura Murphy, a UNBC Research Manager, reviewed my interview guide and questions (Fereday & Muir-Cochrane, 2006). This was done to confirm clarity of interview questions and relevance to my research questions. To familiarize myself with interviewing, I conducted pilot interviews and used a 'hermeneutic circle' approach. Using the practical knowledge I gained during my content analysis and literature review, I tested this knowledge with pilot interviews to confirm my understandings and misunderstandings about concepts, theories, and ideas about my research (Kezar, 2000). I also used the pilot interviews to assess the suitability of the interview questions and style (Stratford & Bradshaw, 2016). The data from these pilot interviews was not analyzed or used within my research outside of confirming that the interview questions were clear, concise, and relevant. Once I transcribed the initial interview, my supervisor and I discussed the transcript contents to establish consistency, accuracy, and trust in my data collection (Belotto, 2018).

I compiled each transcript into a set of notes and sent them back to the participant to ensure the accuracy of their answers (see Section 4.3.1.c). This process verified the accuracy of the interview note summary as well as confirmed the information provided by the participant was correct. To verify rigor in my data analysis, I used a thematic analysis: reading and re-reading the data obtained through interview transcripts to recognize patterns and identify emerging themes (Fereday & Muir-Cochrane, 2006). A thematic analysis approach worked with my research

questions as my research questions held keywords such as “barriers” and “solutions” that could be easily identified within the interview data. An additional system to corroborate rigor within research is to provide reasoning behind the methodology and methods chosen for the study (Baxter & Eyles, 1997). Elaborating on the choice of methodology and methods and explaining how each method was conducted provides insight into research practices (Baxter & Eyles, 1997). This can include providing details of the interview process, quotes from the interviews to confirm the proper representation of interview data, and explanations of the data analysis process (Baxter & Eyles, 1997).

4.2.3.b Validity

Validity in research implies agreement from readers that the research methods and results are convincing (Baxter & Eyles, 1997). To maintain internal validity in my research, I compiled multiple sources of evidence through my literature review to contextualize EET and EVs and have referred to that literature throughout my research as a supporting chain of evidence (Yin, 2003). I used this literature to create interview questions and consistently referred to and updated it throughout the interview process. To establish external validity – contextualizing the domain of my research findings – I included other similar cases and their policies, strategies, and plans from other municipalities as well as other research findings from other case studies in the second part of my question to establish solutions that have transferability to other cases (Yin, 2003; Baxter, 2016).

Acknowledgement of power dynamics between the interviewer and interviewee is an important part of researcher self-reflection and must be addressed to ensure validity in research (Baxter & Eyles, 1997). These dynamics can impact the interview and later interview interpretation (Baxter & Eyles, 1997). I attempted to mediate this by listening to interviews again to hear if I

could improve my interviewing style (not speaking over interview participants, slowing down my speech, watching the amount of information I was giving out as not to overwhelm participants, etc.).

4.2.3.c Reliability (Dependability)

Reliability in research includes the ability of the results to be replicated; demonstrating that the methods of research are well-founded, and there has been legitimacy in the data collection (Yin, 2003). I kept a clear chain of evidence collection to increase research reliability by visually laying out my coding in Excel as I compiled my transcripts (Yin, 2003). I worked closely with my supervisor and committee to ensure the reliability of my research as I am the sole researcher on this project and conducted the interviews, transcribed them, and analyzed the results.

4.2.3.d Triangulation

Triangulation stems from the idea that a single method cannot guarantee accurate research results and, therefore, multiple methods are needed to ensure reliability in research results (Patton, 1999). I used two types of triangulation to support rigor within my research: methods triangulation and triangulation of sources (Patton, 1999). To triangulate my methods, I used a mixed-methods approach; primarily conducting interviews and a content analysis to compare the information gathered and confirm the data results from each method. I triangulated my interviews by speaking with a variety of stakeholders to gain knowledge of the different experiences each group may have with EV uptake in the community. I also triangulated my sources of data using a variety of peer-reviewed articles, books, census data, and grey literature to provide context and compare information as a foundation for my research (Patton, 1999).

Using a mixed-method approach can ensure both rigor and validity in the research by relying on alternative data sources (Baxter & Eyles, 1997). This approach balances the strengths

and weaknesses of both quantitative and qualitative research and enables the researcher to answer, "a combination of exploratory and confirmatory questions" (Lund, 2012, p. 157). Key informant interviews add another component to the triangulation of my research as these types of interviews provide additional sources of opinions, beliefs, and ideas to the research (Lokot, 2021). Through my literature review and analysis of EV policies, strategies, and plans, I triangulated my research by checking sources from various backgrounds with others (such as quantitative research studies on EV adoption versus qualitative research), as well as discussing my research and interpretations with experienced researchers like my supervisor and my supervisory committee.

4.2.4 Limitations

Due to Covid-19 safety measures, there were limitations in the methods used in this research. I was not able to travel to Kamloops or conduct my interviews face-to-face. All communication was held over Zoom/Skype, telephone, or email. This limited the potential ability to assess body language and emotional/physical reactions to questions in interviews. Many participants, specifically in the Business, Passenger Vehicle Dealerships, EV Charging Station, and Real Estate/Construction stakeholder groups, only gave phone interviews immediately when I called them to set up an interview (versus setting up an interview date and going on Zoom). Therefore, no recording device was set up.

I was not able to travel to Kamloops and see firsthand the types of vehicles driven, the layout of the city, and the perceived barriers discussed by participants 'on display' (e.g., lack of charging stations/opportunities). This added challenge as I sometimes found it hard to connect with my research or properly understand what the participants were speaking of as I was unable to visually see the perceived barriers. I added supplementary research to my project to make up for this and to better understand Kamloops, the City, and the barriers discussed. In terms of surveying

residents, I was able to use the *EV Strategy* and public engagement data conducted by AES Engineering and the City. The data analysis on resident's responses to the *EV Strategy* survey has limitations as I did not conduct the surveys myself and am trusting AES and the City's data collected through the 'Let's Talk' campaign.

Chapter Five – Results

This chapter is divided into three main sections and provides the barriers and solutions presented in my data collection. Section one addresses research question one – perceived barriers to EV adoption in Kamloops. The organization of the stakeholder groups' responses is listed and described in greater detail at the start of Section 5.2. Section three discusses my second research question on solutions to EV adoption in Kamloops. Upon reviewing my interview data, I found that many stakeholder groups did not provide suggestions on policy solutions. Therefore, I discuss the policy suggestions gathered across the stakeholder groups.

5.1 Research Question 1: Local Barriers to EV Adoption

The results of my first research question on EV uptake barriers are ordered by stakeholder groups to demonstrate how each group is impacted by EV transitions. I start with the Local Government and Institutions stakeholder group as my research focuses on municipal policy. Real Estate Organizations are discussed second to address the issues with MURBs and adding charging infrastructure to new developments. The third group is the Passenger Vehicle Dealerships to analyze consumer interest in EVs. Fourth, the Business Organizations stakeholder group provides local business perspectives on parking and EV charging. The fifth stakeholder group includes Community groups that worked closely with the City to encourage local EV adoption. The EV Charging Station stakeholder group is not discussed in this section as they were not asked about barriers to local EV uptake, and only contacted for information on charging station usage. The barriers section concludes with data on EV charging station usage and interest in building additional charging infrastructure. The main barriers heard from participants are presented in Table 3.

Table 3: Perceived barriers by stakeholder group

Local Government/ Institutions	Real Estate/Construction	Passenger Vehicle Dealerships	Business Associations	Community Groups
Access to charging	Restrictive policies	Cost	Cost	Affordability
Rural Culture/Culture	Cost	Lack of EV charging opportunities	Restrictive policies	MURB charging station installation
Affordability	Affordability	Topography	Lack of parking Opportunities	Lack of charging stations
Cost	Electrical capacity	Range Anxiety	Rural culture/culture	Wait times for charging
Lack of funding	Sprawl	Sprawl	Mining/environmental impact	EV model availability
Low EV awareness	Low EV awareness	EVs not matching vehicle preference	Range anxiety	Range anxiety
Lack of Parking Opportunities		Lifestyle		Lack of awareness of EVs
Resistance/Hesitancy to new technology		EV model availability		
Lack of EV charging opportunities				
MURB Charging Station installation				

5.1.1 Local Government and Institutions and EV Transitions

Within the Local Government and Institutions stakeholder group, I contacted members of the City and Institutions based on their position on the *EV Strategy* and City EV policy. Participants were asked about their knowledge and/or contribution to the *EV Strategy* (if they were City employees), their thoughts on the plausibility of local EV transitions, community reaction to the City's position on EV adoption, and the building community's response to EV-ready building mandates. Major barriers discussed among the Local Government and Institutions stakeholder groups included access to charging, local culture, affordability, and equitable policy implementation. Details of each proposed barrier are discussed at greater length below.

5.1.1.a Government Perceived Barriers: Access to Charging

A lack of charging infrastructure was one of the most discussed barriers by all participants in the Local Government and Institutions stakeholder group. The importance of home and public charging access is recognized and prioritized by the City as they created the *EV Strategy*. However, participants from the City spoke of the challenges to supply charging stations. One Local Government and Institutions participant quoted "…home charging is the most important factor moving forward for whether or not you're going to adopt an EV." (Participant D9). Many Government participants observed the lack of charging infrastructure in Kamloops, especially in the downtown corridor, and viewed this as a barrier to local EV adoption (Participant D1, D3, D6, D8). Participant D3 observed local hesitation from businesses and construction companies to build charging infrastructure on their properties. They argued that they do not see the demand for charging infrastructure locally. Several Local Government and Institutions stakeholder group participants noted this; two participants used the phrase "chicken before the egg scenario" (Participant D3, Participant D9).

The City held multiple stakeholder engagement sessions with the building sector to discuss EV-ready building policies on new developments. Initially, the building community appeared to be either neutral or in support of the City's position to encourage EV adoption. When the City attempted to pass the zoning bylaw requiring all new developments to be 100% EV-ready, they heard vocal resistance from the local building sector. The City decided to remove that component of the zoning bylaw and to further engage with the building community to compromise on a better solution.

On July 19, 2022, City Council held another vote, and an amendment was made to the parking bylaw that would require one parking stall per dwelling in all new residential buildings

(single family and MURBs) to have an L2 'roughed-in' charging outlet (City of Kamloops, 2022). This would mean that the owner of the unit would be able to install "a L2 of their choice in the future without having to retrofit or upgrade the electrical service, which can be a barrier due to its cost and complexity." (City of Kamloops, 2022, n.p.).

During the post-zoning bylaw stakeholder engagement sessions, the building community put forward their issues with the zoning bylaw. This included concern over the cost to consumers with the addition of a charging station in each new development due to the growing awareness of a lack of local affordable housing. Additionally, the building community had issues with installing a specific type of charging infrastructure in new developments as they perceived this as pre-supposing what the occupant would want with a charger/amp level.

Another participant spoke on the difficulties of overnight access to charging stations for MURB residents (Participant D1). Strata councils require a majority vote of 75% to install charging infrastructure, therefore, if a resident cannot get consensus on their strata board to install charging infrastructure, they lose access to overnight charging (Participant D1). MURB retrofits have added challenges including establishing revenue collection systems, creating contracts with EV charging service providers, and adding electrical load management systems.

During the public engagement campaigns the City held for EV adoption, local businesses expressed resistance to installing charging infrastructure due to the lack of parking availability (Participant D8). Some businesses (in this campaign) discussed their lack of ownership of any parking spots, therefore, they did not have the chance to install charging stations if they wanted to, while other businesses opposed adding restrictions to the already limited public spots available (Participant D8, D6).

5.1.1.b Government Perceived Barrier: Social

Local Government and Institutions participants identified social resistance to EVs within Kamloops as a significant barrier. This included perceived preference for larger vehicles such as trucks and SUVs. Some participants in the Local Government and Institutions stakeholder group observed that the majority of EVs available in the last ten years have been smaller and more compact vehicles that may not align with consumers vehicle preferences in Kamloops (Participant D3, D7). Residents value larger vehicles for their towing/hauling capacity for either recreational purposes (camping, hiking, etc.) or professional purposes (Participant D7).

As noted by Participant D7, "…it's still a bit of a lunch bucket-type town in terms of thinking…guys love their trucks…[drivers] do not mind the fact that they're paying the exorbitant prices at the pump". Until the release of additional EV models to expand EV options, it is unlikely many residents will purchase an EV until they see vehicles that align with their vehicle preference (Participant D7). Participants also commented on the cultural resistance to change from fossil fuel vehicles to electric vehicles. This includes hesitation to move from the convenience of fueling from the many gas stations around Kamloops and the province, and cultural uncertainty about EV technology (i.e., battery lifecycle, charge range, and range anxiety).

5.1.1.c Government Perceived Barrier: Costs and Affordability of EVs

The Local Government and Institutions stakeholder groups recognized cost and affordability as a substantial and unresolved problem for EV adoption. Almost every Local Government and Institutions interviewee discussed the high cost of EVs as a major barrier. One Local Government and Institutions participant explained that most residents do not frequently buy new vehicles, and as many residents consider EVs to be expensive and luxury vehicles, potential consumers may not be considering them as an option when they go to purchase a vehicle

(Participant D1). A couple of participants concluded that until cost parity is reached between fossil fuel vehicles and EVs, EV uptake will be slow (Participant D7, D8).

5.1.1.d Government Perceived Barrier: Policy Barriers

Municipal employees in the Local Government and Institutions stakeholder group spoke of the difficulties to balance assigning resources and prioritizing climate change policy over other local issues. Due to a lack of tax increases in 2020 from Covid-19 and offloaded RCMP costs to municipal governments, the City of Kamloops raised taxes in 2022 for residents. Therefore, the City decided no funds would be directly allocated to the *EV Strategy* (Participant D7). While a Local Government and Institutions interview participant acknowledged a subsidy towards EV purchases or charging stations would be a helpful tool to encourage potential EV buyers, no funding is being allocated to the *Strategy* (Participant D7).

Two participants discussed the conflict of achieving an equitable EV transition with EV strategies. Participant D4 remarked on the issues of funding EV and climate change policies when there are other issues the City is trying to address. The majority of City Council's time is spent discussing local social issues, and it is difficult to balance climate action and EV readiness while ensuring funding is allocated equitably for public benefit. Participant D7 observed that EV readiness does tend to cater to the wealthy, and EV adoption and subsidies are still perceived to be targeted to higher-income residents. As one participant said:

> I think it's Kelowna, where there are places where they're letting EV drivers park for free for a certain amount of time, and some folks will go like "yeah, well…how does that address equity, you're letting rich people park their hundred-thousand-dollar car for free" in the name of climate change. (Participant D1)

Many Government participants were aware of the issues with equity and aiming policy at EV adoption; however, due to the large number of personal vehicles in Kamloops and high transportation emissions, the City decided it is an efficient way to reduce local emissions.

5.1.2 Real Estate/Construction Organizations

It was critical to speak with members of real estate organizations due to the importance of home charging in providing a convenient and efficient charging opportunity. As discussed in the Local Government and Institutions stakeholder group (Section 5.1.1), some resistance was met within the development/construction community when the City attempted to mandate EV charging in new developments. The majority of real estate organization participants supported the City's position on decarbonization and EV adoption but mentioned that certain issues such as a lack of affordable housing must be addressed prior to mandating EV charging stations in new developments.

5.1.2.a Real Estate/Construction Perceived Barrier: Zoning Bylaw on EV Ready New Developments

When asked about the zoning bylaw to require all new developments to be 100% EV-ready, many Real Estate stakeholder group participants agreed that EV transitions were beneficial for emissions reductions (Participant B2, B3, B4, B5). However, this stakeholder group also deemed the requirement of charging infrastructure to new developments as a poor policy due to the associated costs for residents and developers (Participant B3, B4, B5). Participants noted that a minority of residents are currently driving EVs. Therefore, passing off the cost to install charging infrastructure for non-EV owners was unnecessary (Participant B3). A participant also commented on the added construction costs with the City of Kamloops' implementation of the BC Energy Step Code[12]. The added STEP code cost also reduced the incentive to pay the additional costs for the installation of EV charging infrastructure (Participant B4).

[12] The City of Kamloops implemented the BC Energy Step code in January 2022 to require developments to meet energy performance requirements and to build more energy efficient buildings.

5.1.2.b Real Estate/Construction Perceived Barrier: EV Charging Station Interest and Sales

Real Estate interviewees conceded that interest from customers was still modest, if growing, despite the growth in EV charging infrastructure locally (Participant B1, B2, B3, B4, B5). Interest in EV charging stations was non-existent five years ago (Participant B3). When new owners purchase property, more people purchase EV stalls or EV upgrades[13]. When asked about any lost real estate deals due to a lack of EV charging opportunities in new developments, participants did not believe any lost sales had occurred from a lack of EV charging options (Participant B5).

5.1.2.c Real Estate/Construction Perceived General Barriers

The majority of Real Estate participants supported EV adoption, but some participants felt the market is not ready for EV transitions as the purchase price of EVs and EV charging infrastructure is still prohibitive for many residents (Participant B1). Interviewees commented on the rising cost of living in Kamloops (specifically accommodation prices) and the added costs of EVs and charging contribute to that unaffordability (Participant B1).

The final perceived barrier discussed by participants was local electrical capacity (Participant B2, B5). Potential load capacity issues with BC Hydro from the increased electricity demand from EVs concerned one participant (Participant B1). Certain neighborhoods lost power during heat waves as electricity demand skyrocketed in the summer of 2021 (Participant B1). In addition to potential electrical capacity issues, Participant B5 discussed the regulatory confusion with payment for installation and/or expansion of the electrical load circuits in buildings (BC Hydro, developers, residents, etc.). This includes allocating costs for EV electrical usage and the

[13] New residents must purchase a 'EV stall' or 'EV upgrade' as part of their initial property purchase. Some participants within different stakeholder groups spoke of their own experience in MURBs where EV stalls sold out and potential or current EV owners cannot charge their vehicle.

installation or re-wiring of a new electrical system to accommodate increased electrical demand in the building (Participant B1).

5.1.3 Passenger Vehicle Dealerships

Interviewees from Passenger Vehicle Dealerships elucidated local EV ownership and EV interest through information on EV sales, EV supply, and sales trends over the last 5-10 years. The EV adoption literature provides little insight into perceived barriers from passenger vehicle dealerships. To address this gap, I asked general questions in my Passenger Vehicle Dealerships stakeholder interviews to identify their barriers to local EV adoption. The perceived barriers included a lack of consumer interest in EVs, low EV supply, and differences and/or gaps in vehicle preferences (EVs not matching consumer vehicle preferences).

5.1.3.a Passenger Vehicle Dealerships Perceived Barriers: EV Interest

I asked Passenger Vehicle Dealership participants about consumer interest in EVs and EV inquiries at their dealerships. The majority of participants spoke of the 'significant' interest and the growing daily inquiries about EVs they were receiving. Some participants mentioned they could not keep enough EVs in stock (this is due to both consumer purchases and supply constraints) (Participant E1, E3, E6, E7, E8, E10). One participant commented that consumer interest in EV now comprises 10% of total consumer interest at their dealership (Participant E2). Several participants from the same vehicle manufacturer (but different dealerships) mentioned the notable amount of interest in EVs that were set to be released in future years (i.e., an increase in daily inquiries about vehicles and EVs at that dealership) (Participant E2, E7, E10); however, another participant said there is minor interest in the EVs available or to be released compared to their other ICE models (Participant E5). Most dealerships spoke of the general low EV awareness in the community despite the growing interest.

Participant E6 discussed the reasons consumers are purchasing EVs which included: a personal interest in reducing emissions and awareness of climate change, curiosity in new technology, and a general interest in the vehicles themselves (torque, power of the vehicle, etc.). Some participants mentioned EVs are a harder sell in Kamloops as locals use their vehicles for more than just commuting – driving long distances, towing/hauling capabilities, etc. (Participant E5). As larger EVs are released (SUVs, trucks, etc.), there has been an increase in consumer EV interest (Participant E7). Two interviewees correlated EV interest and purchases to the increase in gas prices. Both participants also noted that when there is a significant increase in gas prices, their EV models sell out and inquiries increase substantially (Participant E6, E7).

5.1.3.b Passenger Vehicle Dealership Perceived Barriers: EV Supply, Sales, and Vehicle Trends

Despite EV interest and growing inquiries, EV supply and sales remained low with participants. EV supply restrictions are a problem for Kamloops' passenger vehicle dealerships and are a barrier to local EV adoption. Passenger Vehicle Dealership Participants E1, E3, E4, E5, E6, E7, E9, and E10 had all struggled with supply constraints from chip shortages, supply restrictions due to Covid-19, and road/highway closures (Highway 99). Participants that spoke of increasing EV interest noted the inability to get vehicles to the dealerships to match demand (Participant E3, E5, E6, E8). I asked participants about their EV sales compared to ICE vehicles, and all participants agreed they (EV sales) are a minority of the total vehicles sold. EV sales made up roughly 10-30% of annual vehicle sales from the interviewees that had EVS (Participant E2, E3, E7).

Passenger vehicle dealership participants provided different ideas on vehicle sales trends over the last 5-10 years. The majority of interviewees mentioned high consumer interest in larger vehicles (SUVs/trucks) (Participant E2, E7). I asked seven dealerships about their number one

selling vehicle and all seven responded with an SUV or truck model. Participant E2 contributed this to the outdoor lifestyle many Kamloops residents have with a high priority on being able to tow/haul and gain access non-paved roads. Other participants spoke of the more 'rural culture' Kamloops has and the preference with gas-powered vehicles versus new technology (Participant E2, E9, E10). Some participants saw an increase in trade-ins and downsizing of vehicles (larger trucks to SUVs) (Participant E5). Additionally, a participant mentioned there seems to be an increase in consumers looking for more 'creature comforts' in their vehicles such as remote starts and heated steering wheels and seats (Participant E1).

5.1.3.c Passenger Vehicle Dealership Perceived General Barriers: General

Additional perceived barriers from Passenger Vehicle Dealerships included price caps on MSRPs (Manufacturer Suggested Retail Price) for federal and provincial EV subsidies, the Kamloops topography (sprawl, hills, distance from other urban centers), range anxiety, and inconvenience of EV charging, a lack of four-wheel or all-wheel drive EV options, and affordability of EVs. Two dealerships named the MSRP cap as a barrier as many EVs are priced out of the provincial and federal rebates available (despite not being luxury vehicles) (Participant E1, E10). Some EV trucks are set to be released to address the demographic that prefers a four-wheel drive EV; however, these trucks are priced out of the rebates (Participant E1). A significant perceived barrier to EV adoption is the topography and climate of Kamloops; the distance to drive to and around Kamloops from other areas is significant with many hills and mountains, and there is concern that the cold climate will impact batteries and charge range (Participant E2, E5, E7, E9, E10).

5.1.4 Business Associations

Business associations were contacted to discuss local commercial interest with installing charging infrastructure. I asked Business Association participants if they had worked with the City on the creation of the *EV Strategy* and their perceived barriers to EV adoption locally. Participant response to EV adoption was either keen interest in EVs and installing charging infrastructure or opposition to EV transitions. Perceived barriers by the Business stakeholder group included high EV charging installation costs, issues with mandatory EV parking, hesitancy towards new technology, and EV manufacturing.

5.1.4.a. Business Perceived Barriers: General

The majority of Business stakeholder interviewees observed that there is negligible (less than 10%) demand by business association members for EV parking stations, and little interest to install charging infrastructure. Many participants spoke of the costs involved with installing charging infrastructure and the financial limitations of their organization. As a result, buying and installing EV charging stations, the cost of electricity, and providing dedicated stalls for EV charging were deemed too great for the organization to pursue (Participant A1, A2, A4).

Parking was a consistent issue for local businesses as multiple businesses do not own their parking spaces (see Section 5.2.a). Due to the lack of parking ownership, businesses do not have the incentive to contact the owner of the parking stalls available (City or privately owned) to inquire about building charging infrastructure (Participant A1). Businesses are also hesitant about EV-only parking as they are concerned it would reduce customer turnover (i.e., people park their EVs to charge them and take away parking from potential customers) (Participant A2).

There is additional opposition to installing charging infrastructure by businesses due to technological hesitation. As noted by Participant A1:

> We'll put in the conduit, we'll put in the piping, we'll even put in the capacity space for EV charging stations, but we are not putting in the cabling…higher charging hardware and software…because 10 years from now, it's out of date. (Participant A1)

Some Participants believed that City was focusing too much on EVs and are too aggressive with their *EV Strategy* targets with not a long enough or realistic transition period which "disconnects municipal policy from practical application" (Participant A4). One participant commented:

> There's a whole psychological shift that also has to occur in our population before we get there… We got charging stations, yahoo, but we have to have the housing mentality, we have to have the social shift, we have to have all these other things in play before we get to those vehicles. (Participant A1).

Participants spoke of the social or cultural hesitation with EV adoption locally in Kamloops that is exacerbated by the short timelines with *EV Strategy* targets. It was noted that there can be local resistance to change, and people in North America have a "drive-in" attitude in which they expect to drive everywhere, therefore, expecting that to rapidly change is unreasonable and unrealistic (Participant A1, A4):

Unaffordability was also discussed by Participants through the discussion of increasing housing prices, inflation, etc., as an inhibitor for local EV adoption (Participant A1, Participant A4). Purchasing EVs (new vehicles in general), buying and installing charging infrastructure, and paying for electricity to charge the vehicles are all additional costs that consumers may not want to or be unable to pay for at this time (Participant A2). A final barrier discussed among participants was the negative environmental impact of the production of EVs. This includes mining for the minerals in EVs (lithium, cobalt, etc.) and water usage in the production, etc. (Participant A4, A1). One participant questioned how environmentally friendly EVs are due to the negative environmental impact of their production (Participant A1).

5.1.5 Community Groups and Associations

I asked Community groups several questions about their involvement with local EV uptake and their perceived barriers to EV uptake. Local community organizations worked with the City to implement *EV Strategy* targets and have their own agenda for promoting EVs (Participant C1, C2, C4, C5). I received varied responses on perceived barriers from each participant; however, all responses given matched the general barriers discussed by all participants and in the literature.

5.1.5.a Community Group Perceived Barriers

Community participants shared similar perceived barriers as other stakeholder groups including the issue with MURB charging, a lack of charging infrastructure, affordability and costs of EVs, and the difficulty of retrofitting older buildings with charging infrastructure (Participant C2, C3, C4, C5). Participant C1 discussed MURBs as a major barrier to community EV adoption and one they had personally dealt with. This participant had wanted to add charging stations to their apartment parking but had encountered resistance and apathy toward charging station installation with their strata council. Therefore, despite wanting to purchase an EV for environmental reasons, they chose not to as they did not have a place for overnight charging (Participant C1).

The lack of (convenient) charging infrastructure was shared as a barrier (Participant C3, C4, C5). Participants spoke of the lack of public charging opportunities around Kamloops, especially in the downtown corridor (Participant C3, C4, C5). Two Community interviews explained that driving an ICE vehicle is still more convenient (than an EV) due to the expansive network of gas stations throughout and around Kamloops (Participant C3, C4). Affordability was also discussed as a barrier for consumers. One participant spoke on the income differences between

Kamloops versus a high-income city like Vancouver or Victoria, therefore, until cost parity of vehicles is reached, EV adoption would most likely remain low in Kamloops (Participant C2, C4).

General range anxiety was brought forward as a barrier by Participants C2, C3, and C4, and the sprawl of Kamloops was considered a significant contributor to the range anxiety. The sprawl of Kamloops (requiring driving longer distances across town) and the lack of convenient charging opportunities in the city was discussed as a major inhibitor for residents potentially interested in purchasing EVs (Participant C2, C3, C4). Affordability was also discussed as a challenge for residents to purchase EVs (Participant C1, C2, C3, C4). Despite the ticket price of EVs decreasing, ICE vehicles are still cheaper, and residents feel more comfortable with gas vehicles and gas stations versus trusting a new and expensive technology (Participant C3).

Participants observed a general lack of awareness or knowledge of EVs; including the rebates or vehicle types available, where charging stations are, or charging station installation into homes (Participant C2, C3). This lack of awareness/knowledge was perceived as general hesitation or resistance to the new technology of EVs. One Community interviewee commented "people have a lot of FUD – fear, uncertainty, and doubt" (Participant C2). People are resistant to change and uncertain towards "any new development" (Participant C3). A provided example was the push-back from residents on EV-only parking as it was perceived locally by some residents that their parking spots were being removed from them (Participant C3). One participant commented:

> The adoption rate in town…it's a cultural trend that the City can push as hard as they want, but you need to have like the buy-in of so many industries and people. Like you can't just change a culture…you need a pretty good plan to get there. (Participant C3)

5.1.6 EV Charging Station Owners

I contacted all EV charging station owners or businesses/institutions with charging stations on their property in Kamloops using the app Charge Point. The majority of the participants I spoke with were employees of the business or worked within the institutions and could not provide accurate answers or details to the specifics of the charging stations as the charging stations were typically installed and maintained by a third-party operator. I asked EV Charging Station participants a variety of questions regarding their charging infrastructure including their initial interest in building charging infrastructure, why they choose the charging station company, whether they had seen any/significant usage from it, and if they were interested in obtaining more charging stations. EV Charging Station stakeholder group participants were not asked about their perceived barriers to EV adoption as they were interviewed solely to understand if local charging stations were being actively used.

When asked about the usage of their charging stations, few EV Charging Station participants had seen significant usage of their charging stations (Participants F1, F2, F3, F4, F5, F6, F7). The majority noted there has been consistent demand daily, albeit with few vehicles (Participants 1, F2, F3, F4, F5, F6, F7). One participant brought up an issue they had encountered with some local residents using their (the business') charging station clearly as their main source of charging and were charging their vehicles there for extensive periods of time (Participant F6). This participant was not charging electricity costs at the time and was getting frustrated with locals taking advantage of their charging station and free charging (Participant F6). The participant spoke to the residents charging there constantly and the matter was resolved (Participant F6). When asked about installing more charging stations, Charging Station participants were either unsure what the

company's plans were regarding future EV charging stations or were reluctant to purchase or install more charging stations until they see more demand from EV owners (Participant F1-F7).

5.2 Research Question 2: Solutions to Local EV Adoption

While all stakeholder groups provided a variety of barriers to local EV adoption, the majority of participants were unsure of solutions to overcome the barriers mentioned above. There was consensus among all stakeholder respondents that municipal policy will play a strong role in encouraging EV adoption locally. Public education campaigns were suggested as a good municipal tool to educate the public and dispel any myths about EVS (to reduce the lack of public awareness discussed in Section 5.2). As a lack of charging infrastructure was brought forward by all stakeholder groups, building a convenient charging network was deemed necessary for EV uptake. Finally, marketing hybrid vehicles as an alternative to full battery powered vehicles was provided by multiple different stakeholder groups. Each solution is discussed in greater detail in the below sections.

5.2.1 EV Policy

As this research centers around the City's *EV Strategy,* participants in all stakeholder groups (with the exception of the EV Charging Station group; see Section 5.2.6) were asked about their knowledge and opinion (critiques and/or recommendations) of the *Strategy* and its targets and the City's position on EV uptake. In this section, I review the suggestions and recommendations provided by interview participants. These include adjusting the City parking zoning bylaws, adopting policy on MURB charging station installation, advocating for adjustments to provincial and federal funding requirements (e.g., rebates and subsidies), diversifying emission reductions policies, and updating the *EV Strategy* to ensure an equitable EV transition.

5.2.1.a Zoning Bylaws and EV Charging

The initial zoning bylaw amendment by the City requiring all new developments to have EV-ready charging (all parking stalls in new developments to be pre-wired, with energized outlets, and have L2 charging stations already installed) was met with significant resistance from the building community (see Section 5.2.1.a) (City of Kamloops, 2020). This initial pushback resulted in the removal of that amendment, and the City of Kamloops' Committee of the Whole[14] recommended additional stakeholder engagement with the stakeholder groups who were vocally opposed and the City's Sustainability team to brainstorm a solution (Participant D7).

The Building and Business stakeholder group interviewees shared concerns about affordability (i.e., housing, cost of living) and off-loading costs onto consumers, and were resistant to requiring all parking spots to be EV-ready when there is little EV charging demand (Participants B3, B4, B5). While the Local Government and Institutions and Community Stakeholder groups were empathetic to the Building and Business stakeholder groups' reasonings, they (Local Government and Institutions and Community stakeholder groups) agreed that mandating EV-ready parking in new developments is necessary for increasing EV uptake locally (Participants D1, D2, D4, D9, C1, C5).

The Local Government and Institutions and Community stakeholder groups provided reasoning that requiring new developments to be EV-ready could reduce hesitancy in potential EV buyers as it would increase their access to EV charging. Additionally, one Community stakeholder group participant spoke of the assurance that all residents should have access to EV charging (if

[14] 'Committee of the Wholes' are a form of local government committees made up of all elected officials (councilors or directors, depending on the local government type). The purpose of these committees is to provide a space where all elected officials discuss a specific topic and bring recommendations back to official council or board meetings for a vote (City of Duncan, 2022).

they wanted it) and absorbing this cost now (at the time of build) significantly reduces the cost of installation on EV owners later (as cost of installing EV charging stations is substantially more post-construction) (Participant C5). This participant commented:

> Oh well, in the future, we should make sure that this is ready to… to "oh crap, how do we deal with it today, because people are at the front counter of the City Hall saying I bought a place, or I rented a place, and I can't get charging… and I have a right to charge. (Participant C5).

Installing charging stations at the time of build or having parking be EV-ready would reduce range anxiety and ensure charging opportunities while preventing higher costs to be offloaded to future EV owners with installing charging stations in existing buildings.

5.2.1.b Policy and MURB Charging

Respondents from the Community, Local Government and Institutions, Business, and Construction/Real Estate stakeholder groups suggested solutions to ease confusion with payment and electricity management among strata councils. Some participants in the Community and Local Government and Institutions suggested clearer policies from the City on MURB charging infrastructure so residents can approach their strata councils with a better understanding of the equitable installation of charging systems (Participants C2, C3, C5, D9). Local Government and Institutions and Community participants commented that an EV-ready policy for new developments also eases many difficulties with MURB EV charging (cost sharing of electrical usage, increasing electrical output, etc.) (Participants C2, C3, C5, D9).

5.2.1.c Attract Federal and Provincial Funding for EV Adoption

Interviewees within the Local Government and Institutions and Community stakeholder groups spoke of the limitations they faced to implement EV adoption initiatives (whether legal or

financial restricted). One Government participant commented on policy and City funding with retrofitting existing buildings and charging infrastructure:

> It is also considerably more difficult for local governments to influence those reductions in existing buildings because we do not have any regulatory tools to do that. (Participant D1)

Local governments in BC are governed by the *Local Government Act* and the *Community Charter*, (with the exception of the City of Vancouver). The *Local Government Act* and *Community Charter* outline the responsibilities, purposes, and authority of BC local governments. Local governments have a variety of responsibilities over land use (zoning), services (water, sewer, etc.), and protection of the natural environment, buildings, and structures among others (Community Charter, 2003; Local Government Act, 2015). While local governments (municipalities) can provide subsidies/grants to residents in their area for EV adoption etc., this legislature restricts certain subsidies – for example, a municipality cannot provide financial assistance to businesses (Community Charter, 2003; Local Government Act, 2015).

Participants in the Local Government and Institutions, Community, and Business stakeholder groups all suggested seeking federal and provincial funding for local EV adoption to support the building of local EV charging infrastructure, education campaigns, and the potential provision of subsidies for EV charging stations in existing buildings. Interviewees in the Business stakeholder group were the biggest supporters of provincial and federal funding to encourage EV uptake. Funding from these two levels of government could open additional opportunities for municipalities such as building charging stations, providing subsidies for the local building industry, and could help with the equity component of EV transitions (Participant A4, A2).

5.2.1.d. Provincial and Federal Subsidy Updates

Passenger Vehicle Dealership respondents suggested lifting the limits on federal and provincial subsidies to accommodate more vehicles. Federal and provincial subsidies on EVs are currently capped at a $55,000 MSRP. As discussed by the Passenger Vehicle Dealership stakeholder group (see Section 5.2.3), many EVs are currently priced beyond the $55,000 MSRP price cap. While municipalities cannot control the MSRPs of EVs or the provincial and federal subsidy amount, they can advocate to the province and the Canadian government to increase the price cap beyond the $55,000 to allow consumers to use the rebates for EVs above that price. This solution requires no funding from the municipality as it would be an advocacy effort from the City's Mayor, Council, and administrative staff. Advocacy could include letter writing to the province or speaking with their local Member of Parliament on this issue.

5.2.1.e. Municipal Government 'Top-up' Funding

'Top-up' subsidies towards building or adding charging infrastructure are being used by other municipalities and could increase access to charging and EV ownership in Kamloops (Participants D1, D9). Government participants commented that this funding could help reduce the unaffordability barrier as the funding covers some of the cost of charging station purchase and/or installation. For example, as retrofitting existing buildings is substantially more expensive than making buildings 'EV-ready' at development, providing a 'top-up' funding opportunity for residents or businesses to add charging infrastructure in existing buildings could increase the affordability of local EV adoption (Participant D9).

5.2.1.f Diversifying Emissions Reductions Policy

The City is focusing on reducing transportation emissions through promoting and encouraging local EV uptake. Participants in the Local Government and Institutions and Business

stakeholder groups suggested a diversification of emissions reduction policies to reduce transportation emissions (versus solely relying on one strategy) (Participant D1, A1, A2). The City acknowledged reducing local emissions will require a multi-pronged approach, and one participant from the Local Government and Institutions stakeholder group commented:

> Let's decarbonize the thing we're all crazy about in this community, which is cars and trucks, and then, at the same time, build out our active transportation in transit systems so that we can get people to shift into those even more sustainable options, even more, cost effective, affordable options. (Participant D1)

Diversifying emissions reduction policies might also reduce the total emissions produced in Kamloops. To diversify policies, participants from the Government and Business groups suggested adding policies on re-zoning to increase densification within Kamloops (Participant A1, A2, D1). Densification could reduce total driving times which would encourage EV adoption again through reduced range anxiety (Participant A1). Mixed zoning could also reduce driving times around the city as it mixes commercial and residential areas (versus driving to get groceries, etc. elsewhere) (Participant A2). The City recently granted a 10-year revitalization tax exemption for developers to develop a parking lot downtown with mixed zoning (residential on top with commercial zoning on the bottom) (Participant D8).

5.2.1.g Ensuring Equitable Policy

Participants from all stakeholder groups consider equity important in addressing EV adoption barriers and policies. They spoke of the higher costs of EVs being a main barrier to adoption. A participant from the Construction/Real estate group discussed how EVs are still viewed as luxury vehicles (Participant B4). One Local Government and Institutions participant acknowledged that while the City's focus on EVs may seem to target middle to high-income residents, prices are decreasing for EVs, and the City needs to be proactive on emissions reduction

policies (Participant D7). Creating policies that are equitable and not viewed as subsidizing the wealthy was discussed by interviewees from most stakeholder groups.

Some Local Government and Institutions participants discussed the difficulty of balancing the equity component and creating proficient climate change policies; for example, providing free parking for EV drivers is a financial incentive, but subsidizing EV ownership may reflect poorly among local residents if many residents perceive they cannot afford EVs (Participant D1, D2, D4, D6). A participant in the Community group suggested a fee be applied to EV owners similar to the annual charge of $150.00 to EV owners in Saskatchewan as a 'road-use charge' as EV drivers are not paying fuel taxes that go towards highway and road maintenance (Participant C3; see also Province of Saskatchewan, 2021).

5.2.2 Public Education Campaigns

Education is key to communicate and diffuse misconceptions about EVs and charging stations. When I asked all participants about their knowledge of EVs, the response was varied; some participants were passionate about EVs and were well-read on the vehicles and technology while others ranged from hesitant to apathetic with little to no knowledge. A minority of respondents owned EVs while others were interested or curious about EVs but had not purchased one – EV ownership was most predominant in the Local Government and Institutions and Community stakeholder groups, with one Construction/Real estate participant owning a PHEV. Many interviewees in the Passenger Vehicle Dealership stakeholder group had driven an EV, and some were currently driving an EV for work but did not own the vehicle. Other respondents in the Construction and Business groups were unaware of the technology or had older preconceptions of EVs (unreliability, short charge range, short battery life, etc.).

The City has held various public education campaigns such as co-hosting EV car shows, purchasing educational EVs (EVs with information on the vehicle), public information on the City of Kamloops website for EVs, and working with Plug-In BC (a Fraser Basin Council program to advance EV uptake in BC) for public education campaigns (Local Government and Institutions Participants; City of Kamloops, 2020; AES Engineering, 2020). Both the City and various community groups have held or participated in various education campaigns on EVs. 'Hot Nite in the City' is an annual car show in Kamloops that showcases various vehicles (Hot Nite in the City, n.d.). In 2017, community groups and the City created and supported the first 'Electric Avenue' addition of 'Hot Nite in the City' where EV owners can demonstrate their vehicles and the benefits of owning an EV. A small number of residents had been participating in the original car show with their EVs for a number of years prior to 2017 (Participant D1, C5, C2).

One participant in the Community stakeholder group who was involved with the organization of 'Electric Avenue' observed the first year had around 80 attendees, while the second show had approximately 400 people attending (Participant C2). There were few EVs in the car show initially but now there are around 20 EVs present (Participant C2). The City and community groups applied for various grants (mostly through provincial funding) to set up 'Electric Avenue'. Community groups contacted Kamloops passenger vehicle dealerships with EVs to participate in the show, and all participants that helped with 'Electric Avenue' noted "the demand and curiosity about EVs is huge" (Participant C2).

Public education campaigns could address the unaffordability barrier by explaining the potential savings of owning an EV, including savings from high gas prices and low maintenance costs. These campaigns could also educate the public on the resources, financial incentives, and subsidies available for potential EV owners. One participant observed:

> Many people are most likely not going to want to purchase EVs until they can see the financial incentive (gas savings, etc.) to do so. (Participant A1)

Another participant commented on the perceived high cost of EV ownership:

> You can do this quite cost-effectively relative to what a lot of people…assume it's going to cost, based on their limited knowledge of the sector, and once people learn how to do this, they tend not to be nearly as freaked out about it. (Participant D9)

When I asked participants in the Business and Passenger Vehicle Dealership stakeholder groups about their knowledge of subsidies or public support provided by governments (municipal, provincial, and federal) (e.g., a provincial program that offers a MURB consultant that works with MURB residents wanting to install charging stations in their buildings), many were unaware of these resources (Plug In BC, 2023).

5.2.3 Building Charging Infrastructure

A lack of charging infrastructure was discussed by all stakeholder groups as a major barrier to EV adoption. Most participants felt that residents drive longer distance due to the geographic location of Kamloops (distance from other urban centers) and the sprawl within the city. The longer driving distances and the current lack of charging infrastructure creates a notable feeling of 'range anxiety' among participants. Ensuring multiple fast charging opportunities along major high highway routes (Kamloops-Merritt, Kelowna, Vancouver, Calgary, etc.) was provided as a solution to address range anxiety by all stakeholder groups. Two respondents from the Local Government and Institutions and Community stakeholder group observed the large lineups in Hope, BC in the summer of 2021 as EV drivers waited to charge their vehicles (Participant D8, C2). Participants D8 and C2 spoke of this event as a clear indicator of why consumers hesitate to purchase EVs; fearing the added time and waiting for EV charging stations. Building more fast charging stations along major highway routes would hypothetically reduce wait times.

Building charging infrastructure (both publicly and privately run) throughout the city was a perceived general solution by all stakeholders. As mentioned previously, private companies have shown hesitancy to building new or additional charging infrastructure as they do not currently see a demand for it. To mediate that, a solution provided by Community, Local Government and Institutions, and Business groups was to have City build or support charging infrastructure that could bring more charging stations to Kamloops and encourage private investment in charging stations.

Business stakeholder group respondents were frustrated with the pressure to build EV charging stations in commercial parking as the City owns land and parking spaces downtown that they could (but are not) building charging stations at (Participant A1, A2, A4). As noted within the *EV Strategy* (which references the International Council on Clean Transportation, C40 Cities), the literature suggests initial public investment in charging infrastructure from governments to begin a charging network and then supplement it with private investment (AES Engineering, 2020). If the private sector is solely relied upon to provide charging infrastructure, it is likely initial infrastructure will be underbuilt, contributing to a slower EV adoption rate (AES Engineering, 2020). Some City respondents were supportive of a collaboration between the City and an EV charging station provider like Flow or ChargePoint. The Kamloops municipal government has opportunities to provide city-owned land for EV charging infrastructure. A Local Government and Institutions participant spoke of the role cities can play as owners of large amounts of land to invest in public charging infrastructure:

> It's not like, especially right now, the markets are just going to take care of it; there is value for additional sort of investment in that space by local governments. (Participant D9)

One Local Government and Institutions participant suggested a collaboration between the City and a charging station provider to reduce the resources required by the City:

> We may need to find a way for more strategically placed City supported EV charging infrastructure...Likely in a sort of a public/private partnership, where the City will provide the land, and the space and then we'll likely work with a service provider like Charge Point or Flow or something like that to run the system, provide the maintenance…so it's a little hands off. (Participant D1)

Building additional charging infrastructure in Kamloops would not only encourage potential new EV buyers but also increase the equitability of EV transitions as it could reduce the importance of home charging (if EV owners did not have access to home charging).

5.2.4 BEV Alternatives - Hybrids

Many participants spoke about BEVs themselves as a barrier to EV adoption. Passenger Vehicle Dealerships discussed the lack of BEVs available to match local consumer preference (for larger vehicles such as SUVs and trucks), perceived low range, and a lack of affordable vehicles as barriers to adoption. Vehicle manufacturers of EVs are increasingly producing larger EV options to fulfill consumer demand for EV SUVs/trucks (e.g., electric Ford F-150, electric Hummer). The range of EVS of all sizes has been growing with innovations in technology.

Participants in the Passenger Vehicle Dealerships and Community stakeholder groups suggested hybrid vehicles as a logical local solution for EV adoption.

> (Hybrids) might be a better solution for Kamloops because of the gas motor back up – Kamloops is rurally located and spread out, so people may have peace of mind with not relying solely on electric motors. (Participant C1)

Hybrids could reduce range anxiety as EV drivers would still have access to a fossil fuel-powered ICE. Hybrids provide an 'easing-in' opportunity for consumers who are hesitant to purchase what is perceived to be new or 'unreliable' technology. As part of a diversified campaign

on emissions reduction, the municipal government could encourage EV adoption through prioritizing education on hybrid vehicles as well as EVs.

5.3 Concluding Thoughts

My research identifies significant challenges to EV adoption in communities like Kamloops. The local lack of knowledge of EVs and the preferred use of large vehicles (e.g., SUVs and trucks) combined with the terrain of the city and its location relative to other destinations underscores the slow EV uptake in Kamloops. The need for more public education campaigns is reflected in the fact that many interview participants could list barriers to local EV uptake but could not provide solutions. The generally perceived barriers by participants (range anxiety, lack of charging stations, cost, etc.) matched EV uptake literature, but the amount of misinformation and lack of knowledge and/or awareness of EVs exceeded my initial presuppositions. The City of Kamloops should prioritize public education campaigns to dispel the myths discussed by many of my participants and increase EV awareness. Building charging infrastructure is also a key solution provided by both the EV literature and my interview participants that will encourage EV uptake and reduce range anxiety.

Chapter Six – Discussion and Conclusion

My research assessed local barriers to EV adoption in the City of Kamloops and provided municipal policy solutions to address these perceived barriers. The purpose was to assess the City's *EV Strategy*, the EV literature, evaluate local perceived barriers to local EV adoption, and provide policy suggestions for the City of Kamloops to overcome said barriers. In this chapter, I discuss my research findings in relation to my research questions and provide policy recommendations on encouraging local EV uptake. As this research focuses on municipal policies, certain barriers and solutions provided by participants (battery technology, EV manufacturing) are not discussed as municipalities have little to no control over the outcome.

6.1 Barriers and Solutions to EV Adoption in Kamloops

According to my research, the barriers to local EV adoption in Kamloops are: unaffordability (purchasing EVs and charging stations is still expensive with a limited used vehicle market at this time), range anxiety and lack of charging networks, MURB charging, and social barriers (i.e. resistance to change, new technology, vehicle preference, etc.). The overall awareness of EVs was low among participants across the stakeholder groups (except for the Community and Local Government and Institutions stakeholder groups). Participants spoke of a of general low interest in EVs in the community as the vehicles were deemed expensive and not fitting to the topography, climate, or many residents' lifestyles or jobs.

6.1.1 Kamloops Psychological and/or Social Barriers

The perception of Kamloops from participants is the community is culturally 'rural' (implying low-environmental awareness), has a personal preference for large vehicles (trucks and SUVs), and a generally low interest in EVs. While 'rural' is traditionally associated with

remoteness, an agriculture-based economy, and lower population densities, participants considered Kamloops to be culturally 'rural'. Culturally 'rural' was defined as a perceived hesitancy to change, slower environmentalism (i.e., not prioritizing reducing emissions or living environmentally consciously), lack of building or population density, and a significant 'blue collar' workforce (Participants D3, D5, E5). Participants D3, D5, and E5 attributed the 'blue collar' workforce[15] as one of the main barriers to EV adoption due to perceived associations of distrust or resistance to new technology and a preference for ICE larger vehicles (i.e., trucks).

Multiple participants in the Business, Local Government and Institutions, Community, and Passenger Vehicle Dealerships stakeholder groups observed a trend towards larger vehicles and trucks as the social norm in Kamloops (Participants A1, D9, E9, D8, D6, D5, C3, A4, E2, E5, D7). The reasons provided included lifestyle, occupation, and general aesthetics. (Participants E2, E5, E7). Lifestyle is noted as a perceived barrier in the EV literature as potential EV buyers assume EVs cannot fit with their lifestyle due to limited models (smaller vehicles etc.), limited range, etc. (Rezvani, Jansson & Bodin, 2015).

6.1.1.a Equity and Municipal EV Policy

The equity component of municipal policy is a significant factor in EV adoption. EV adoption is still primarily occurring within the mid- to high-income ranges (Hardman, Fleming, Khare & Ramadan, 2021). Some EV policy tools to encourage uptake (i.e., subsidizing or providing incentive) are perceived as subsidizing the wealthy (Participant C3). For example, the multiple free EV charging stations across the city raise perceived unfairness: "The theme you hear often from EV versus non-EV [drivers]'Oh, well must be nice to get a free fill up when I have to

[15] The core drivers of Kamloops' economy are forestry, mining, retail, and agriculture according to Venture Kamloops, the City of Kamloops' economic development organization (Venture Kamloops, 2023).

pay $1.55 for gas'" (Participant C3). This participant noted the financial impacts of Covid-19 and other affordability issues (e.g., inflation) have caused concern and potential financial insecurity of residents (Participant C3).

Participant A4 felt that the City was focusing 'too much' on EV adoption as a strategy versus other ways to reduce driving emissions (as an alternative, they provided an example of a car-sharing service). This participant noted the emission reduction strategy of EVs require consumers to purchase new, more expensive vehicles and charging stations, thus putting a financial burden on residents (Participant A4). The City is aware of the equity issues with EV transition policies and are reluctant to impose use-based policies (e.g., free parking). As per City Council's recommendations, the City spent time engaging with the public on how to approach and encourage EV adoption (Participant D6). Suggestions include amending the building code and zoning bylaws to target new developments and encourage the building of EV charging stations as an equitable policy for EV adoption (Participant D5, D8).

Several participants from the Local Government and Institutions and Business stakeholder groups discussed the social issues facing Kamloops and the difficulty in encouraging EV adoption when City Council must spend a significant amount of time addressing social challenges within the community (Participant D2, D4, D7, A1, A4). The participants within the Local Government and Institutions stakeholder group noted the City must balance the current public safety and social issues with climate change and emission reduction policies (D2, D4, D7).

6.1.2 Range Anxiety and EV Charging Infrastructure

Maybury, Corcoran, and Cipcigan (2022) describe range anxiety as both a technological and psychological barrier: there may be an actual lack of charging infrastructure, but also potential EV buyers may be unwilling to include the time to charge and multiple stops as they drive longer

distances. The sprawl and lack of density in Kamloops were considered by all participants to be furthering the problem of range anxiety. The city continues to be built outwards and sprawls within its' boundary of almost 300 square kilometers (see Section 3.1.2) (Statistics Canada, 2021). Out of the eight neighborhoods assessed in the *Community Climate Action Plan*, two were categorized as having 'high walkability' while the others had 'moderate to low' walkability due to sprawl and a lack of local amenities (City of Kamloops, 2021). The main method of transportation in Kamloops is personal vehicles (88%) (as of 2017) (City of Kamloops, 2021). This adds to the difficulty of building convenient public charging infrastructure (Participant A1, A2, C3, D1; see also Baatar, Heckmann, Jarvis & Sakhiya, 2019).

One Local Government and Institutions interviewee believed that residents in Kamloops drive longer distances than residents in the Lower Mainland (as Kamloops drivers must drive longer distances both across the city and to go to other areas). Participant D4 also commented that other cities, such as Kelowna or Vancouver, are around two to four hours away (around 170-400km depending on the route). Other participants spoke on the uncertainty of trusting an EV to get them where they wanted to go due to these longer driving distances in and around Kamloops.

6.1.2.a EV Charging Infrastructure

Most of the charging infrastructure in Kamloops is located west of downtown and when looking at the phone app Plugshare, an app that displays all charging stations on a map, few (1-2) charging stations appear along the highways going to the surrounding cities (to Merritt, Vernon, Kelowna, Cache Creek, Salmon Arm) (accessed February 2, 2023). Access to convenient forms of charging increases the flexibility of EV ownership and can reduce range anxiety (see Section 2.5.2a) (Csonka, Havas, Csaba & Földes, 2020). Participant C3 observed the convenience in the number of gas stations in and around Kamloops and to achieve mass EV uptake, the EV charging

system network must provide close to, if not that level of, convenient ‘re-fueling’ opportunities. The majority of Kamloops’ charging stations are on private property (businesses, car dealerships, hotels) with some public charging stations (Tourism Kamloops, Kamloops Airport, Kamloops Courthouse) (PlugShare, accessed October 31, 2022).

6.1.2.b MURB Retrofitting

Single-family homes are currently the number one dwelling type in Kamloops, but MURB construction is anticipated to increase with the growth of the population of Kamloops (AES Engineering, 2020). Installation of EV charging in single-family homes is typically easier and less expensive than MURB charging installation (see Section 2.5.2a) (Lopez-Behar, Tran, Froese, Mayaud, Herrera & Merida, 2019a). The City anticipates that MURBs (defined as “medium to high-density multi-family housing (e.g. apartments and condos))” will make up 46% of local housing by 2039 (AES Engineering, 2020, p.9). Currently, MURBs are a minority of the housing stock, yet with the anticipated transition to higher density housing in Kamloops, many participants in the Community and Local Government and Institutions stakeholder groups deem MURB installation of charging infrastructure to be a current and/or future barrier to local EV adoption (Participant A1, A2, C3, D1). Some participants in the Community and Local Government and Institutions stakeholder groups personally faced issues with EVs and charging in MURBs. These included resistance from other residents regarding electrical payment and EV spots (as they are limited) selling out immediately at the time of sale (Participant C1, C5, D1).

6.1.3 Affordability Barriers

EVs have not reached cost parity with ICE vehicles, and there is a limited (but growing) used EV market (Torkey & Abdelgawad, 2022). For example, Autotrader.ca had 237 vehicles available within a 100km radius of downtown Kamloops as of October 27, 2022. Out of the 237

vehicles available, only three were ZEV (Autotrader, n.d., accessed on October 27, 2022). Another website, Kijiji had 1,185 used vehicles available of which 21 were EVs (from both passenger vehicle dealerships and privately advertised) (Kijiji, n.d., accessed on October 27, 2022). The costs of EV transitions, including purchasing the vehicle and installing EV chargers, were consistently noted as one of the main barriers in all stakeholder groups. A BC Hydro survey reported 56% of BC residents think EVs are still too expensive despite EVs dropping in price (Adoba & Dioha, 2021). The City is limited in their capacity to reduce the purchase price barrier due to funding restrictions to the *EV Strategy* (and the Council's current unwillingness to allocate funds to EV transitions due to other priorities).

6.2 Suggested Policy Solutions to Barriers

Based on this research, I provide recommendations for the City of Kamloops to help overcome the stated barriers in the literature and by participants. The suggested solutions require little or no funding from the City and are taken from both the literature and suggestions from participants. While supporting EV adoption, the City should also look at additional alternate policy solutions to substantially reduce transportation emissions in Kamloops. The sprawl of the city, preference for large vehicles, uncertainty, disinterest, or lack of knowledge of EVs are all significant barriers that ensure EV uptake in Kamloops will be slow.

6.2.1 Public Education Campaigns

The lack of general knowledge, hesitation, or resistance to EVs will need to be addressed and prioritized by the City to expedite EV uptake. Public education campaigns can reduce hesitancy around new technology, range anxiety, and resistance to change (Haddadian, Khodayar & Shahidehpour, 2015). The City should investigate partnering further with local climate change non-profit organizations and other institutions to ensure education is reaching all potential public

outlets and residents and to share capacity, costs, and resources when providing educational EV campaigns. The City previously partnered with different community groups to promote EV adoption (see section 5.3.2) but due to the high rate of uncertainty or lack of knowledge on EVs, the public education campaigns on EV adoption should continue.

The EV literature suggests a lack of knowledge of EVs as a barrier to widescale EV adoption; therefore, public education campaigns can increase EV awareness among potential consumers and reduce misconceptions (Haddadian, Khodayar & Shahidehpour, 2015). Participants in all stakeholder groups discussed the lack of knowledge or hesitancy to new technology as a major barrier to local EV adoption and suggested more public education campaigns on the benefits of EVs (e.g., cost benefits of not paying for fuel, reduced emissions, high torque, etc.) (Participant C2, C3, C5, D1, D3, D6).

The City produces public education resources for the community on EV uptake; the City's website 'Our Community' page (from their 'Environment and Sustainability page) provides general knowledge of EVs including the types of EVs available, benefits (fuel and maintenance savings, environmental, etc.), as well as general information on EV charging (where to find charging stations, resources for strata members on installing EV charging in MURBs, etc.) (City of Kamloops, 2022). The City worked with Emotive BC, Plug-In BC, and a local resident to create a video of 'Driving an Electric Vehicle' in Kamloops in 2022 to showcase EV ownership within Kamloops (City of Kamloops, 2022). This public education work should continue and resources should be deployed to further this work on updating all residents on the benefits of EVs and dispelling any myths or misconceptions. The City prioritized public education campaigns (both for the benefits of EVs themselves and for rebates available) as part of their EV adoption strategy. After speaking with City employees as well as exploring the EV page on the City of Kamloops

website, it appears the City is actively promoting EV benefits. However, they should increase this campaign to reach all residents (City of Kamloops, 2022).

6.2.2 City Fleet

City fleet ownership can raise daily public awareness as people can see EVs used locally. This can reduce the 'chicken before the egg' issue by having potential EV charging station owners visually see a demand for charging infrastructure and increase the building of charging infrastructure (Egnér & Trosvik, 2018; O'Neill, Moore, Kelleher & Breteton, 2019). I recommend adding the promotion of corporate or city fleets to the City's public education campaign and to expedite their public procurement of EVs. Studies show that public education and EV publicity can increase potential consumers' perception of EVs positively through indirect experience and exposure (Liu, Ding, Jiang, Sun, Jiang & Qiang, 2020). There can typically be a social hesitancy to new technology. However, educational campaigns and marketing of EVs can reduce resistance (Driscoll, Lyons, Mariuzzo & Tol, 2013). If residents and travelers see an increase of EVs on the road, they can be reassured about charging opportunities, and it may incentivize the building of charging stations. Transitioning to an EV fleet should be prioritized as an internal policy for the City.

6.2.2 Building Charging Infrastructure

The City should prioritize building, or the promotion of building, charging infrastructure for EV adoption. The lack of charging stations is discussed in both the literature and by participants in all stakeholder groups as one of the main perceived barriers to EV adoption (Haddadian, Khodayar, Shahidehpour, 2015; Palencia, Otsuka, Araki & Shiga, 2017). Participants within the Community, Real Estate, and Business stakeholder groups mentioned that it appears residents are waiting for more charging stations to be developed or installed, yet businesses or landowners are

waiting for more EVs on the road to warrant a demand for more charging stations. Multiple participants across all stakeholder groups commented on the lack of charging infrastructure in Kamloops, specifically downtown.

The City owns a significant amount of land both in downtown Kamloops and around the city. One participant from the Local Government and Institutions stakeholder group suggested a collaboration between the City and a charging station operator, "a public/private partnership" (Participant D1). The City could work with a charge station operator to build charging infrastructure on City-owned land, and the charging station operator would take the revenue and maintain the units throughout its lifecycle (Participant D1). The City already installed charging infrastructure at public locations – the Airport, Courthouse, and Tourism Kamloops, through a third-party charging station operator (Participant C3, Participant D8).

I recommend that the City supply local government-owned land to EV charging station operators. Participants in the EV Charging Station group noted that they (the businesses, etc.) do not have to conduct any maintenance on the machines or to "deal with the charger(s) at all" as the operators perform maintenance on the charging stations (Participants F2, F3, F4, F5, F6, F7). One participant observed there were issues with this as some stations were abandoned by operators if they were deemed too old or their maintenance issues too significant to fix (Participant F6).

6.2.3 Urban Planning: Densification

One of the strongest suggestions I can provide for decreasing passenger vehicle emissions and increasing EV uptake is prioritizing the densification of Kamloops. Despite stating to "support urban densification" in the City of Kamloops' *Official Community Plan* (KAMPLAN), the city continues to be developed outwardly with a reliance on personal vehicles for travel (City of Kamloops, 2018, p. 60). A participant in the Business stakeholder group shared their frustration at

the City consistently approving permits for the construction of low-density, large units that sustain the reliance on private vehicles for transportation (Participant A1). The majority of Kamloops residents live in single-family-style homes, and there is a low population and housing density (AES Engineering, 2020). The Province of British Columbia introduced legislation, Bill 44, to streamline the construction of homes, infrastructure, and services and encourage the densification of communities (British Columbia, 2023c). Bill 44 requires local governments (of populations of more than 5,000) to update their zoning bylaws and Official Community Plans to encourage densification (e.g., increasing multi-unit buildings versus approving single-use lots), and to submit 'Housing Needs Reports' outlining 20 year housing needs for the community (Canadian Home Builders' Association: British Columbia, 2023).

To be in compliant with Bill 44, the City will need to reevaluate their zoning bylaws and create a densification policy to have minimum requirements for all large-scale development projects. This can include densifying housing (ensuring multi-unit projects are efficiently utilizing space - for example, creating apartments (vertical density) versus townhouses (horizontal density), requiring mixed zoning for large-scale projects (increasing walkability to schools, work, and commercial areas; reducing the need to drive), and reducing the approval of large home developments.

Encouraging densification through City zoning and planning could ease the barrier discussed by participants of where to install convenient public charging infrastructure. It could also reduce range anxiety – creating more mixed-zone neighborhoods could reduce the necessity to drive longer distances across the city for goods and services. As Kamloops is quite spread out, there is a question of where to build charging infrastructure. The EV literature suggests building charging stations by tourist attractions, commercially dense areas, areas of high EV ownership,

and areas with high population density. Having charging stations by tourist attractions and commercially dense areas gives drivers an activity to do while charging (i.e., shopping, etc.), while installing charging stations in areas of high EV ownership and population density increases EV charging demand (Maia, Teicher & Meyboom, 2015).

6.3 Future Research Opportunities

While my research provides some solutions to the issues of EV adoption, there are further research opportunities to explore. This includes further research into equity and environmental transitions, EV uptake and barriers in regional hubs versus metropolitan centers, the sufficiency of the electricity supply, other transportation emission reduction policies, and EV manufacturing and raw material supplies. There has been some research done to address the equity debate associated with climate change policies; however, more research on how to increase equity in EV adoption policy and subsidies could be done. Within the EV sector, as price is one of the largest barriers of EV adoption, researching a multi-pronged approach of a mix of transmission reduction policies (e.g., taxing vehicle weight on ICE vehicles to encourage the manufacturing of smaller and more efficient vehicles, building additional public transportation options) with encouraging EV uptake will be key for creating future equitable climate change reduction policies. It would also be interesting to see future research on the demographics of EV ownership as EV uptake increases. For example, conducting research using surveys on EV ownership and gender, time spent living in the area, professions, experience/interest with EVs, and level of environmentalism.

As mentioned, the majority of EV research is based on urban centers with some focus on rural areas. Cities that serve as regional centers, especially those that are farther from other metropolitan centers, have not been addressed. These regional centers that have significant distance between them will be necessary to study as key areas to build up charging infrastructure,

especially along major travel routes. Assessing the social components of EV adoption in these areas could also be key in understanding resistance to EVs – while the majority of Canadians live within major cities, many of the smaller cities outside of these densely populated areas share similarities with Kamloops.

Many participants discussed the concern about the electrical supply and the capacity of BC Hydro to meet demand if a full EV transition occurs. Research on this seems inconclusive as results seem to vary with BC Hydro reports and academic studies. As the government continues to pressure EV adoption rate increases, this will need to be addressed. It would also be interesting to see more research about other emissions reduction policies within a Canadian context. This could include low-emissions zones in cities, where there are no or limited vehicles allowed in those areas, and how that would impact transportation emissions even in smaller cities like Kamloops. Low-emission zones are being used in other cities around the world; however, these have not been put in place in Canada.

Finally, there is a need to assess the negative manufacturing and production concerns regarding EVs. Many participants in all stakeholder groups discussed their concerns with mining for minerals used in EVs. Additionally, there have been articles released in media outfits such as the Globe and Mail regarding cooper mining production being able to meet EV demand. These were discussed as environmentally concerning to many participants, both from the damage from increased mining activity and the potential lack of raw materials to make EVs. Additional research on social barriers to EV adoption regarding EV mining and production as well as mineral resources available could reduce consumer hesitancy towards EV purchases.

The barriers and solutions from my research will be summarized and sent back to all participants from my key informant interviews I conducted. The summary and notes will be available for any local government/interested individual should they inquire about EV barriers and solutions for regional hubs and non-metropolitan centres. I hope this research provides clarity and a better understanding on for municipal governments EV transitions in regional hubs and non-metropolitan centers, both on the barriers for local EV adoption and solutions to help overcome them.

6.4 Closing Thoughts

In closing, despite the government promotion of EVs, the lack of EV familiarization, knowledge of EVs and their benefits, and uncertainty of EV technology are considerable barriers to EV adoption in Kamloops. The preference for large, inefficient (high fossil fuel consuming) vehicles will persist in hindering EV adoption due to the deficit of EVs available to match the local consumer preference. The lack of charging infrastructure, locally and in the surrounding area, will maintain the perceived range anxiety of potential EV drivers. Kamloops is built on sprawl and continues to develop outwardly, sustaining the reliance on personal vehicles as the main source of transportation. The sprawl and lack of mixed zoning areas add complication as to where to build charging units that are convenient and easily accessible.

A rapid reduction of emissions from private vehicle transportation in Kamloops will not be from EV uptake. The local hesitancy and the reluctance to transition to EVs are too strong to ensure a fast EV uptake substantial enough to rapidly reduce emissions. However, EV adoption must remain a policy priority with the City of Kamloops as EVs transitions, albeit slow, will continue to reduce transportation emissions. PHEVS should be prioritized as a solution for residents who are concerned or unsure of EVs and promoted by the City through engagement and education

campaigns. Building charging infrastructure through third-party partnerships or encouraging the building of charging stations will increase EV ownership as it will visually reduce range anxiety by seeing the charging stations around the city.

I recommend the City approaches emissions reduction with a multi-pronged approach and not focus only on EVs as the main method for emissions reduction of transportation. My research conveys that the social barriers (e.g., hesitancy to new technologies, preference for ICE/larger vehicles, hesitancy to change, equity concerns), the cost of EVs, and the lack of charging infrastructure in Kamloops will continue to prohibit fast or consistent EV uptake in Kamloops. The preference for larger, less efficient vehicles was discussed as a significant common theme among participants. Even if EVs begin to match consumer demand of larger vehicles, large EVs will not be energy efficient, and the growth of range will always be prohibited with the requirement of producing larger vehicles to meet demand. Engaging with the community to try and change the culture around vehicles (e.g., preference for large vehicles) through public education campaigns will also be necessary to reduce local transpiration emissions and change the preference for vehicles to smaller, more efficient vehicles. The City must diversify their transportation emissions reductions program outside of EVs (they are not affordable options for many residents) to ensure equitable sustainable policy.

The strongest recommendation I can provide to the City of Kamloops is the necessity to re-evaluate their zoning bylaws for development. Zoning bylaws should be amended to prioritize mixed zoning and high-density housing projects. High density and mixed zoning bylaws have the potential to reduce emissions through increasing walkability (mixed zoning implies having shops, schools, housing, etc. in the same area), providing clarity on where to build convenient charging stations (ideally in areas of high vehicle traffic, high population density, and with activities to do

by the charging stations (e.g., coffee shops, grocery stores, tourism attractions)), and reduces driving time, therefore, reducing range anxiety. It also has the added benefit of creating efficient public transportation routes as busses etc. can go from one dense area to another. The development of Kamloops must move away from the 'large homes on large lots' development path.

The City of Kamloops created the *EV Strategy* to encourage local EV uptake and reduce transportation emissions. Through my research, the community response is too slow to produce the reduction of emissions needed to slow climate change. Public engagement campaigns should be continued to dispel local myths on EVs, charging infrastructure ought to be built to reduce range anxiety, but changing the zoning bylaws to require higher density and mixed zoning must occur to reduce emissions from current ICE vehicles, create convenient charging locations, and reduce driving times.

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Appendix A: Research Ethics Board Letter of Approval

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

RESEARCH ETHICS BOARD

MEMORANDUM

To: Erin Nevison
CC: Greg Halseth

From: Davina Banner-Lukaris, Chair
Research Ethics Board

Date: July 27, 2021

Re: **E2021.0522.022.00**
Policy and Energy Transitions: Barriers to the electrification of Passenger Vehicles in the City of Kamloops

Thank you for submitting revisions to the Research Ethics Board (REB) regarding the above-noted proposal. Your revisions have been approved.

We are pleased to issue approval for the above named study for a period of 12 months from the date of this letter. Continuation beyond that date will require further review and renewal of REB approval. Any changes or amendments to the protocol or consent form must be approved by the REB.

During the COVID-19 pandemic, no *in-person* interactions with participants are permitted without an approved Safe Research Plan and the protocol mitigations for COVID-19 being submitted as an amendment and approved by the REB. Please refer to the Chair Bulletins found on the REB webpage for further details. If questions remain, please do not hesitate to email reb@unbc.ca.

Good luck with your research.

Sincerely,

Dr. Davina Banner-Lukaris
Chair, Research Ethics Board

3333 University Way, Prince George, BC, V2N 4Z9, Telephone (250) 960-6735

Appendix B: Stakeholder Interview Consent Form

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

CONSENT FORM

Policy and Energy Transitions: Assessing Passenger Vehicle Electrification in the City of Kamloops

Researcher:

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Supervisor:

Dr. Greg Halseth
Natural Resources and Environmental Studies (Geography)
University of Northern British Columbia
Tel: (250)-262-1423 email: greg.halseth@unbc.ca

Purpose:

Passenger vehicle transportation is a significant greenhouse gas (GHG) emitter within British Columbia. To decrease these emissions, the provincial government created the *Zero-Emission Vehicle (ZEV) Act* – requiring 90% of new passenger vehicles sold within the province to be zero-emission (hybrid or fully battery powered) by 2035. Municipalities, such as the City of Kamloops, have created an *Electric Vehicle (EV) Strategy* to increase EV adoption in their community. However, perceived barriers exist that may impede EV uptake including high purchase price of EVs, lack of charging infrastructure, model availability, and charge range.

There are two research objectives with this research project: (1) Assess barriers identified within the City of Kamloops' *EV Strategy,* and any additional challenges that may impede EV adoption within the city; and (2) Create policy recommendations to overcome these barriers, both for the City of Kamloops, and for other municipalities that do not have an EV Strategy. This research project is the thesis research for graduate student Erin Nevison, the main researcher on this project. The thesis will be published at the conclusion of this research as a public document.

How Respondents Were Chosen:

All participants were selected due to their potential knowledge about and connection to electric vehicle transitions (EVs, EV charging infrastructure, EV policies, etc.). Municipal government employees were

contacted through the City of Kamloops website, and were selected based on their potential relationship with EV transitions and the City of Kamloops *EV Strategy*. Stakeholder groups that are impacted by EV transitions were contacted via publicly available lists. Stakeholder groups have been selected instead of contacting individual residents or businesses to reduce the number of interviews required to complete this project.

Anonymity and Confidentiality:

Names and information to identify participants will not be used in any final report, and measures will be taken to reduce chances to identify participants within the research. All information gained or shared within these interviews will be held in strict confidentiality by the researcher. All information relating to the research and interviews will be kept in a locked room, and will only be accessible by the researcher. The main researcher on this project is Erin Nevison, a Masters of Natural Resources and Environmental Studies candidate at UNBC, and this is her Master's thesis research. Her supervisor professor is Dr. Greg Halseth (UNBC). The information gained from the interviews will be kept until the final project is complete, upon which this information will be destroyed.

Potential Risks and Benefits:

This research project has been assessed and approved by the UNBC Research Ethics Board. This project has been deemed low risk as the researcher does not consider there to be risks to participants. Participation in this study can provide potential benefits such as gaining knowledge about EVs and EV transitions, and providing EV transitions policy recommendations to the City.

Voluntary Participation:

Interview participation is voluntary, and participants may choose to stop the interview at any time, and/or not answer interview questions. If an interviewee is uncomfortable with the interview and/or any publication of information shared within the interview, that information will be withdrawn from the study and destroyed. A summary of the interview will be sent to interviewees, and they will have a chance to edit, remove or add any information within a two-week period (more time may be allocated if needed). If notes are not returned within the agreed due date, the original interview notes will be used. The interviews will take between 30 minutes to an hour to complete.

Research Results:

If you have any questions about this research, or would like to contact the researcher on this project, please contact Erin Nevison (778-267-0720; nevison@unbc.ca) at UNBC. A final project report will be distributed to all participants.

Complaints:

If there are any complaints about this project, please direct them to the Office of Research at UNBC (250-960-6735 or email: reb@unbc.ca).

CONSENT:

I have read or been described the information presented in the information letter about the project.
YES NO
I have had the opportunity to ask questions about my involvement in this project and to receive additional details I requested.
YES NO

I understand that if I agree to participate in this project, I may withdraw from the project at any time up until the report completion, with no consequences of any kind.

YES NO

I have been given a copy of this form.

YES NO

I agree to be recorded.

YES NO

Follow-up information (e.g. transcription) can be sent to me at the following email or mailing address (*if applicable*):

YES NO _____

I have read the research project description above, and I understand the conditions of my participation. My signature indicates my participation in this study.

_____ _____

Printed Name Signature

Date (Day/Month/Year) _____

Appendix C: General Interview Guide:

Policy and Energy Transitions: Barriers to the electrification of passenger vehicles in the City of Kamloops

Interview Guide

Participant name: _____

Contact information: _____
_____
_____

Interviewer: _____

Date: _____

Interview Time: Start _____ Finish_____

NOTES:

_____

A. Background Questions

_____

1. Can you describe your position, and your connection to EV transitions?
   Prompts: how long have you been at the firm, working in that position
   What do you know about the City's *EV Strategy?*
   Prompts: Targets set by municipality
2. Have you seen more EVs or charging stations around Kamloops in the past five years?
   a. Have you noticed any reaction about the community to EVs? (indifference, excitement, resentment, dislike)

_____

Stakeholder Background Questions:

1. Can you describe your position, and your connection to EV transitions?
   Prompts: how long have you been at the firm, working in that position

If they have charging stations:

2. Do you have a charging station?
   a. Why did you choose to install a charging station?
   b. Was there significant cost to you?
   c. Would you encourage other businesses to add one if they asked you?

d. Have you seen much use from it?
e. Would you consider getting another one?
f. Is it for customers only?

3. How did you choose which charging company to go through?
4. What do you know about the City of Kamloops' *EV Strategy*?
   Prompts: Amend By-law to require EV parking in commercial/industrial spaces, potentially requiring businesses to put in EV charging spaces
5. Were you involved in the making of the *Strategy*? Do you feel you had any input? If not, what input could or would you have added into that process?
   Prompt: Attended any of the seminars, community engagement sessions, workshop
6. How has this strategy affected your group? Will it affect your group?
   Prompt: potentially adding/feeling pressured to add charging infrastructure, change in capital/operational costs, any help from the municipality?

Section 1: Businesses

1. Within the strategy, there has been discussion to encourage 10% of parking to be EV friendly, has the City approached you regarding this?
   Prompts: installed charging infrastructure, contacted the City regarding financing, applied for provincial funding

2. Have you had any interest or seen a need for implementing charging infrastructure?
   Prompts: What would incentivize you to add a charging station, why would you not want to?

3. Has there been any investment or discussion of investments with EV infrastructure charging with your association or local businesses?
   Prompts: Any discussion about adding infrastructure at meetings, reaction to that.

4. Were you involved in the making of the *Strategy*? Do you feel you had any input? If not, what input could or would you have added into that process?

5. What are your thoughts on electric vehicle transitions and the plausibility of passenger vehicles transitioning to EVs in Kamloops?
   Prompts: fitting with lifestyle, vehicle preference, other impacts of EVs

6. How has this strategy affected your group? Will it affect your group?

7. What are your thoughts on electric vehicle transitions and the plausibility of passenger vehicles transitioning to EVs in Kamloops?

8. What do you think are the barriers to EV adoption in Kamloops?

9. What would you suggest to overcome these barriers?

Passenger Vehicle Dealerships:

1. What is your position at the dealership and connection with EVs?
2. Do you currently have any EV's available in stock at your dealership?
   Prompt: are you anticipated to get any?

3. When did you get the EVs in stock? Has there been much interest/have you sold many?
4. Has there been any or growing consumer interest in EVs (PHEVs or fully battery powered vehicles)?
5. Do you have maintenance capacity at your dealership?
6. Is it difficult to obtain any EVs (BEVs or PHEVs) for your dealership to meet demand due to supply difficulties?
7. Do you help EV owners with charging installation?
8. Have you noticed any trends with vehicle sales over the last five to 10 years?
9. What is your number one selling vehicle?
10. What are some issues you perceive or anticipate will be barriers with EV adoption in Kamloops?
11. What would you suggest to overcome these barriers?
12. What percentage of vehicle sales are EVs at this point in time? Do you think the first level of the provincial *ZEV Mandate* (10% of all vehicle sales and leases to be ZEV by 2025) is attainable?

Real Estate/Construction:

1. Can you describe your position, and your connection to EV transitions?
2. What do you know about the City's *EV Strategy?*
   Prompts: Targets set by municipality –
3. Has there been interest with investors/customers to add charging infrastructure to new developments prior to the *EV Strategy?*
4. Have you seen an increase in properties advertising EV-ready charging stations?
5. Does EV charging effect sales at all?
6. Have you ever installed or worked with EV charging stations?
7. The City recently tried to mandate 100% EV-ready parking in new developments, and Council had them take it out. Thoughts?
8. The City has required the installation of one charging station (capable of Level 2 charging) for every two stalls of off-street parking in single-family developments – how has that impacted your business?
9. With the requirement of EV charging infrastructure being installed in new developments, how has the municipality helped with that?
10. Do you think the City's requirements to have 100% EV-ready residential parking requirements for all new developments will be effective or is realistic?
11. Another target by the *EV Strategy*, is "by 2030, to have all residential parking in existing apartments to be EV-ready" – this is nine years away. Is this a realistic goal?
12. What are your thoughts on electric vehicle transitions and the plausibility of passenger vehicles transitioning to EVs in Kamloops?
    Prompts: fitting with lifestyle, vehicle preference, other impacts of EVs
13. What do you think are the barriers to EV adoption in Kamloops?
14. What would you suggest to overcome these barriers?

EV Charging Station Owners:

1. When did you get your EV charging station?
2. Why did you choose that one?
3. How many do you have?
4. Have you seen much use out of it?
5. Are you planning to get more?
6. Are you currently charging people for it?
7. Was there any cost to you to install it? For maintenance?

Government:

1. Can you describe your position and your connection with EVs in Kamloops?
   Prompt: working with City on promotion, drive an EV
2. Were you involved with the creation of the EV Strategy?
3. What are your thoughts on the EV Strategy and their targets?
   Prompts: Is it enough, too much, too little?
4. What are your thoughts on the City prioritizing EV adoption in Kamloops?
5. What do you think of the Council's decision to pass the Strategy with no funding attached, and how will this impact the Strategy in the future?
6. How do you balance an equitable transition with EVs in Kamloops?
7. What has the City done to encourage EVs in the building community regarding the EV-Ready MURB zoning by-law?
8. Why do you think Kamloops has slower EV uptake than other municipalities?
9. What more do you think could be done to encourage EV uptake in Kamloops?
   Prompt: investing in public charging infrastructure, etc.
10. What would you recommend to overcome those barriers?

Community:

1. Can you describe your position, and your connection to EV transitions?
   Prompts: how long have you been working in that position
2. What do you know about the City of Kamloops' *EV Strategy*?
   Prompts: Amend By-law to require EV parking in commercial/industrial spaces, potentially requiring businesses to put in EV charging spaces
3. Were you involved in the making of the *Strategy*? Do you feel you had any input? If not, what input could or would you have added into that process?
   Prompt: Attended any of the seminars, community engagement sessions, workshop
3. What work has your organization done to encourage EV adoption?
   Prompts: Add charging stations, host EV Education Nights
4. Have you worked with the City or other organizations to encourage EV uptake?
5. Why has your organization prioritized EV charging infrastructure (fleet?) as part of their sustainability plan as a university?
6. What are your thoughts on electric vehicle transitions and the plausibility of passenger vehicles transitioning to EVs in Kamloops?
   Prompts: fitting with lifestyle, vehicle preference, other impacts of EVs
   Kamloops: Four largest barriers: (8) price, range, model availability, ***access to charging***
7. What do you think are the barriers to EV adoption in Kamloops?

8. What would you suggest to overcome these barriers?

Appendix C: Interview Codes

Data Analysis Interview Codes: Round One

Organized in alphabetical order.

Affordability	Climate Change	Education	Funding	MURB Charging	Supply Chain Issues
Barriers	Charging Infrastructure	EV Fleet	Geography	Policy	Targets
Budget	Charge Range	EV Sales	Government Policy	Promotion	Topography
Builder Hesitancy	Community Engagement	EV Shows	Home Charging	Range Anxiety	Trends
Building Charging Infrastructure	Costs	EV Strategy	Lack of Charging Infrastructure	Resistance	Unaffordability
Building Industry	Culture	EV Supply	Maintenance	Social Challenges	Zoning Bylaws
Climate	Densification	EV Transition	Municipal Government	Solutions	

Data Analysis Interview Codes: Round Two

Affordable Vehicles	Drive-in Culture	Equity	Incentives	Public Support	Sprawl
Change Hesitancy	Electrical Output	Financial Capacity	Lifestyle	Rebates/Grants	Tourism
City Comparison	Environmental Impact	Free EV Parking	New Developments	Recreational Purposes	Vehicle Preference
Community Feedback	EV Interest	Fuel Costs	Off-Loading Costs	Right to Charge	Vehicle Reliance
Cultural Shift	EV Uptake	Hesitancy	Parking	Rural Culture	

Data Analysis Interview Codes: Round Three

Alternative Transportation	EV Benefits	Housing Affordability	Rentals	STEP Code
City Comparison	Hybrids	Larger Vehicles	Second Vehicle	Technology