Bulk Buy Program: Sourcing Zero-Emission Transportation Options for Small- to Medium-Sized Fleets

Pacific Institute for Climate Solutions - Fast Track Project

Project Partners:

Fraser Basin Council | Plug In BC | THE UNIVERSITY OF BRITISH COLUMBIA | PICS PACIFIC INSTITUTE FOR CLIMATE SOLUTIONS

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Research partners:

The **Pacific Institute for Climate Solutions (PICS)** is an independent, non-partisan organization that is policy neutral, and technology neutral. PICS aim is to develop innovative, evidence-based climate solutions knowledge that is actively used by decision-makers within British Columbia, nationally and internationally.

Fraser Basin Council (FBC) is a charitable non-profit organization that brings people together to advance sustainability in British Columbia. Established in 1997, FBC is a collaboration of four orders of government (federal, provincial, local and First Nations), along members of the private sector and civil society.

Plug In BC is a program of FBC which administers provincial incentives under the CleanBC Go Electric Fleets program and the CleanBC Speciality Use Vehicle program, as well as provides support for fleet electrification in BC.

CleanBC Go Electric Fleets is a program under CleanBC's Go Electric programs of the British Columbia Ministry of Energy and Low-Carbon Innovation (BC-EMLI).

Advisory Group:

This project was steered by an Advisory Group consisting of representatives from the funder, Pacific Institute of Climate Solutions; Fraser Basin Council and its program, Plug In BC; the British Columbia Ministry of Energy and Low-Carbon Innovation (BC EMLI); the University of British Columbia (UBC); and Geotab, a private sector firm specializing in fleet vehicle telematics. The advisory group met quarterly to deliver timely feedback and ensure the project was on track to meet objectives.

Confidentiality

The research protocol was approved by the University of British Columbia's Behavioural Research Ethics Board (Certificate number: H21-02338). Only de-identified data is presented in this report. Survey respondents' and interviewees' names are kept confidential. Where used, respondents' and interviewees' job titles and organization's names are generalized to mitigate the risk of identification. Additionally, only de-identified data would be used in future publications or presentations based on the findings of this study.

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Key Findings for Policy Makers

Most fleets in British Columbia are comprised of less than 50 vehicles. Based on a survey of 68 private and public sector organizations with small to medium-sized fleets (SMF)—a total of 2194 fleet vehicles altogether—electric vehicles are a viable option, *now*. However, SMF operators typically lack the purchasing power that larger fleet operators can leverage in procurement processes. A **bulk-buy program**, in which SMF demand is aggregated, can accelerate the adoption of electric vehicles in this segment. This study demonstrates that there is interest from private and public actors in such a program, warranting further exploration on its potential for accelerating adoption. In particular, the following are key findings for policy makers:

1. ***"There are no electric vehicles that meet my operational needs" is a perceived barrier.*** Despite this survey response being most frequently expressed, the actual use cases of many organizations suggests that their operational needs can be met by electric vehicles that are currently available. Hence, tackling this perception is key to accelerating adoption of electric vehicles in this segment.

2. ***Public sector organizations expressed more interest in electric vehicles than private sector organizations.*** The latter are likely to be driven by internal commitments to climate plans, whereas private sector organizations are more sensitive to the financial case for electric vehicles.

3. ***SMF operators are knowledgeable of their operations and maintenance costs***, hence the total cost of ownership (TCO) of vehicles can be a useful tool in educating operators on whether there is a beneficial financial case for their organizations to use electric vehicles.

4. ***Partnerships are key to the success of a program.*** A local agency is an important element in the success of a bulk-buy program. Other actors, such as business associations, boards of trade, and dealerships, can help advance programming and establishing an 'ecosystem' of partners.

Key Findings for Fleet Operators

Most fleets in British Columbia are comprised of less than 50 vehicles. For these small to medium-sized fleets (SMF), electric vehicles are a viable option, *now*. Based on a survey of 68 private and public sector organizations across the province consisting of various vehicle categories ranging from light to heavy duty—a total of 2194 fleet vehicles altogether—the use cases of these vehicles showed that:

1. Most SMF vehicles across most vehicle category types **travel less than 200km in a typical day or shift**.

2. Most SMF vehicles across most vehicle category types are **driven on mostly on city roads rather than on highways**.

3. Although upfitting is common in SMF vehicles, **most modifications are unaffected by an electric drivetrain**.

Organizations that have use cases for which electric vehicles may not presently be a viable option include ones in which large **towing and carrying capacity are key operational requirements**.

1. Introduction

Intended Outcomes

The intended outcome of this research project is to explore whether demand exists for a 'bulk-buy program' for electric vehicle procurement targeted at small- to medium-sized fleets (SMF) in British Columbia. Such a program would allow SMF operators to aggregate their market power to secure lower costs for electric vehicles that are fit for their needs and facilitate access to electric vehicles which potential buyers may otherwise have limited access to.

This paper is analysis of a survey of 68 private and public sector organizations in British Columbia to develop insights on the viability of a bulk-buy program. The following research questions were posed to address this objective:

a. What are the characteristics of SMF operators that are interested in using electric vehicles?
b. What are the use cases of SMF vehicles which may be met by using electric vehicles?
c. What specific barriers impede SMF operators in their decision to purchase electric vehicles?

This paper also reviews best practices of existing bulk-buy programs that have been implemented in other jurisdictions, focusing on factors that have contributed to success.

Report overview

Section 2 establishes the context of zero emissions vehicles and fleet incentive programming in British Columbia, as well as highlighting the challenges faced by SMF operators. Section 3 reviews literature on bulk-buy programs, focusing on the elements that have contributed to the success of existing programs in other jurisdictions. Section 4 describes the methodology used to survey public and private sector organizations in British Columbia to gain an understanding of their organizational characteristics, operational needs, and perceived barriers to adopting electric vehicles. Section 5 describes the results of the survey, focusing on the variation between public and private sector organizations in response to the survey, and develops a summary of the findings for each vehicle category in an 'information card' format.

2. Context

Transportation accounted for 25% of Greenhouse Gas (GHG) emissions in Canada in 2018 [1], whereas the same sector accounts for 40% of GHG emissions in the province of British Columbia [2]. While British Columbia's largely decarbonized electricity grid disproportionately outsizes the GHG impacts of transportation compared to many other jurisdictions, it also positions the province to reap the benefits of transport electrification.

British Columbia's provincial government has been more ambitious than federal government on zero-emissions vehicle (ZEV) deployment. BC's Zero-Emissions Vehicle Act (2019) established a mandatory passenger ZEV sales target, whereas Canada's 2020 federal climate plan initially set sales targets as voluntary goals. The federal government's Emissions Reduction Plan (2022) established mandatory sales targets, which were surpassed again by British Columbia's CleanBC Roadmap 2030.

As of 2021, British Columbia had the most aggressive interim ZEV sales targets in North America, at 26% by 2026 and 90% by 2030 [3]. In contrast, California and Quebec, two other sub-national jurisdictions in North America with leading ZEV sales, both have quota-based mandates for manufacturers as opposed to sales targets [4]. Sales of ZEV as a percentage of total new vehicle registrations in British Columbia have kept pace with the same metric in California and have been larger than Quebec from 2017 to 2021 (Figure 1).

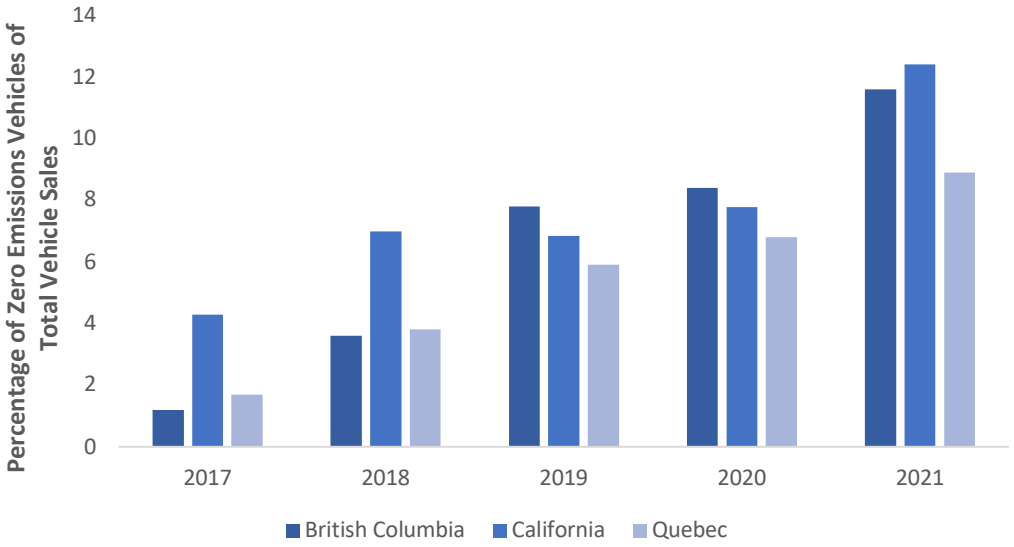

Figure 1: Zero Emissions Vehicle sales

Source: [5], [6]

ZEV accounted for 13% of all new light-duty vehicle sales in 2020 in British Columbia, five years ahead of the province's original target [7]. While the light-duty ZEV mandate provided an enabling environment, British Columbia's successful deployment of over 60,000 light-duty electric vehicles (EV) registered by 2020 is likely a result of the provincial-level consumer rebate added on top of the federal incentive program [8]. In addition, several provincial and municipal incentive programs

have facilitated the deployment of charging infrastructure, indicating that a cohesive and mutually supportive suite of policies at multiple levels of governance has contributed to British Columbia's leadership in ZEV deployment over other provinces in Canada. In addition to incentives for individual consumers, British Columbia also offers a suite of programs supporting electrification of fleet vehicles, under the Go Electric Fleets program (Table 1).

Table 1: Incentives available for fleet electrification in British Columbia

Fleet incentive	Description
ZEV Fleet Advisor	Up to 40 hours of advisory services
Training sessions	Professional development webinars and in-person events
Fleet assessment	50% up to $50,000 ($3000 without telematics) of costs to install telematics, ZEV suitability assessment, and business case analysis (75% of costs for Indigenous communities and businesses, and public sector organizations, excluding ministries and crown corporations)
Infrastructure assessment	50% of costs up to $5000 for assessment of electrical systems (50% up to $10,000 for public sector organizations; 75% up to $5,000 for Indigenous communities)
Electrical infrastructure support	33% of costs up to $20,000 for electrical work (50% up to $80,000 for public sector organizations; 75% up to $25,000 for Indigenous communities)
Charging infrastructure rebate	50% of costs up to $2,000 per Level 2 charger* to a maximum of $25,000 per applicant *Amounts differ for direct current fast charging (DCFC) stations

Source: [9]

Challenge

Despite the increasing ZEV deployment to date in British Columbia, reaching the 100% target will likely require targeted efforts to reach niche segments *[interview 5; personal communication 2 – see Section 3 for explanation of Methodology]*. Although British Columbia's ratcheting of sales targets indicates that the province has had a measure of success in the deployment of electric vehicles, one of the gaps remaining is increasing the adoption in the fleet vehicle segment.

Table 2: Vehicle registration in British Columbia

		Business	Personal	Other
Commercial vehicles	**Fleet**	174,483 (20.4%)	798 (0.1%)	1,857 (0.2%)
	Non-fleet	169,373 (19.8%)	485,859 (56.9%)	22,240 (2.6%)

		Business	Personal	Other
Passenger vehicles	**Fleet**	55,136 (2.2%)	1,851 (0.1%)	3,307 (0.1%)
	Non-fleet	171,664 (6.7%)	2,204,152 (86.6%)	110,068 (4.3%)

Source: [10]

Fleet vehicles comprise a significant demographic of vehicles in British Columbia: In 2020, over a fifth of commercial vehicles were registered under fleet insurance, along with 2.2% of passenger vehicles (Table 2). However, the actual number of fleet vehicles used in practice is likely greater. The Insurance Corporation of British Columbia (ICBC) allows a group of at least five vehicles to be registered under a fleet insurance package if the primary use is for business or commercial purposes [11]. Alternatively, businesses that qualify for fleet insurance but have less than 20 vehicles, also have the option to insure each vehicle individually. Hence, some fraction of 19.8% of commercial vehicles and 6.7% of passenger vehicles registered as non-fleet vehicles are utilized in business or commercial fleets.

While the vehicle registration data does not provide information on what fraction of fleet vehicles are registered under smaller fleets, practitioners in this space anticipate that most fleet vehicles in British Columbia are likely to belong to smaller fleets of less than 50 vehicles—by one estimate, over 90% of fleet vehicles have ten or less vehicles *[interviews 1, 4]*.

Larger fleets often have dedicated procurement processes and personnel, allowing them to take advantage of the larger number of vehicles to secure lower prices per unit. On the other hand, smaller fleets lack such access, presenting a barrier that makes the financial case for electric vehicles unfavourable.

Hence, targeted programming to address the needs of smaller fleets is critical to electrification of this segment and achieving British Columbia's emissions reduction ambitions. The aggregation of purchasing power to access large quantity discount arrangements offers one avenue for advancing electrification in this segment, as well as lowering the risk of investment (Figure 2).

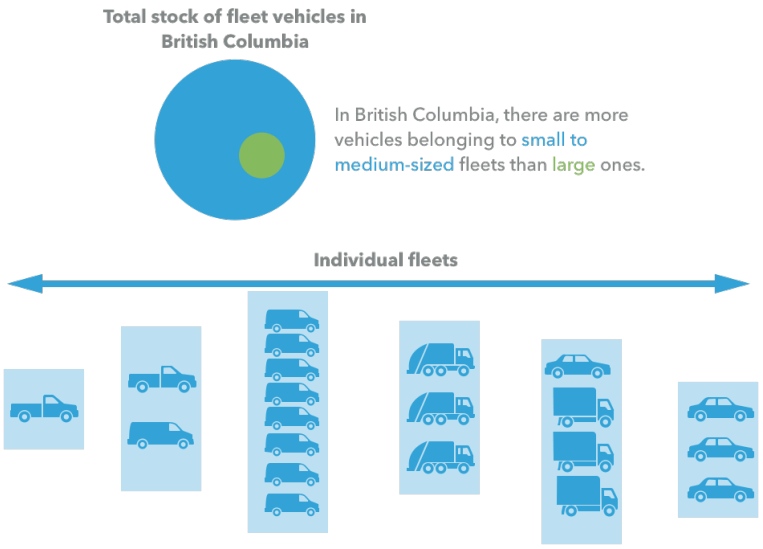

Figure 2: Large vs small fleets in British Columbia

Vehicle fleets typically travel farther than non-fleet vehicles, i.e., higher vehicle-kilometres travelled (VKT). Although non-fleet vehicles are more common, fleet vehicles contribute an outsized proportion of emissions because of the higher VKT. Hence, the emissions reduction potential of fleet vehicles is greater per vehicle than non-fleet vehicles. As such, polices that target the maximization of electric mileage versus the deployment of electric vehicles may then be one approach to unlocking early economies of learning and scale [12], [13].

3. Bulk purchase models

The following section contains a *literature review* of bulk purchase programs, which was further informed by *informational interviews* with experts and practitioners to fill in knowledge gaps. Plug In BC—a program of Fraser Basin Council which administers British Columbia provincial government incentives for electrification of fleet vehicles—conducted prior research to validate the prospect of a bulk-buy program. Key information gaps in this prior research were addressed via informational interviews conducted by the author. In addition, personal communications conducted by the author provided further context. See Appendix 1: Interviews and personal communications for a full list.

Types of bulk purchase programs

There are two major types of bulk purchasing programs, group-buy (or 'community bulk-buy') and bulk-buy (Table 3). While the latter is the focus of this study, the wider implementation of group-buy programs indicates that a reputable local agency and engagement with prospective buyers via information sessions are key elements of successful programming that could be transferrable. With respect to a role in the fleet ecosystem, this suggests that Plug In BC is well-positioned to implement a prospective bulk-buy program.

Table 3: Group-buy versus bulk-buy programs

	Group-buy ("Community bulk-buy")	**Bulk-buy**
Primary target group	Individual consumers	Fleets
Description	(a) Local agency negotiates a discounted price for an electric vehicle from a dealer or automaker; or (b) Private company sources used vehicles and aggregates sales into a group-buy	Commercial buyer purchases multiple vehicles at discounted price for its fleet
Process	Prospective buyers participate in an EV information session, after which they are eligible for a credit towards purchase of an EV	Prospective buyers commit to purchase of a certain number of vehicles directly from an OEM, or via a third party (e.g., fleet management company, or procurement agency)
Benefits	Increase in EV sales (additional benefit if coupled with another incentive); Saves time for dealers	Sale of excess supply; Possibility of multi-year agreements
Implementation	48 programs between 2015 to 2019 in the US	Less than 10 programs found by author's research

Sources: [14], *[interview 2]*

A variation of the community bulk-buy program is a for-profit business model. The Good Car Company, a private company based in Australia, imports used light-duty electric vehicles from

Japan and the United Kingdom, and then resales them in a community bulk-buy program in various locations across Australia [15]. 'Gray market goods' or 'parallel imports' of vehicles, which are legally imported from another country through channels other than the manufacturer's official distribution system, are not uncommon [16]. Hence, an extension to the electric vehicle marketplace is not surprising in electric vehicle supply-constrained jurisdictions such as Australia. The Good Car Company's success has led to copycat firms in Australia [17], and at least one dealership in British Columbia has successfully implemented this as a business model *[personal communication 1]*. However, the integration of a community bulk-buy component by Good Car Company appears to be unique, at least insofar as publicly available information on other for-profit business model is limited.

Examples of Zero Emissions Vehicle bulk-buy programs

Unlike group-buy programs for individual consumers which have been more commonly implemented, bulk-buy programs for fleets require more formalized structures and partnerships between the parties involved. Examples of some bulk-buy programs are described below.

Sourcewell

'Cooperative purchasing' is procurement by, or on behalf of, a public procurement unit [18]. Sourcewell, is a US-based public entity with over 50,000 participating agencies utilizing its services, including federal, state, and municipal governments and public sector organizations; public and private K-12 and post-secondary educational institutions; and non-profit organizations. Businesses and for-profit private sector organizations are unable to participate in procurement via Sourcewell. Sourcewell solicits contracts through a competition process, and vendors who are awarded contracts are then able to offer their products and services to Sourcewell's participating agencies for procurement. Typically, vendors who hold a "Sourcewell Awarded Contract" pay an administrative fee, which is, a percentage of sales processed through the competitive solicitations process [18]. For fleet vehicles, Sourcewell vendors can include original equipment manufacturers (OEMs) and dealerships. Hence, an organization that uses Sourcewell as a third-party procurement firm can purchase directly from an automaker or via a dealer. In addition to having access quantity-based discounts and outsourcing procurement sourcing, a key advantage of Sourcewell is that participating agencies do not pay fees for membership, hence the growth of the cooperative purchasing model in the US [19].

Climate Mayors EV Purchasing Collaborative

To address growing municipal demand, the City of Los Angeles led a group of 30 other US cities to establish the 'Climate Mayors EV Purchasing Collaborative' in 2017. This partnership emerged from a network of over 470 mayors of US cities, known as Climate Mayors, an initiative to encourage climate action at the municipal level. The Collaborative aims to leverage the collective buying power of its participants to advance electric vehicle deployment. The initiative developed an online procurement portal to provide US public sector organizations access to competitively bid electric vehicles and charging infrastructure. The Collaborative also has a capacity-building and information-sharing component, as it provides training and resources, and produces analyses of best practices to support fleets transitioning to electric vehicles.

The Collaborative itself is not a procurement firm. Rather, all of offerings via the Collaborative's portal are Sourcewell Awarded Contracts. Hence, an organization must be a participating agency of Sourcewell to have access to the procurement process. The value of the Collaborative is thus in providing a user-friendly web portal that consolidates information on available electric vehicles and charging infrastructure.

The establishment of the Collaborative was driven partly by two vendors which hold Sourcewell Awarded Contracts and offer electric vehicles for procurement, National Auto Fleet Group and NCL Government Capital [20].

Fleets for the Future

'Fleets for the Future (F4F)' is a US-based partnership of regional and municipal public sector organizations, Clean Cities coalitions, and industry experts which coordinate five regional and one national procurement initiatives. F4F, funded by the US Department of Energy's Clean Cities Program, is available through Sourcewell, and locally in the 101 municipalities of the Metropolitan Boston area via its regional planning agency, the Metropolitan Area Planning Council. F4F states that it has discount agreements with several OEMs, which are available to Sourcewell participating agencies upon reference at the time of procurement [21], [22].

Other Jurisdictions

Australian Capital Territory (ACT): The Australian sub-national government of ACT developed an action plan to transition the public fleet to electric vehicles in 2018, which included an encouragement for local jurisdictions to partner with the ACT government in a bulk-buy program of light-duty electric vehicle procurement for government fleets [23] . The ACT government outsources its fleet procurement to a third-party firm, which acknowledged that it initially had limited experience in electric vehicles. While it is not clear the extent to which local jurisdictions partnered for a bulk-buy arrangement, the ACT government had 300 electric vehicles out of a total fleet of 680 vehicles by 2021 [24].

Drive Electric Northern Colorado: This partnership between the Electrification Coalition, two municipalities and one university, offered at least two rounds of a fleet group buy program, with the last one in 2016 [25]. The program offered a pre-negotiated discount prices on two Nissan Leaf trims, so long as a buyer purchased a minimum of two vehicles. Both offerings were for new vehicles, so participants were also able to obtain the state and federal tax credits.

Danish Energy Agency: This division of Denmark's Ministry of Climate and Energy offered a bulk purchase program for procurement of plug-in hybrid electric vehicle between 2008 to 2015. The program was open to municipalities and regions, along with private sector organizations. The program resulted in increased procurement of plug-in hybrid electric vehicles [26]. While uptake for public sector organizations was driven mainly by organizational commitments to climate action, Denmark's aggressive electric vehicle deployment policies offered an environment that was advantageous for uptake by private companies [27].

Considerations for a prospective bulk-buy program

Prior to this research project, Plug In BC had conducted exploratory research to validate the prospect of a bulk-buy program. This included considerations of the demand side, i.e., the level of interest in a bulk-buy program, and the supply side, i.e., whether Original Equipment Manufacturers (OEM) had interest in offering quantity-based discounts.

On the demand side, Plug In BC informally surveyed the West Coast Electric Fleets group in 2019 to 2020 to explore the interest of participating members in a bulk-buy arrangement. It was found that many larger fleets had preexisting supply chains and procurement processes in place. Typically, larger fleets outsource to third-party firms specializing in procurement. Hence, the general perception was that a bulk-buy program would not benefit larger fleets. Moreover, some public sector organizations have a link to a broader set of similar organizations (e.g., school districts under the provincial government), and may thus have access to a third-party procurement firm even if fleets are smaller *[interview 1]*.

On the other hand, smaller fleets expressed a degree of interest in such a program. It was noted that a successful program would likely need to address three factors: (a) discounts would have to be greater than what smaller fleets could obtain on their own; (b) the program would need to allow for flexibility in both vehicle specification and delivery timeline; and (c) pledges to purchase vehicles could be fulfilled at local dealerships with whom the smaller fleets had pre-existing relationships for maintenance needs. The latter factor was found to be associated in some instances with internal commitments of organizations to "buy local, buy green" *[interviews 1, 2]*.

On the supply side, Plug In BC consulted several OEMs, including five large legacy automakers producing light-duty electric vehicles currently available on the market, as well as several smaller manufacturers of medium- and heavy-duty and speciality vehicles. Of the large automakers consulted, one declined, two did not express interest in such a program but indicated openness to reassessing in the future, and two expressed an interest in the program but declined to comment on the magnitude of discount until the scale of demand could be provided. The OEMs that declined indicated the total consumer demand outweighed the supply at that time. Of the smaller manufacturers consulted, the general response was openness to being involved in a bulk-buy program, so long as the vehicles requested had the same specifications.

This uniformity of specifications presents a challenge when faced with diverse operational requirements of organizations, which effectively lead to a need for bespoke products *[interviews 1, 3]*. Furthermore, fleet vehicles are typically "upfitted" i.e., modified to perform some function beyond the original specification, or carry additional, specialized equipment safely and effectively. Upfitting was thus suggested as an additional barrier to aggregating large quantities of vehicles with uniform specifications *[interview 3]*. On the other hand, this also suggests that bulk-buy programs may be effective for vehicle categories in which fewer options are necessary, for example, delivery vans.

For smaller fleets, the low quantities and prevalence of one-time purchases are factors that limit the economies of scale. Hence, such organizations provide a less attractive business case for a third-party procurement firm. Plug In BC also found that there was greater interest from public sector organizations than private sector. The latter rely on solely on economics and the secondary benefits of 'green marketing', whereas public sector organizations are increasingly driven by internal commitments to climate action plans, and in the case of medium-sized fleets, access to cooperative purchasing agreements with other public sector organizations.

Regardless of fleet size, in general, most fleet operators also face a "readiness" barrier, i.e., the extent to which organizations are prepared financially, technically, and culturally to adopt electric vehicles *[interview 1, 3, 4; personal communications 2, 4]*.

It is worth noting that following adoption of electric vehicles, another set of issues emerge. There are, "fleets that want to electrify, and fleets that want to optimize" *[interview 3]*— after electric vehicles have been adopted, there is organizational learning that must occur to take advantage of the benefits of electric vehicles, while mitigating the potential drawbacks of early adoption. Included in this is the 'right-sizing', or installation of the appropriate design and scale of charging infrastructure that meets an organization's operational requirements.

4. Methodology

Unit of Analysis

While there is no commonly agreed upon definition of what constitutes a "small- to medium-size fleet", the term is used in this report to refer to any organization with a fleet consisting of less than 50 vehicles. 'Small- to medium-sized enterprise' (SME), on the other hand, is defined as an organization with less than 500 employees [28]. Of SMEs that have fleets, there may be some degree of greater likelihood that such organizations have small- to medium-sized over a large one, but this relationship is unknown, and moreover may be inconsequential for the purpose of this study. More importantly, the unit of analysis of this study is taken as fleet vehicles, rather than people. Thus, while the SME has some utility in framing the target population, the small- to medium-sized fleet (SMF) is the most appropriate unit of analysis for the intended objectives of this study.

Survey

A *structured survey* was designed and deployed in digital format to a sample frame of SMF in British Columbia. The sample frame was conceptualized as consisting of two major target groups: (1) "Current users", i.e., fleet managers (or equivalents) of SMF which currently have electric vehicles in their fleet, though have not electrified their entire fleet; and (2) "latent demand", i.e., organizations which may stand to benefit from using electric vehicles but do not currently have any in their fleets.

The survey consisted of questions in three parts: (a) organizational characteristics, (b) fleet operational characteristics, and (c) perceptions towards electrification. The second section was scoped to include light-, medium- and heavy-duty vehicles to encompass a broad range of organizational types. Respondents were referred to the vehicle categories of the US Environmental Protection Agency's regulations (Figure 3) and asked to identify what types of vehicles their fleet was constituted of. The second section of the survey was then repeated for each type of vehicle category that a respondent indicated.

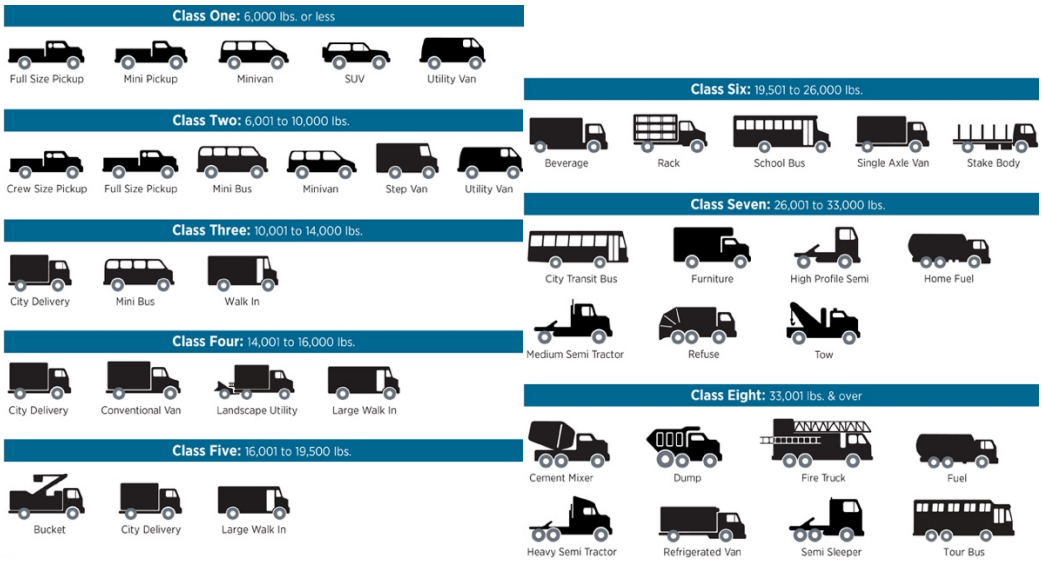

Figure 3: US federal regulatory vehicle categories

Source: [29]

Given that the survey was scoped as exploratory, the questionnaire was designed to minimize the number of questions asked while also balancing the need to collect usable data. For example, "Do you have a central parking location?", and "Do you have permission to install electrical upgrades?", avoided the need for additional question on charging infrastructure readiness and reduced respondent burden for technical information.

The survey was deployed via distribution lists of two chambers of commerce, via the networks of two organizations with a client base of sustainability-oriented businesses, and via the internal distribution lists of Plug In BC which consists of current and past program subscribers, and of Fraser Basin Council which consists of organizations that have expressed interest in FBC activities. The survey was also distributed directly via email to the general inboxes of all municipalities, regional districts, and school districts in British Columbia. The marketing campaign also included several of the largest boards of trade and relevant industry associations in British Columbia, however, these did not result in successful deployment.

Webinar

A webinar was marketed alongside the survey as an information-awareness offering. The webinar, which took place in December 2021, was hosted by Plug In BC as its quarterly webinar offering. The webinar topic was, "Benefits of electric vehicle for small- to medium-sized organizations" and featured a brief overview of Plug In BC programs, followed by presentations from representatives of two private sector organizations in the electric vehicle and transportation industry. The webinar also contained an overview of the survey as a means of reinforcing its deployment.

5. Survey results

Organizational characteristics

A total of 68 survey respondents included private and public sector organizations (Figure 4). Public sector organizations comprised 55% of the total respondents, which at the local level included municipalities and regional districts, and at the provincial level, predominantly school districts. Non-profit organizations were included in the private sector grouping for the purpose of conceptualization. Private sector organizations surveyed included several economic sectors: Construction and trades, transportation and logistics, landscaping, engineering consulting, security, as well as corporate vehicles for other sectors.

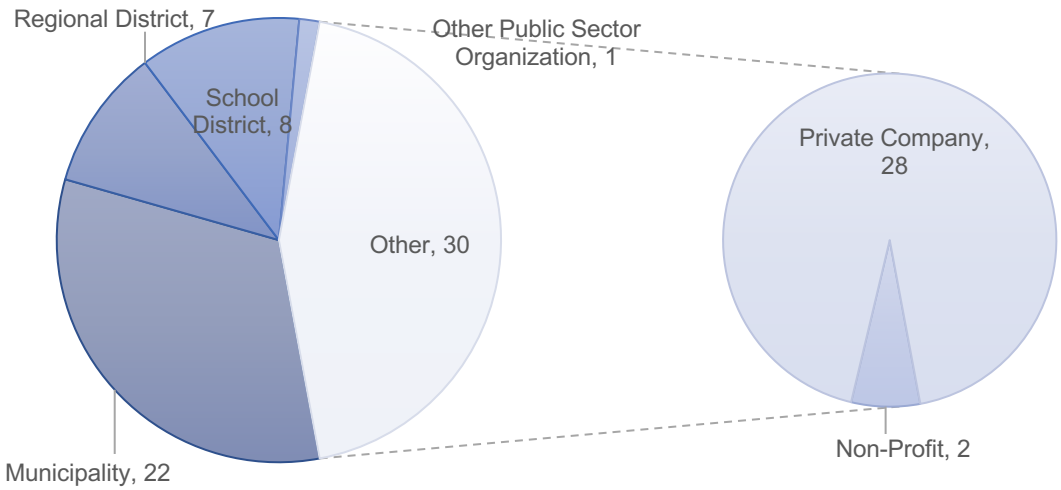

Figure 4: Number of survey respondents by organization type

Ownership and procurement

For both public and private sector organizations in the sample, full ownership is the most common type of ownership (Table 4). Within the sample, private sector organizations tend to utilize the leasing model more than public sector organizations.

Private sector organizations indicated that they procure from mostly from a dealership, although other procurement types are also used. Public sector organizations procure primarily from a dealership. This suggests that the size of SMF fleets for certain vehicle categories may not be sufficient for using a third-party procurement firm. The organizations which indicated that they use a third-party procurement firm tend to have heavier duty-class vehicles or larger quantities of lighter duty-class vehicles.

Table 4: Ownership and procurement types

(A) Ownership type

	Fully owned	Financing	Lease	Other
Public	97%	3%	0%	0%
Private	72%	7%	14%	7%

(B) Procurement type

	Dealership	Direct from automaker	Third party procurement firm	Other
Public	73%	11%	8%	8%
Private	41%	10%	21%	28%

Parking and charging access

Two survey questions were posed to assess the readiness for charging infrastructure: Access to a central parking location, and permission to install new electrical equipment (Figure 5). Public sector organizations largely had access to a central parking location, whereas the ones that did not have such access indicated that vehicles are parked at employees' homes or at work sites. Private sector organizations indicated less access to a central parking location, with such vehicles parked at homes, either in a garage or on the street, or at public parking lots.

Public sectors organizations largely have permission to install new electrical equipment, and private sector organizations have less access. The variation of responses is similar for both the central parking location access and permission for installation of electrical equipment, suggesting that access to a central parking location generally corresponds with ability to install charging infrastructure. The exception was some private sector organizations which indicated that they have no permission to install equipment, despite having access to a central location. In this case, such organizations use a parking location for which they are not the sole owner (e.g., rented spaces, shared location).

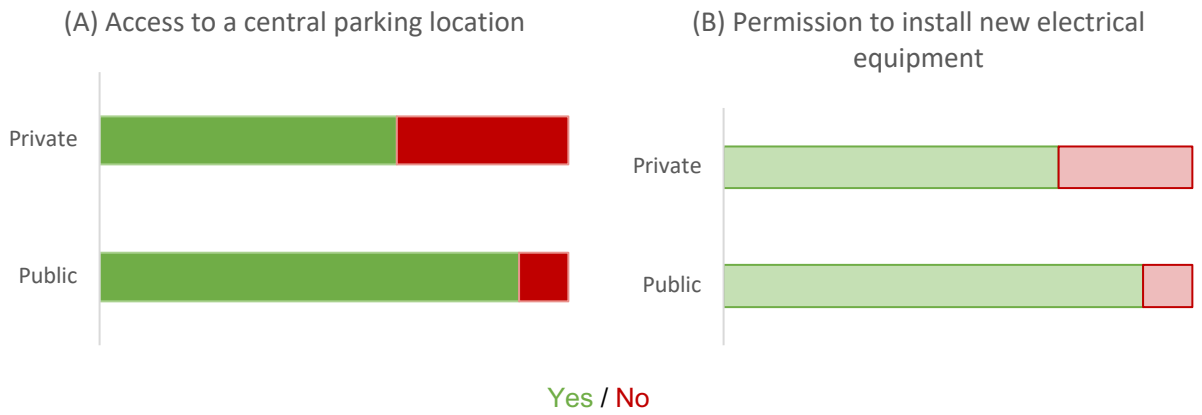

Figure 5: Access to central parking and permission to install electrical equipment

Perceptions towards electrification

The organizations surveyed generally had a positive perception towards the likelihood of electric fleet vehicles to reduce overall costs for both maintenance and operations (Figure 6). Given that the intended target group of the survey was to explore "latent demand" for electric vehicles in SMF, the sampling bias towards organizations which favourably perceive electric vehicles confirms that members of the appropriate target group responded to the survey.

The predominantly favourable positive perception towards maintenance and operations costs reductions also suggests that SMF fleet operators have a relatively strong understanding of total costs of ownership (TCO) of vehicles. Hence, targeted information awareness campaigns with a focus on TCO may have a greater impact on advancing deployment of electric vehicles in this group, versus the impact of the same information on a typical private consumer.

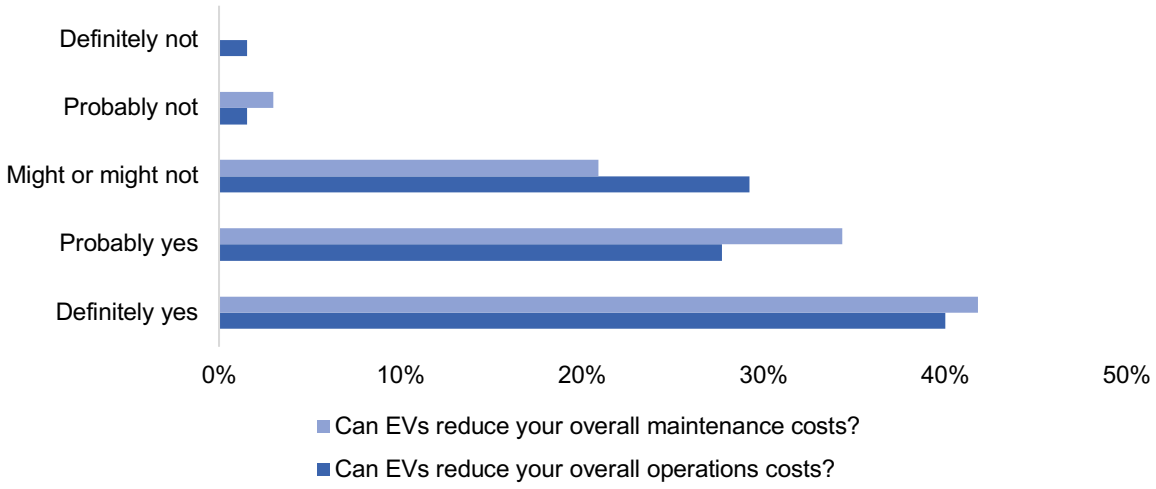

Figure 6: Perceptions on operations and maintenance costs

The most common barrier towards adopting electric vehicles for public sector organizations was the perception that currently available electric vehicles do not meet their operational requirements (Figure 7). Private sector organizations were nearly equally as sensitive towards the prohibitive cost of electric vehicles. Whereas all public sector organizations surveyed had considered purchasing an electric vehicle for their fleets, nearly a quarter of private sector organizations surveyed expressed that they had not considered the same. The latter suggests that the sensitivity to the larger upfront capital cost may preclude many private sector organizations from seriously considering electric vehicle adoption.

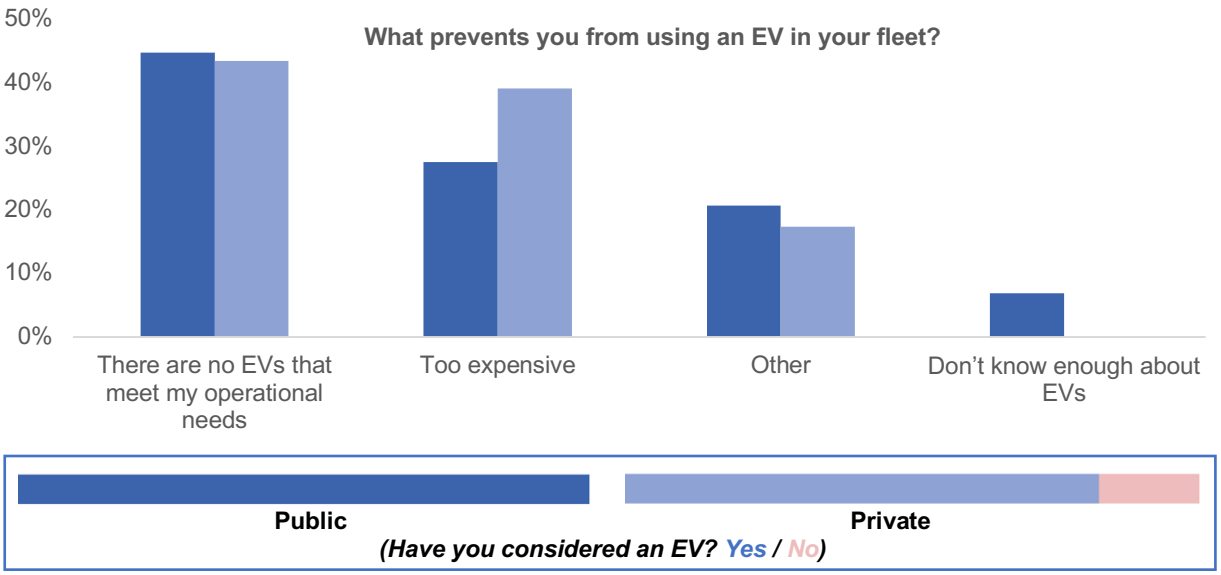

Figure 7: Perceptions on barriers to electrification

Where survey respondents indicated that some other barrier prevented them from electric vehicle adoption, common responses for public sector organizations included: Uncertainty of performance in cold weather, the cost of charging infrastructure installation, supply chain delays which resulted in limited vehicle selection and availability, frequency of power outages in a rapidly developing area, and not reaching the replacement schedules for current vehicles. Private sector organization responses focused on inadequate public charging infrastructure, and inability to make electrical infrastructure upgrades.

Fleet operational characteristics

The aggregate of the fleets of all respondents comprised a total of 2194 vehicles (Figure 9). Over two thirds of respondents indicated that they had a full-size pick-up truck (Figure 8), which was by far the most common vehicle type in the aggregate of the fleets. The next most common vehicle types, each comprising approximately a tenth of the aggregate of the fleets, included heavy-duty trucks, crew-size pick-up trucks, cargo vans, and SUVs.

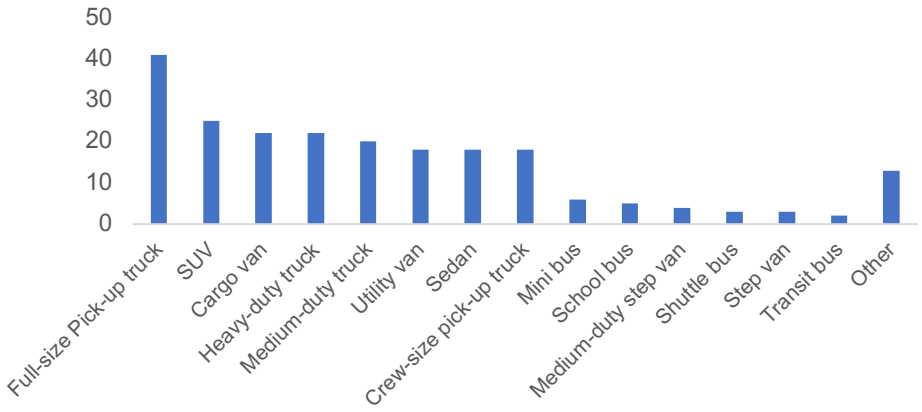

Figure 8: Number of responses per vehicle category

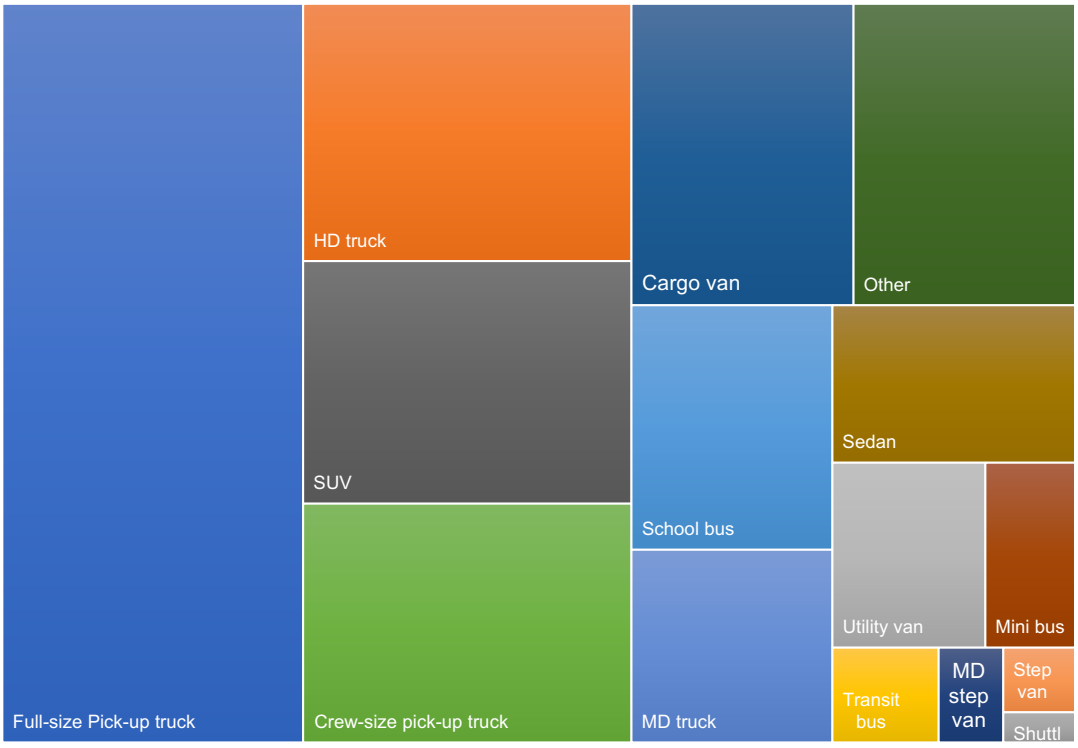

Figure 9: Breakdown by vehicle category of vehicles in total survey sample

The survey data for each vehicle category is summarized in the following pages in an 'information card' format. Table 5 depicts a key to interpreting the summary results for the information cards.

Table 5: Interpretation of survey results

Vehicle category	
Number of units (range)	Smallest to largest number of such vehicles in the fleets of survey respondents.
Most common model year	Where possible, a range of the most common model year of vehicle is recorded. In the case of many vehicle categories, the model years were highly varied between the fleets of survey respondents.
Fraction upfitted	Colour-coded. For some vehicle categories, a subset of fleets had a higher fraction of upfitting. In such cases, the color-coding is of the subset with upfitting. Text in this box provides additional context to interpret the data. >75% | 50-75% | 25-50% | Minimal
Typical modifications	Commonly listed modifications. Responses are ordered by prevalence.
Fraction travels more than 200km in a day/shift	Colour-coded. For some vehicle categories, a subset of fleets had a higher fraction of travel >200km. In such cases, the color-coding is of the subset with longer trips. Text in this box provides additional context to interpret the data. >75% | 50-75% | 25-50% | Minimal
Highway vs city driving	Colour-coded representation of highway versus city driving. A longer blue (right) bar indicates greater prevalence of city driving. A longer yellow (left) bar indicates greater prevalence of highway driving. Highway | City
Other operational requirements	Respondents were asked to list any major operational requirements

Sedan

Sedan	
Number of units (range)	1-20
Most common model year	2012-2019
Fraction upfitted	Negligible
Typical modifications	Police vehicle radios, lights, and sirens Cargo securement Decals, seat covers, GPS beacon, dashcams
Fraction travels more than 200km in a day/shift	Predominantly none
Highway vs city driving	Highway / City
Other operational requirements	None described

SUV

SUV	
Number of units (range)	1-50
Most common model year	Highly varied
Fraction upfitted	Minimal overall Of fleets with upfitted vehicles, over 75% of vehicles upfitted
Typical modifications	Lights/sirens, radios, camera systems, AC power outlet, data terminal
Fraction travels more than 200km in a day/shift	Minimal in total sample Of those with travel more than 200km, <25% of trips
Highway vs city driving	Highway / City
Other operational requirements	All-wheel drive; Extra electrical systems (for data terminals, camera systems)

Full-size pick-up truck

Full-size pick-up truck	
Number of units (range)	1-50
Most common model year	highly varied
Fraction upfitted	50-75%
Typical modifications	Tool storage, emergency or work lights, headache rack, arrow board, reader board, snowplow, sander, salter, tommy gate, lift gate, flat deck, dump box, towing kit, camera system, mini crane, buggy whip, service body, inverter
Fraction travels more than 200km in a day/shift	<25%
Highway vs city driving	Highway / City
Other operational requirements	1 tonne carrying capacity, 2 tonne towing capacity; Occasional <300km trips; To run hydraulic systems; all-wheel drive; locking differential; multi-ply tires for gravel roads

Cargo van

Cargo van	
Number of units (range)	1-40
Most common model year	highly varied
Fraction upfitted	Over 75%
Typical modifications	Shelving, exterior racks, headache racks, storage bins, cargo barriers, interior cabinets, cargo lights, traffic advisors, bulkheads, cranes, security locks and bars, insulation, inverter, rubber floor, auxiliary power for operational requirements, radios, bucket lift on roof
Fraction travels more than 200km in a day/shift	<25%
Highway vs city driving	Highway / City
Other operational requirements	All-wheel drive; Towing capacity of ¾ to 1 tonne

Step van

Step van	
Number of units (range)	1-8
Most common model year	Highly varied
Fraction upfitted	Minimal overall Of fleets with upfitted vehicles, over 75% of vehicles upfitted
Typical modifications	Conversion to propane, cranes, generators, heaters, air compressors
Fraction travels more than 200km in a day/shift	Minimal
Highway vs city driving	Highway / City
Other operational requirements	Hydraulic functions

Utility van

Utility van	
Number of units (range)	1-28
Most common model year	Highly varied
Fraction upfitted	Half of total sample upfitted Of fleets with upfitted vehicles, 50-75% of vehicles upfitted
Typical modifications	Cabinets, shelving, racks, bulkhead dividers, Roof mounted man-lifts, generators, inverters, work and strobe lights, camera systems, radio systems
Fraction travels more than 200km in a day/shift	Minimal
Highway vs city driving	Highway / City
Other operational requirements	Towing package for utility trailer

Minibus

Minibus	
Number of units (range)	2-19
Most common model year	Highly varied
Fraction upfitted	Minimal overall Of fleets with upfitted vehicles, over 25-75% of vehicles upfitted
Typical modifications	Radios system, data terminal, telematics, paramedic equipment, buggy whips, beacon lights
Fraction travels more than 200km in a day/shift	Mostly none Of fleets with travel >200km, over 75% of trips
Highway vs city driving	Highway / City
Other operational requirements	

Crew-size pick-up truck

Crew-size pick-up truck	
Number of units (range)	1-50
Most common model year	Highly varied
Fraction upfitted	Over 75%
Typical modifications	headache racks, tool storage, work and strobe lights, flat decks, dump boxes, sanders and plows, lift gates, bumper cranes, winches, removal, headache racks, cargo partition, inverter, mudflaps, running boards, service body, buggy whips, small cranes
Fraction travels more than 200km in a day/shift	Minimal
Highway vs city driving	Highway / City
Other operational requirements	-

Medium-duty step van

Medium-duty step van	
Number of units (range)	1-7
Most common model year	2015-2017
Fraction upfitted	Over 75%
Typical modifications	Shelving and cargo storage, street sweepers, mobile picker cranes, deck trucks
Fraction travels more than 200km in a day/shift	Mostly none
Highway vs city driving	Highway / City
Other operational requirements	

Medium-duty truck

Medium-duty truck	
Number of units (range)	1-19
Most common model year	Highly varied
Fraction upfitted	Over 75%
Typical modifications	Dump boxes, power tailgate, cranes, plows, sanders, hook lift attachments, cranes, flat decks, tool storage boxes, service bodies, tonneau cover, rubber floor mats, radio systems, chains, fire extinguishers
Fraction travels more than 200km in a day/shift	Minimal
Highway vs city driving	Highway / City
Other operational requirements	hydraulics

Shuttle bus

Shuttle bus	
Number of units (range)	1-4
Most common model year	2013-2019
Fraction upfitted	50%
Typical modifications	Wheelchair lift, seats removed for storage
Fraction travels more than 200km in a day/shift	Over 75%
Highway vs city driving	Highway / City
Other operational requirements	-

School bus

School bus	
Number of units (range)	3-50
Most common model year	Highly varied
Fraction upfitted	Mostly none
Typical modifications	Radio systems, camera systems
Fraction travels more than 200km in a day/shift	50%
Highway vs city driving	Highway / City
Other operational requirements	Occasional longer trips for emergency services, school charters, field trips

Transit bus

Transit bus		
Number of units (range)	2-26	
Most common model year	2015-2018	
Fraction upfitted	None	
Typical modifications	-	
Fraction travels more than 200km in a day/shift	Over 75%	
Highway vs city driving	Highway	City
Other operational requirements	-	

Heavy-duty truck

Heavy-duty truck		
Number of units (range)	1-50	
Most common model year	Highly varied	
Fraction upfitted	Over 75%	
Typical modifications	Dump boxes, sanders and salters, plows; modifications for vacuum equipment, garbage collection, water transportation, street sweeping, sewer cleaning; multi lift, underbody plow, fire apparatus, derricks, booms, custom bed or trailer equipment, work and strobe lights, camera systems, racks, tool storage boxes, tilt flat deck, inverter, tow package	
Fraction travels more than 200km in a day/shift	50%	
Highway vs city driving	Highway	City
Other operational requirements	Occasional longer trips for goods transportation; Hydraulics; 24-hour operation for heavy snowfalls; Carrying capacity	

Other vehicles

Other vehicles		
Types of vehicles	*Construction equipment:* Loader, grader, dozer, excavator, crane, boom truck, backhoe, dump truck *Specialized function:* street sweeper, ice re-surfacer *Emergency:* fire truck, ambulance	
Number of units (range)	1-50	
Most common model year	Highly varied	
Fraction upfitted	50-75%	
Typical modifications	Cranes, mowers, compressors, generators, electrical trailer, snow gates, wings, street sweepers, tractors, mowers, light/sirens, data terminal, medical equipment	
Fraction travels more than 200km in a day/shift	None	
Highway vs city driving	Highway	City
Other operational requirements		

6. Key findings

Several broad insights emerge from a synthesis of the survey, informational interviews, and literature review. These include insights for both small to medium-sized (SMF) fleet operators and policy makers exploring the viability of a bulk-buy program targeted at SMF vehicles.

Key findings for Fleet Operators

The use cases of the SMF vehicles surveyed showed that:

1) ***Most SMF vehicles travel less than 200km in a typical day or shift.*** A variety of existing electric vehicle models can meet the needs of the survey respondents, particularly light and medium-duty classes.

2) ***Most SMF vehicles are driven more often in cities than on highways.*** Batteries have superior energy efficiency, or "fuel economy", in city driving. While there are many use cases that require an ability to travel long distances on highways, range anxiety may be more of perceived barrier than an actual one for a variety of use cases in this sample.

3) ***An electric drivetrain has no impact on many SMF vehicle modifications.*** Upfitting is common in SMF vehicles, with many modifications that require no power, and hence are not impacted by an electric drivetrain. On the other hand, there are many common modifications that do require power, for example, snowplows and sanders. In such cases, these modifications can be linked directly via electrical connections to the battery of an electric vehicle, which may be an appealing factor for many SMF operators.

On the other hand, there are many organizations which have use cases for which electric vehicles may not be a viable option presently. In particular,

4) ***Large towing and carrying capacity are key operational requirements of many SMF vehicles***. The use cases of many SMF vehicles require that they transport a large mass, either on-board or in tow. A focus on comparing the towing and carrying capacities with an equivalent internal combustion engine vehicle may be useful to help fleet operators understand whether an electric vehicle can meet their needs. Moreover, the ability of electric drivetrains to achieve instantaneous torque is an advantage that is not possible in internal combustion engine vehicles.

Key findings for Policy Makers

For policy makers that are exploring the viability of a bulk-buy program targeted at SMF vehicles, the following insights:

5. ***"There are no electric vehicles to meet operational needs" is a perceived barrier.*** Despite this survey response being most frequently expressed, the actual use cases of many organizations suggests that their operational needs can be met by electric vehicles that are currently available, particularly, light- and medium-duty categories. For many use cases, "good enough

automobility" [30] of currently available electric vehicles may be sufficient to meet purely functional needs. Hence, tackling this perception is key to accelerating adoption of electric vehicles in this segment. This may be addressed by a program component that helps to demonstrate to SMF fleet operators how their needs are meet by an electric vehicle.

5) ***Public sector organizations expressed more interest in electric vehicles than private sector organizations.*** A lower response rate was observed with private sector organizations. Public sector organizations, which comprise a smaller total population of organizations, had a higher response rate. Public sector organizations are likely to be driven by internal commitments to climate action plans, whereas private sector organizations are more sensitive to the financial case for electric vehicles.

6) ***SMF operators are knowledgeable of their operations and maintenance costs***. SMF operators are likely to have a strong understand of the total cost of ownership (TCO) of vehicles. Hence, using a TCO to help educate SMF operators may be a useful approach to helping them understand whether their organizations have a positive financial case for electric vehicles.

7) ***Partnerships are key to the success of a program***: Bulk-buy programs in other jurisdictions show that a trusted local agency is a key factor in delivering a successful program. To take this a step further, the local agency also needs partners to help disseminate the program. This is particularly the case for private sector organizations, which were a more difficult population to access than public sector organizations for this survey. Business associations and boards of trade can spread awareness of the program, including in resources that are available to their members, e.g., a 'small business toolkit' *[personal communications 9]*, or an additional discount. There is also a role that major private businesses, particular dealerships, can play at the point of sale *[personal communications 10]*. Other partners can include municipal and local-level actors, such as a local economic commission, or a regional authority. Approaching the program from an 'ecosystem' approach would help to develop an understanding of what actors may contribute to various aspects of electric vehicle adoption and use.

Summary

To conclude, this study has provided further evidence that while a demand exists for electric vehicles in small- to medium-sized fleets in British Columbia, several barriers prevent broader uptake in this segment. While many of these barriers are common for prospective electric vehicle buyers in general, there are specific challenges that fleet operators face, and perhaps even more so, small- to medium-sized ones. A program specifically targeted at addressing the barriers facing SMF operators would help advance electrification in this segment beyond current programming.

The survey data from this study suggests that at least some of these barriers are perceived. Despite many survey respondents indicating that currently available electric vehicle models cannot meet their operational needs, most SMF operators in this sample travel less than 200km in a typical day across several vehicle categories ranging from light to heavy-duty. Although use cases vary markedly, over 50% of these vehicles are driven in the city, rather than on highways. Hence, the operational requirements barrier may very well be a perceived barrier rather than an actual one, given that electric vehicle models currently on the market or available in the near term are likely to able to address many of the use cases of SMF operators. The exception to this would be heavier

duty classes, as well as use cases of lighter duty classes with long travel ranges or continuous operation, for which currently available electric vehicles may be inadequate.

A successful bulk buy program would then focus on the use cases for which electrification is possible in the near term. Plug In BC is uniquely situated for such a program offering, given its role as a reputable local agency. Private sector organizations were less responsive to the survey, suggesting that uptake of fleet programming may be greater by public sector organizations. Thus, a successful program would have to build strategic partnerships with local organizations to effectively reach private sector organizations. In conclusion, this study demonstrates that there is interest in a bulk-buy program and provides ground for further exploration on the viability of such a program to advance electric vehicle uptake in small- to medium-sized fleets in British Columbia.

Appendix 1: Interviews and personal communications

The following is a list of interviews that were conducted for the purpose of this research project. All communications were conducted via video conferencing (i.e., Zoom or Microsoft Teams), unless otherwise noted.

Interview reference number	***Role and Organization***	***Date***
1	Program lead #1 at Plug In BC	May 18, 2021
2	Program lead #2 at Plug In BC	June 1, 2021
3	Program lead at Geotab	May 19, 2021
4	Program lead at 7 Gen Capital	June 29, 2021
5	Representative of Vancouver Electric Vehicle Association	October 5, 2021

The following is a list of personal communications with the author, which serve as sources of background information. All communications were conducted via video conferencing (i.e., Zoom or Microsoft Teams), unless otherwise noted. Job titles are generalized, and in some cases, organization is generalized to protect data confidentiality.

Personal communication reference number	***Organization***	***Date***
1	Sales representative at an auto dealership in Vancouver region	February 2, 2020
2	Policy expert at Electric Mobility Canada	August 25, 2021
3	Representative of a board of trade in British Columbia	February 17, 2022
4	Corporate representative of a major auto dealership group in British Columbia	March 31, 2022

Appendix 2: Survey questionnaire

The survey was administered digitally on the Qualtrics platform. The survey can be found here:

https://ubc.ca1.qualtrics.com/jfe/form/SV_6gQni0xuuJWZULY

References

[1] NRCan, "Energy and Greenhouse Gas Emissions (GHGs)," 2020. [Online]. Available: https://www.nrcan.gc.ca/science-data/data-analysis/energy-data-analysis/energy-facts/energy-and-greenhouse-gas-emissions-ghgs/20063. [Accessed: 02-Jun-2021].

[2] P. of British Columbia, "Provincial greenhouse gas emissions inventory - Province of British Columbia," 2020. [Online]. Available: https://www2.gov.bc.ca/gov/content/environment/climate-change/data/provincial-inventory. [Accessed: 02-Jun-2021].

[3] M. Yakub, "British Columbia updates 2030 climate plan with new ZEV sales target," *Electric Autonomy Canada*, 2021. [Online]. Available: https://electricautonomy.ca/2021/10/28/british-columbia-zev-sales-targets/. [Accessed: 06-Jun-2022].

[4] B. Moawad and M. Wolinetz, "California and Québec's ZEV mandates description," May 2019.

[5] Statistics Canada, "New motor vehicle registrations: Quarterly data visualization tool," 21-Jul-2022. [Online]. Available: https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021019-eng.htm. [Accessed: 31-Aug-2022].

[6] California Energy Commission, "New ZEV Sales in California," *Energy Almanac*, 2022. [Online]. Available: https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/new-zev-sales. [Accessed: 31-Aug-2022].

[7] K. Chan, "13% of new car sales in BC in 2021 were electric-battery models | Urbanized," *Daily Hive*, 01-Apr-2022. [Online]. Available: https://dailyhive.com/vancouver/bc-electric-vehicle-statistics-sales-uptake. [Accessed: 07-Jun-2022].

[8] L. Sarabia, "New Canadian EV sales figures from Statistics Canada show strong recovery in Q3 2020, following sharp lockdown dip," *Electric Autonomy Canada*, 2021. [Online]. Available: https://electricautonomy.ca/2021/02/11/canadian-ev-sales-data-q3-2020/. [Accessed: 02-Jun-2021].

[9] British Columbia, "Program Guide for the CleanBC Go Electric Fleets Program," 2022.

[10] Insurance Corporation of British Columbia, "Vehicle Population Data," 2020. [Online]. Available: https://public.tableau.com/app/profile/icbc/viz/VehiclePopulationIntroPage/VehiclePopulationData. [Accessed: 06-Jun-2022].

[11] Insurance Corporation of British Columbia, "Autoplan Insurance | Fleetplan," 2022. [Online]. Available: https://www.icbc.com/insurance/commercial/Pages/Fleetplan.aspx. [Accessed: 06-Jun-2022].

[12] D. Rajagopal and A. Phadke, "Prioritizing electric miles over electric vehicles will deliver greater benefits at lower cost," *Environ. Res. Lett.*, vol. 14, no. 9, 2019.

[13] R. R. Desai, R. B. Chen, E. Hittinger, and E. Williams, "Heterogeneity in Economic and Carbon Benefits of Electric Technology Vehicles in the US," *Environ. Sci. Technol.*, vol. 54, no. 2, pp. 1136–1146, 2020.

[14] Southwest Energy Efficiency Project, "The Electric Vehicle and Photovoltaic Power Purchase Handbook," Mar. 2016.

[15] The Good Car Co, "About Us | The Good Car Company." [Online]. Available: https://www.goodcar.co/about-us. [Accessed: 06-Jun-2022].

[16] D. Coffin, J. Horowitz, D. Nesmith, and M. Semanik, "Examining Barriers to Trade in

Used Vehicles," Mar. 2016.
[17] N. O'Malley, "Inside Australia's growing pirate electric car market," *Sydney Morning Herald*, 28-Dec-2021. [Online]. Available: https://www.smh.com.au/business/entrepreneurship/inside-australia-s-growing-pirate-electric-car-market-20211224-p59k0y.html. [Accessed: 06-Jun-2022].
[18] Sourcewell, "Understanding How Cooperative Purchasing Contracts Work I Sourcewell," 2022. [Online]. Available: https://www.sourcewell-mn.gov/cooperative-purchasing/how-it-works. [Accessed: 06-Jun-2022].
[19] S. Goldsmith and S. Becker, "Cooperative Procurement: Today's Contracting Tool, Tomorrow's Contracting Strategy," Oct. 2018.
[20] Climate Mayors, "Offerings | Drive EV Fleets," 2020. [Online]. Available: https://driveevfleets.org/offerings/#1602703631510-d6b58bc5-f222. [Accessed: 06-Jun-2022].
[21] Fleets for the Future, "Fleets for the Future." [Online]. Available: http://www.fleetsforthefuture.org/. [Accessed: 06-Jun-2022].
[22] Fleets for the Future, "Electric Vehicle Procurement Best Practices Guide," Washington, DC, 2016.
[23] S. Rattenbury, "In collective climate action push, ACT offers electric vehicle coordination 'bulk buy' purchasing arrangement with local partners," *Australian Capital Territory Government Media Releases*, 19-Oct-2018. [Online]. Available: https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/rattenbury/2018/in-collective-climate-action-push,-act-offers-electric-vehicle-coordination-bulk-buy-purchasing-arrangement-with-local-partners. [Accessed: 06-Jun-2022].
[24] M. Costello, "ACT government moving public-servant fleet to EVs, will slash running costs," *CarExpert.com.au*, 04-Apr-2021. [Online]. Available: https://www.carexpert.com.au/car-news/act-government-moving-public-servant-fleet-to-evs-will-slash-running-costs. [Accessed: 06-Jun-2022].
[25] Drive Electric Northern Colorado, "Introducing: EV Fleet Group Buy!," *Drive Electric Northern Colorado*, 2016. [Online]. Available: http://driveelectricnoco.org/group-buy-fleet/. [Accessed: 06-Jun-2022].
[26] T. Anderson, "Electric vehicles in Danish Municipalities: An Understanding of Motivations, Barriers, and the Future of Sustainable Mobility," *Vehicles*, vol. 1, no. 1, pp. 57–68, 2019.
[27] Ea Energy Analyses, "Promotion of electric vehicles: EU Incentives & Measures Seen in a Danish Context," Jan. 2015.
[28] S. and E. D. C. Innovation, "Key Small Business Statistics — 2020 - SME research and statistics," 10-Dec-2020. [Online]. Available: https://www.ic.gc.ca/eic/site/061.nsf/eng/h_03126.html#definition. [Accessed: 06-Jun-2022].
[29] U. D. of E. Alternative Fuels Data Center, "Types of Vehicles by Weight Class." [Online]. Available: https://afdc.energy.gov/data/10381. [Accessed: 06-Jun-2022].
[30] D. Zuev *et al.*, "How clean are electric vehicles? Evidence-based review of the effects of electric mobility on air pollutants, greenhouse gas emissions and human health," *Renew. Sustain. Energy Rev.*, vol. 34, no. 3, pp. 1–17, Mar. 2018.