CONSULTANT TECHNICAL APPENDIX REPORT

CONTENTS:

APPENDIX A: BETTERFLEET TRANSITION ANALYSIS

1 Introduction to BetterFleet Plan™ Modeling

The Zero-Emission Vehicle (ZEV) Fleet Strategy seeks to map the best pathway to a zero-emissions fleet considering the demands and operational context of the District of Saanich. Through BetterFleet Plan™ modelling, a fleet transition plan has been developed to guide zero-emission vehicle (ZEV) investments in the short, medium, and long-term. Complementing the BetterFleet Plan analyses are strategic recommendations to guide ZEV investments across the District's fleet and in consideration of the longer-term mandates outlined in the Saanich Climate Plan.

The BetterFleet Plan analysis defines and quantifies opportunities and challenges arising from the transition to ZEVs, articulates pathways toward meeting Saanich climate goals, and provides context to support other related strategic initiatives (such as EV infrastructure development).

1.1 Methodology underpinning analysis

The aim of the BetterFleet Plan analysis is to help the District understand when assets are technically and commercially suitable for electrification. The methodology applied herein is presented below:

1. Map replacement schedule and emissions for business-as-usual like-for-like replacements (lowest total cost of ownership (TCO)).
2. Understand if there are like-for-like ZEV replacements based on duty requirements in the market at each replacement date and the expected market timing for alternatives.
3. Map asset replacement schedules for the forecast period under the devised scenarios, selecting the most appropriate replacement vehicle according to the preferences of given scenarios, delivering economic budgets, and evaluating emissions outcomes.
4. Assemble preliminary emissions and costing information for the forecast period, excluding out-of-scope considerations such as infrastructure deployment.

A like-for-like analysis assumes the functional attributes of the existing vehicles in the fleet are optimized for particular purposes, and the need for a purpose is certain and cannot be replaced. Like-for-like light vehicle replacements are determined by matching existing fleet assets against all options within the same peak-body designated vehicle segment and sub-segment. Heavy vehicles are generally more customized, so replacements are identified based primarily on gross vehicle mass (GVM).

A derating factor is applied to the energy consumption rating to account for variability of battery performance in cold and hot weather conditions, and the added relative drain of heating and air conditioning systems. Modeling the peak energy consumed by electric vehicle replacements to existing fleet assets therefore presents worst-case energy consumption.

Master data is applied to total cost of ownership (TCO) and asset replacement modeling tools, set up to compute results for scenarios according to the assumptions underpinning each scenario. We note that this analysis is built on several assumptions based on a combination of empirical data from other jurisdictions, professional judgment, and data provided by Saanich. As such, while the nearer-term years of the forecast can be expected to be relatively accurate, the future years provide a framework for analysis and will need to be updated on a regular basis as the market matures.

1.2 Fleet transition scenarios

The following pathways have been used as the core framework for the analysis of future scenarios for the District of Saanich's fleet.

Table 1: Description of modeled scenarios

Scenario name	Scenario description
Business-as-usual (BAU) scenario	The lowest TCO vehicle equivalent is procured. Procurement of ZEVs is excluded under this scenario regardless of TCO outcome to outline a consistent baseline from which the ZEV transition scenarios can be compared. The intention of BAU is that it is the "do nothing" scenario, i.e., it is reflective of how the District would continue to procure vehicles if there were no mandates or initiatives related to emissions reduction or fleet electrification. In the BAU, hybrid and plug-in hybrid examples might be procured where lowest TCO is demonstrated.
Cost-optimized scenario	The cost-optimized scenario seeks to meet your emissions and fleet electrification targets in the most cost-optimized manner. In this scenario, generally the lowest TCO vehicle example is procured, however, ZEVs may be selected even if the TCO is not the lowest if they are required to meet your climate objectives and policies, so long as there is a viable alternative that can meet the needs of the District. This scenario generally results in higher costs than for BAU as a result of the 'green premium' of purchasing ZEVs.
Technology leadership scenario	The technology leadership scenario seeks to position Saanich as an industry leader in fleet electrification. Whereas in the cost-optimized scenario we are only electrifying the fleet as much as necessary to meet your objectives, in the technology leadership scenario we are generally halting all purchases of internal combustion engine (ICE) vehicles provided there is a suitable ZEV alternative. This results in a faster transition of your fleet to ZEVs but also results in the highest TCO out of the scenarios.

2 Fleet Transition Plan

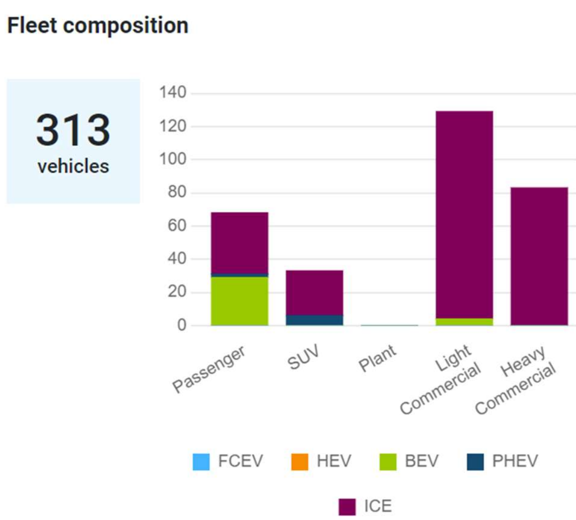
To begin the BetterFleet Plan modelling, the District's fleet was divided into light-duty vehicles and heavy-duty vehicles. Separate analyses were run for each within the BetterFleet Plan platform, taking into account the differences between light-duty and heavy-duty fleet operations, and then combined in a single interactive dashboard across the fleet as a whole.

2.1 Light- and heavy-duty vehicle fleet

2.1.1 Fleet Composition

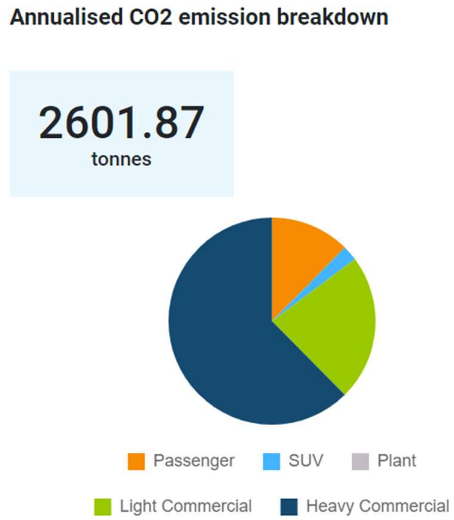
Pickup trucks and vans are the largest components of the light-duty vehicle fleet at the District. An assortment of van vehicle sizes and types exists within the District's fleet. There is a substantial amount of small vehicles in both passenger and SUV types. In total, there are 230 light-duty vehicles in the fleet that are primarily ICE. The remaining 83 vehicles in the fleet are heavy commercial vehicles.

Figure 1: Mixed vehicle fleet composition



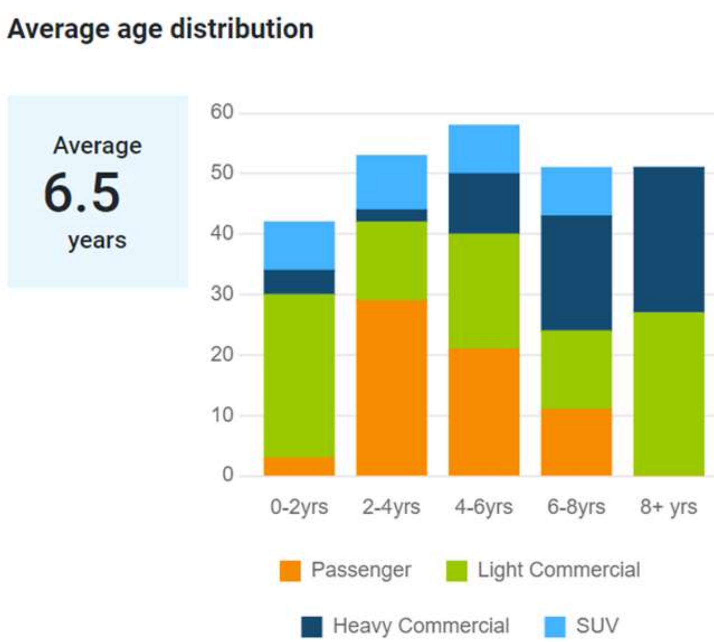
Based on fuel data provided by the District, the BetterFleet Plan modelling shows 2,602 annual tonnes of CO_2. Although heavy-duty vehicles do not constitute the majority of the District's fleet, due to the high-emitting nature of heavy-duty vehicles relative to light-duty vehicles, the majority of the emissions come from the heavy-duty vehicle fleet.

Figure 2: Mixed vehicle emissions breakdown



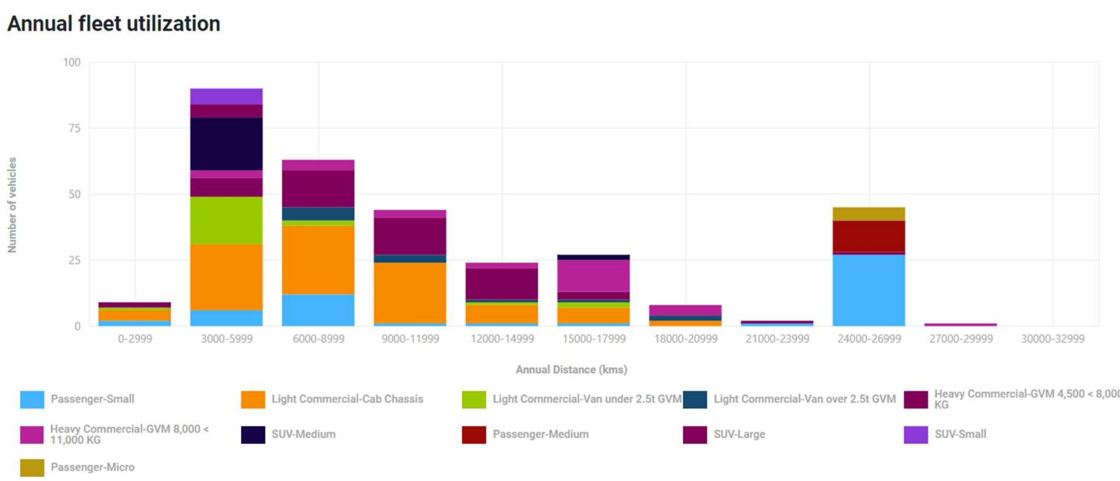
The District's fleet has an average age of 6.5 years. As several vehicles are due for replacement in between now and 2027, this suggests that there could be ample opportunities for early ZEV deployments in the short-term, depending on vehicle specifications, use cases, and duty cycles.

Figure 3: Mixed vehicle average age distribution



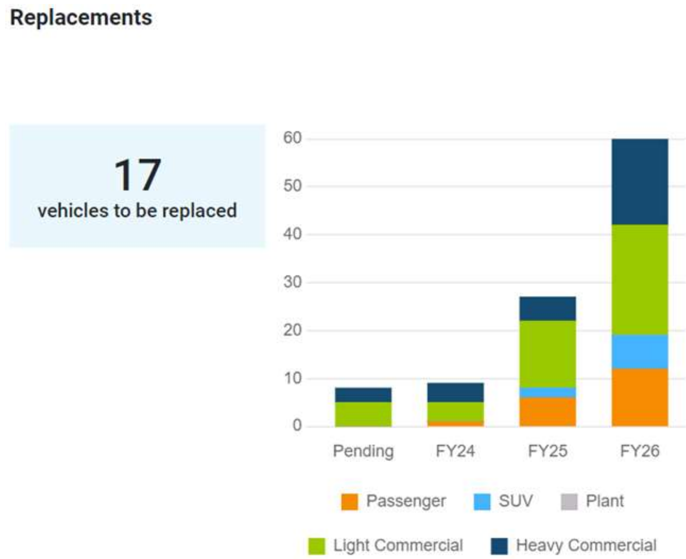
The District's fleet consists of a mix of vehicles with light, medium, and heavy utilizations. Heavily utilized vehicles can be difficult to transition to ZEVs if their daily duties are demanding, and potentially prohibitive on the basis of range/mileage requirements or a limited amount of time available for charging. On the other hand, lightly utilized vehicles, while generally more feasible for transition, will bring limited benefits in terms of emissions savings and operating cost savings compared to their more highly utilized counterparts. In preparing the fleet transition plan, the BetterFleet Plan software sorts through which vehicles may feasibly be transitioned based on today's technologies, and which cannot be.

Figure 4: Mixed vehicle annual fleet utilization



The time-to-replacement profile is important for determining which vehicles are coming up for replacement in the next few years. The vehicles due for replacement shortly are primarily the light commercial and heavy commercial vehicles. In total, there are 17 vehicles due for replacement in between now and year-end 2024. Many vehicles are also due for replacement in 2025, 2026, and 2027, including more passenger and SUV assets.

Figure 5: Mixed vehicle time-to-replacement profile



2.1.2 Market Capability and Transition Feasibility

The challenge for heavy-duty vehicles at the moment, as noted above, is the lack of suitable EV equivalents in this part of the market. Small and medium-sized passenger vehicles have greater options currently.

While similar markets overseas provide many times more vehicle choices per segment, and the technology is now well and truly validated, the electric vehicle market is only slowly increasing in competitiveness. More options are becoming available at lower price points, with growing access to fleet-centric options. There is growing diversity in battery size options trending in the market, with vehicles now available described as 'standard range' and 'extended range' or similar.

The table below describes the existing and anticipated battery capacities in different market segments. This becomes a key consideration in assessing technical feasibility.

Table 2: Light vehicle class and typical maximum battery sizes

Light Vehicle Class	Sub Class	Largest Battery Size in Market (Example Vehicle)	Example Vehicle
SUV	Large and Upper Large	87 kWh (Rivian R1S)	Rivian R1S
SUV	Medium	76 kWh (Hyundai IONIQ 5)	Hyundai IONIQ 5, Volkswagen ID.4, Volvo XC40
SUV	Small	64 kWh	Kia Niro EV, Mazda MX-30, Hyundai Kona Electric
Passenger	Large	70 kWh	Mustang Mach-E
Passenger	Medium	60 kWh	Volvo C40, Chevy Bolt EUV
Passenger	Small / Light	52 kWh	Chevrolet Bolt EV
Light Commercial	Small Truck	200 kWh	Ford F-150 Lightning, Chevrolet Silverado EV
Light Commercial	Van over 2.5T	125 kWh	Ford E-Transit
Light Commercial	Light bus (under 20 seats)	125 kWh	Ford E-Transit

2.1.3 Transition Results and Economic Analysis

As noted above, a cost-optimized scenario and a technology leadership scenario were developed as possible implementation alternatives for the ZEV Fleet Strategy.

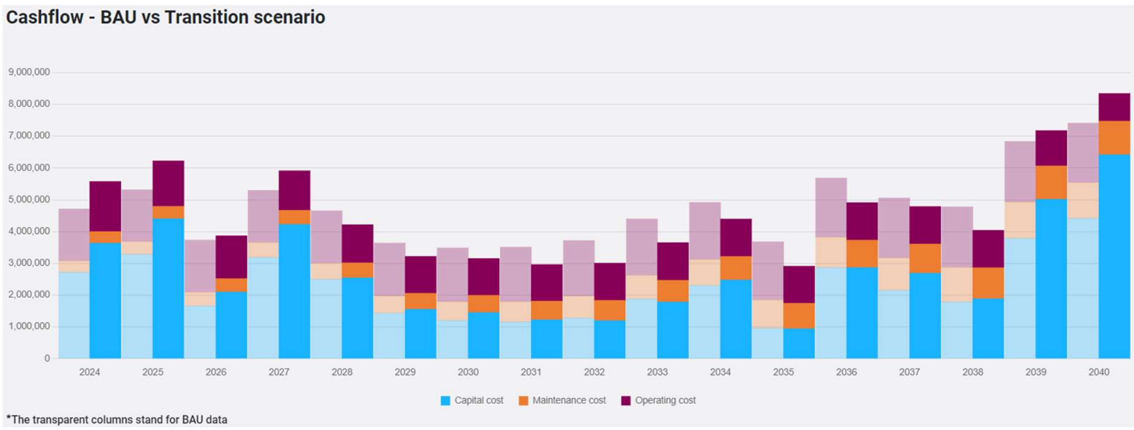
The cost-optimized scenario looks for comparable ZEVs and considers the TCO and emissions differential with respect to the existing fossil fuel fleet. When a vehicle reaches its retirement year, if it has a viable ZEV option that has a lower TCO than its ICE counterpart, the cost-optimized scenario recommends the ZEV; otherwise the model will recommend the cheaper ICE option. For the District of Saanich, a large portion of the light commercial vehicles remains ICE because of this very metric. The currently available ZEV options are slightly more expensive than their ICE counterparts. SUVs and passenger vehicles currently don't have this concern so a larger portion of them are available to transition to ZEVs, particularly in later years of transition when an increasing number of ZEV models are expected to reach cost parity.

Overall, the net present value (NPV) of the cost-optimized transition through the year 2040 is approximately $78M, compared to a business-as-usual NPV of approximately $81M. This NPV includes both capital and operating costs related to the vehicles and are exclusive of other infrastructure-related costs that would be determined through site visits, discussions with the utility, and through a more robust cost estimation process. These values also do not include applicable incentives and allow for a worst case NPV results. In many cases the District would be eligible for incentives on the purchase of new ZEVs, however, it is unclear how long these incentives will be offered. Both incentives and infrastructure-related costs would need to be considered for a true apples-to-apples comparison of the two scenarios. Total CO_2 emissions through the year 2040 in this cost-optimized scenario is 30,121 tonnes compared to 45,539 tonnes in the business-as-usual scenario, resulting in a 34% decrease. While these values represent cumulative emissions through 2040, annualized emission profiles are shown in section 2.1.4 Preliminary CO2 Emissions Analysis. The transition of ZEVs under the cost-optimized scenario is shown below.

Figure 6: Cumulative 2040 Mixed vehicle transition results – cost-optimized transition by type

Under the BAU scenario, the spending is generally under $5,000,000 per year, with exception of occasional years of higher spending due to the quantity of vehicles being procured, and their combined value. The variable part of the spend is the capital expenditure for vehicles which varies in line with peaks and valleys in procuring vehicle replacements. The operating costs and maintenance costs remain relatively constant over the period. This scenario forms the baseline against which the cost-optimized and technology leadership scenarios are compared.

Figure 7: Mixed vehicle transition cost profile – business-as-usual and cost-optimized scenarios



In the cost-optimized transition, slightly greater capital spending occurs in the short term, when greater quantities of ZEVs are added to the fleet. Small cost savings in operating costs and maintenance costs are seen beginning in 2024 after the first vehicles have transitioned to ZEV alternatives. By around 2030 many vehicles may be cheaper to acquire as EVs than ICE.

Departmental vehicle capital cost breakdowns into the Fire, Municipal, and Police Fleets are as follows. Notably, these capital costs differ from what is illustrated in Figure 7 above because these are exclusively the forecasted capital costs for vehicle acquisition, whereas Figure 7 also considers vehicle residual values, operating costs and planning-level estimates of infrastructure capital costs.

Table 3: Departmental vehicle capital cost breakdowns – business-as-usual and cost optimized

Business-as-usual

Dept.	2024	2025	2026	2027	2028	2029	2030	2031	2032
Fire	$1.483M	$0.521M	$0.000M	$0.046M	$0.085M	$0.072M	$0.836M	$0.116M	$0.163M
Municipal	$1.710M	$2.972M	$1.491M	$3.358M	$2.586M	$1.303M	$0.598M	$0.911M	$1.023M
Police	$0.385M	$0.822M	$0.562M	$0.595M	$0.570M	$0.711M	$0.073M	$0.357M	$0.578M
Total	$3.577M	$4.314M	$2.054M	$3.999M	$3.241M	$2.086M	$1.506M	$1.383M	$1.764M

Dept.	2033	2034	2035	2036	2037	2038	2039	2040	Total
Fire	$0.134M	$0.347M	$0.438M	$0.578M	$0.781M	$0.267M	$0.146M	$0.342M	$6.353M
Municipal	$1.243M	$1.766M	$0.048M	$2.341M	$1.626M	$1.377M	$4.038M	$4.326M	$32.716M
Police	$1.030M	$0.609M	$0.712M	$0.725M	$0.125M	$0.410M	$0.560M	$0.727M	$9.551M
Total	$2.408M	$2.722M	$1.198M	$3.644M	$2.531M	$2.053M	$4.743M	$5.395M	$48.619M

Cost-optimized scenario

Dept.	2024	2025	2026	2027	2028	2029	2030	2031	2032
Fire	$1.483M	$0.521M	$0.000M	$0.046M	$0.085M	$0.072M	$0.836M	$0.116M	$0.163M
Municipal	$2.025M	$3.919M	$1.794M	$4.297M	$2.586M	$1.371M	$0.812M	$0.981M	$0.979M
Police	$0.514M	$0.940M	$0.652M	$0.638M	$0.587M	$0.728M	$0.073M	$0.371M	$0.608M
Total	$4.022M	$5.380M	$2.446M	$4.981M	$3.258M	$2.171M	$1.720M	$1.468M	$1.750M
Dept.	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**Total**
Fire	$0.134M	$0.347M	$0.438M	$0.616M	$0.802M	$0.267M	$0.161M	$0.382M	$6.467M
Municipal	$1.129M	$1.952M	$0.076M	$2.277M	$2.207M	$1.574M	$5.512M	$6.414M	$39.906M
Police	$1.057M	$0.572M	$0.679M	$0.709M	$0.101M	$0.375M	$0.499M	$0.649M	$9.752M
Total	$2.321M	$2.871M	$1.193M	$3.601M	$3.110M	$2.216M	$6.172M	$7.444M	$56.125M

Vehicle and charging infrastructure rollout in the cost-optimized scenario are illustrated in the following two figures. Further details on the vehicle transitioning for each asset in the Fire, Municipal, and Police fleets are appended to this report. Notably, the charging infrastructure rollout should be viewed as an initial estimate. There may be opportunities to reduce the number of chargers needed, though this would be dependent on a more fulsome analysis of vehicle domiciles and duty cycles.

Figure 8: Fleet composition over time for the cost-optimized scenario

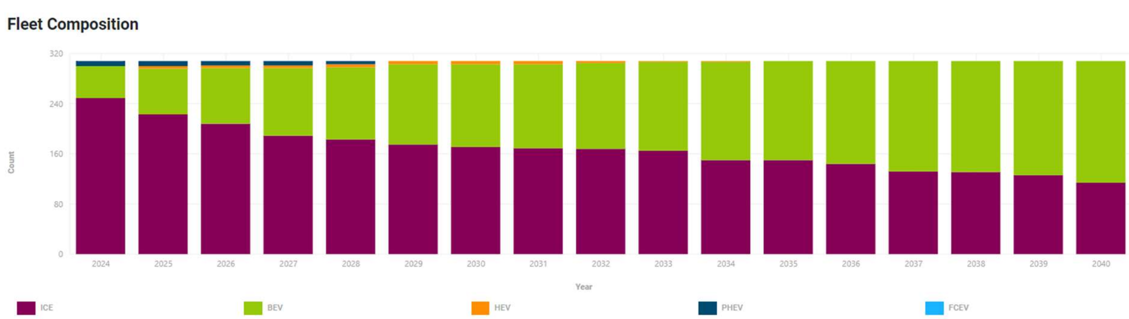


Figure 9: Charging infrastructure rollout (quantities) over time for the cost-optimized scenario

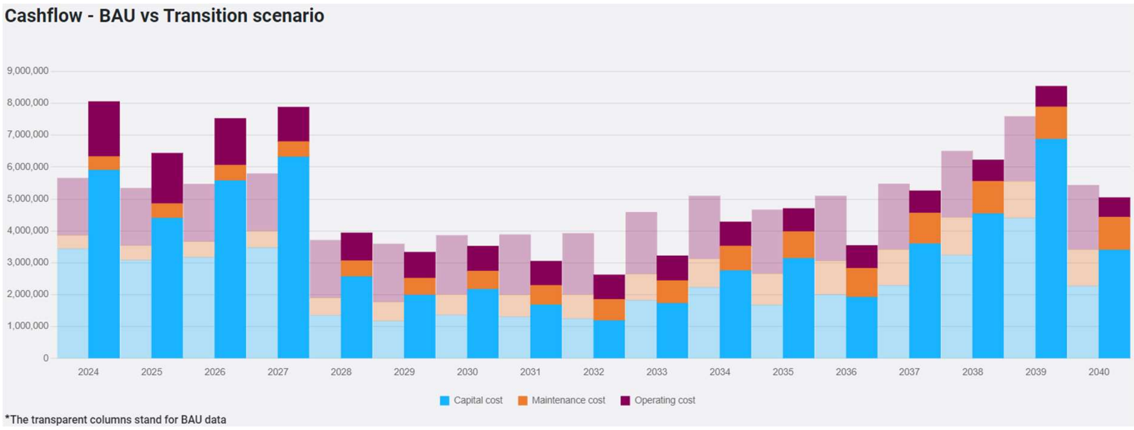
Unlike the cost-optimized scenario, the technology leadership scenario looks for comparable vehicles and identifies ZEVs for fleet transition exclusively based on market availability and fit-for-purpose, and without regard to the cost premiums. That is, when a vehicle reaches its retirement year, if there is a viable ZEV option, the technology leadership scenario recommends implementing the ZEV.

Overall, the net present value (NPV) of the technology leadership transition through the year 2040 is approximately $87M, compared to a business-as-usual NPV of approximately $81M. This NPV includes both capital and operating costs related to the vehicles and are exclusive of other infrastructure-related costs that would be determined through site visits, discussions with the utility, and through a more robust cost estimation process. Total CO_2 emissions in this cost-optimized scenario is 21,722 tonnes compared to 45,539 tonnes in the business-as-usual scenario, resulting in a 52% decrease. While these values represent cumulative emissions through 2040, annualized emission profiles are shown in section 2.1.4 Preliminary CO2 Emissions Analysis. The transition of ZEVs under the technology leadership scenario is shown below.

Figure 10: Cumulative 2040 Mixed vehicle transition results – technology leadership transition by type

In the technology leadership transition, greater differentials of capital spending are more prevalent across more of the forecast years compared to the cost-optimized transition, as larger quantities of ZEVs are identified for implementation. Cost savings in operating costs and maintenance costs are seen beginning in 2024 after the first vehicles have transitioned to ZEV alternatives. From 2030 some vehicles may be cheaper to acquire as EVs than ICE.

Figure 11: Mixed vehicle transition cost profile – business-as-usual and technology leadership scenarios



Departmental vehicle capital cost breakdowns into the Fire, Municipal, and Police Fleets are as follows. Notably, these capital costs differ from what is illustrated in Figure 11 above because these are exclusively the forecasted capital costs for vehicle acquisition, whereas Figure 11 also considers vehicle residual values and planning-level estimates of infrastructure capital costs.

Table 4: Departmental vehicle capital cost breakdowns – business-as-usual and technology leadership

Business-as-usual

Dept.	2024	2025	2026	2027	2028	2029	2030	2031	2032
Fire	$1.483M	$0.521M	$0.000M	$0.046M	$0.085M	$0.072M	$0.836M	$0.116M	$0.163M
Municipal	$1.710M	$2.972M	$1.491M	$3.358M	$2.586M	$1.303M	$0.598M	$0.911M	$1.023M
Police	$0.385M	$0.822M	$0.562M	$0.595M	$0.570M	$0.711M	$0.073M	$0.357M	$0.578M
Total	$3.577M	$4.314M	$2.054M	$3.999M	$3.241M	$2.086M	$1.506M	$1.383M	$1.764M

Dept.	2033	2034	2035	2036	2037	2038	2039	2040	Total
Fire	$0.134M	$0.347M	$0.438M	$0.578M	$0.781M	$0.267M	$0.146M	$0.342M	$6.353M
Municipal	$1.243M	$1.766M	$0.048M	$2.341M	$1.626M	$1.377M	$4.038M	$4.326M	$32.716M
Police	$1.030M	$0.609M	$0.712M	$0.725M	$0.125M	$0.410M	$0.560M	$0.727M	$9.551M
Total	$2.408M	$2.722M	$1.198M	$3.644M	$2.531M	$2.053M	$4.743M	$5.395M	$48.619M

Technology leadership scenario

Dept.	2024	2025	2026	2027	2028	2029	2030	2031	2032
Fire	$2.473M	$0.377M	$0.045M	$0.046M	$0.161M	$0.096M	$0.945M	$0.219M	$0.127M
Municipal	$2.338M	$3.851M	$5.507M	$6.594M	$2.153M	$2.027M	$1.103M	$1.340M	$0.826M
Police	$0.925M	$0.957M	$0.741M	$0.467M	$0.637M	$0.375M	$0.371M	$0.421M	$0.715M
Total	$5.735M	$5.185M	$6.293M	$7.106M	$2.952M	$2.497M	$2.420M	$1.980M	$1.667M

Dept.	2033	2034	2035	2036	2037	2038	2039	2040	Total
Fire	$0.102M	$0.457M	$2.053M	$0.000M	$1.271M	$0.340M	$0.147M	$0.600M	$9.458M
Municipal	$1.189M	$1.906M	$0.785M	$1.979M	$2.304M	$4.960M	$7.697M	$3.206M	$49.765M
Police	$0.936M	$0.661M	$0.664M	$0.389M	$0.374M	$0.323M	$0.694M	$0.652M	$10.300M
Total	$2.227M	$3.023M	$3.502M	$2.368M	$3.949M	$5.623M	$8.537M	$4.458M	$69.523M

Vehicle and charging infrastructure rollout in the technology leadership scenario are illustrated in the following two figures. Further details on the vehicle transitioning for each asset in the Fire, Municipal, and Police fleets are appended to this report. Notably, the charging infrastructure rollout should be viewed as an initial estimate. There may be opportunities to reduce the number of chargers needed, though this would be dependent on a more fulsome analysis of vehicle domiciles and duty cycles.

Figure 12: Fleet composition over time for the technology leadership scenario

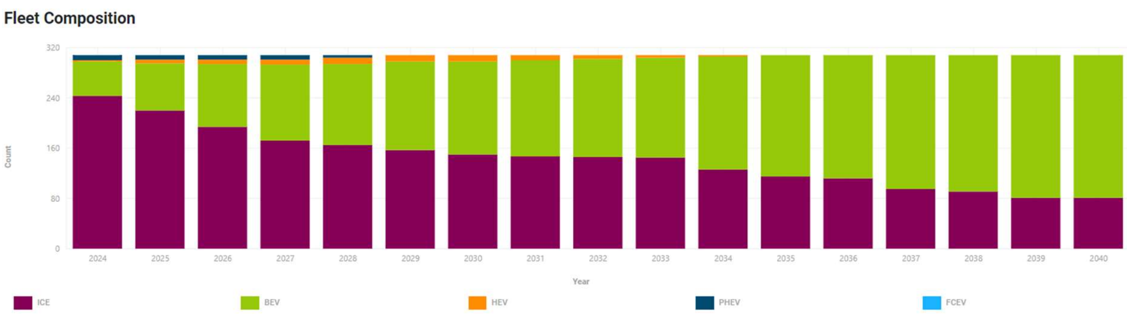


Figure 13: Charging infrastructure rollout (quantities) over time for the technology leadership scenario

2.1.4 Preliminary CO_2 Emissions Analysis

The emissions profiles for District's fleet, shown below, illustrates the impact the transition to ZEVs has on CO_2 emissions. Under the cost-optimized transition, emissions fall to under 1,800 tons per year by 2030, while the BAU continues to emit close to 2,700 tons of CO_2 per year (including well-to-wheels emissions). The remaining emissions in the cost-optimized scenario are the result of the fleet not reaching 100% ZEV due to the cost restraints built into the model. By 2040, there is a 62% decrease in total annual emissions across the full fleet in the cost-optimized scenario.

For the technology leadership scenario, we see an even larger decrease in total emissions. By 2030, annual CO_2 emission tonnes are around 1,100, and by 2040 there is an 81% decrease in total annual emissions across the fleet.

Figure 14: Transition emissions profile, BAU versus cost-optimized scenario

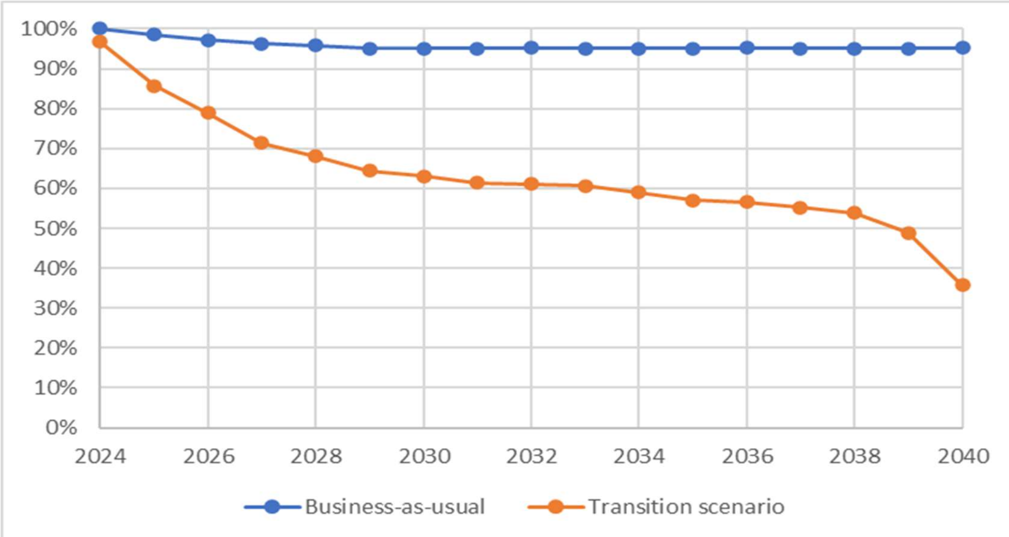
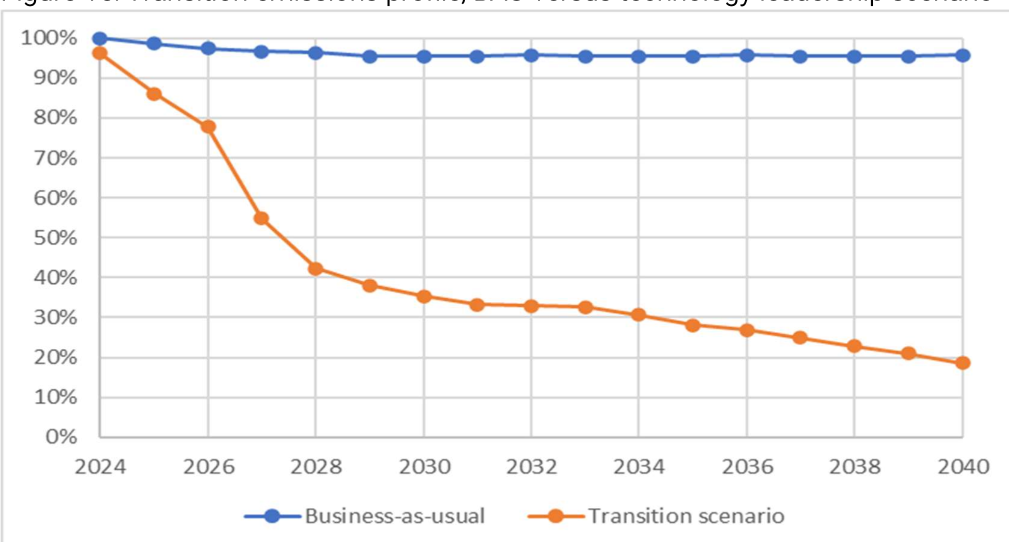


Figure 15: Transition emissions profile, BAU versus technology leadership scenario



3 Conclusions and recommendations

The core focus of the BetterFleet analysis was to evaluate the District of Saanich's fleet, identify suitable EV replacements that meet key operational fit-for-purpose requirements, and outline a preliminary strategy to help guide initial fleet transitioning action in the short to medium term.

Some of the key conclusions from the analysis include:

1. Saanich's fleet contains a large number of vehicles that are due for transition, providing low-hanging fruit to begin transitioning to an EV fleet.

1.1. The cost-optimized scenario and the technology leadership scenario illustrate two possible pathways to electrification, but they are not the only two possibilities.

1.2. Regardless of the scenario selected, there are short-term opportunities for Saanich to demonstrate 'quick wins' in electrification, with ZEVs identified as early as 2024 in both the cost-optimized and technology leadership scenarios.

1.3. Appropriate budgets should be established, and appropriate funding and grant sources identified, to help guide the implementation. Essential infrastructure to support the EV transition will also need to be considered.

1.4. Fleet transitioning is best approached with a mind of efficiency, where charging infrastructure is phased in over time and not unnecessarily front-end loaded. The District should take a pragmatic approach to phase in infrastructure at garaging locations accordingly. The significant number of sites (considering the total fleet size) suggests the District should consider prioritizing sites based on criteria like suitability for electric upgrades, vehicle capacity, and operating characteristics.

2. Emphasizing light-duty vehicles in the transition is a prudent approach for early pilots.

2.1. Light-duty vehicles generally have stronger feasibility for electrification in the short-term as the technology is more established and the TCO gap is more manageable.

2.2. However, there are considerable opportunities for heavy-duty vehicle electrification too, in both the cost-optimized and technology leadership scenarios.

2.3. Prioritize learnings through early electrification projects targeting the lowest TCO gap. Take advantage of new and existing sources of data to build a deeper understanding of the duty cycle demands on assets at relatively low cost.

Dept.	Asset	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Fire	607		ICE					ICE					ICE					ICE
	608		ICE					ICE					ICE					BEV
	609	ICE					ICE					ICE					ICE	
	610		ICE												ICE			
	611	BEV												BEV				
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	621		BEV								BEV							
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	623								ICE									
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	715																	
	1625							ICE										BEV
	1001			BEV							BEV							BEV
	1002					ICE							ICE					
	1003			BEV							BEV							BEV
	1004			BEV							BEV							BEV
	1005		BEV							BEV							BEV	
	1006		ICE								ICE							
	1007					BEV							BEV					
	1008	ICE								ICE								ICE
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	1017			BEV								BEV						
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APPENDIX B: PBX CHARGING INFRASTRUCTURE OVERVIEW & ELECTRICAL CAPACITY ASSESSMENTS

PBX Engineering Ltd.

300-131 Water Street
Vancouver, BC, V6B 4M3
T + 604.408.7222
F + 604.408.7224

201-2612 Bridge Street
Victoria, BC, V8T 4S9
T + 250.388.7222
F + 778.433.9130

www.pbxeng.com

Technical Memorandum No. 01 v1.0 - FINAL

PROJECT NAME:	**SAANICH ZERO EMISSIONS FLEET STRATEGY**		
OWNER:	District of Saanich		
PRIME CONSULTANT:	Innotech Fleet Strategies	**DATE:**	December 22, 2023
CONTRACTOR:	N/A	**MEMO NO.:**	01 v1.0
ATTENTION:	**Steven Wiebe P.Eng, PMP**		
SUBJECT:	**Preliminary Assessment**		

1 Introduction

The District of Saanich is interested in increasing efficiency and reducing greenhouse gas (GHG) emissions of their fleet operations. The District of Saanich retained Innotech Fleet Strategies to provide recommendations that allow the District to understand the industry, set realistic emission reduction targets, balance risk, and provide a roadmap for a cost-effective and successful implementation. Innotech Fleet Strategies retained PBX Engineering Ltd to:

- Perform a detailed review of the electrical record information for six (6) locations,
- Support Innotech as required for development of the Charging / EVSE plan,
- Based on information provided by the District of Saanich, determine:
  - the potential EVSE load based on the Charging plan, and
  - the spare capacity after EVSE installation and whether or not an electrical service upgrade is required.
- Determine electrical infrastructure requirements to support the Charging plan that comprises:
  - a conceptual design that includes the location of charging equipment,
  - an estimate of electrical infrastructure costs including any necessary electrical service upgrades, and
  - reference to any design provisions for future expansion of charging to support fleet electrification growth.

The District of Saanich is considering electrifying their fleet at the following six (6) locations:

- Municipal Hall (and Annex)
- 3500 Blanshard
- Saanich Operations Centre
- Public Safety Building
- Fire Hall #1 (Public Safety Building)
- Fire Hall #2

The purpose of this Technical Memorandum is to:

- Review proposed equipment and determine requirements,
- Summarize the findings from the electrical record information,
- Summarize the findings from the electrical capacity assessments, and
- Determine options for providing power to the EVSE infrastructure.

2 Codes and Standards

This Technical Memorandum has been prepared in accordance with all authoritative / legislated codes and standards adopted at the time of design by the Authorities Having Jurisdiction (AHJ), including the following:

- BC Hydro Electric Vehicle Charging Guidelines
- Canadian Electrical Code Part 1: CSA C22.1 – 2021
- Canadian Electric Vehicle Infrastructure Deployment Guidelines – 2014

3 Record Information / Information Provided By Others

The following information has been used as reference information in the preparation of this technical memorandum:

- District of Saanich Buildings EV Charging Station Feasibility Study – Condition Assessment Findings, Draft Sep 17, 2019, Stantec
- Public Safety Building EV Charging Stations (Police) Preliminary Design Summary, Technical Memorandum, Feb 24, 2020, PBX Engineering Ltd.
- Saanich Public Works Yard EVSE, Feasibility Report, Jun 08, 2020, Evolve Engineering Inc.
- Saanich Hall Annex and Public Works Yard EVSE Upgrade, Schematic Design Report, Dec 18, 2017, Evolve Engineering Inc.
- Saanich Municipal Hall Annex EV Charging Station Upgrade, Issued for Tender Drawings, May 22, 2018, Evolve Engineering Inc.
- Saanich Hall and Annex Single Line Diagram, Record Drawing, Oct 02, 2018, Evolve Engineering Inc.
- 3500 Blanshard, IFT As-built Drawings, Nov 26, 2020, AES
- Parks Admin Bldg SLD, Hand Sketch, 2018
- Fleet Bldg SLD, Hand Sketch, 2018
- Stores Bldg SLD, Hand Sketch, 2018
- Saanich Operations Centre EVSE, Construction Drawings, Mar 08, 2022, PBX Engineering Ltd.
- Public Works Admin SLD, Hand Sketch, 2018
- Parks Construction Bldg SLD, Hand Sketch, 2018
- Parks Mechanics Shop SLD, Hand Sketch, 2018
- Brine/Salt Shed SLD, Hand Sketch, 2018
- DoS Public Safety Building SLD and Floor Plan, Record Drawings, Oct 28, 2016 PBX Engineering Ltd.
- DoS Public Safety Building Ops Centre Upgrade, Tender Drawings, Jul 16, 2019, PBX Engineering Ltd.
- DoS Public Safety Building EV Charging Stations, Construction Drawings, Sep 09, 2022, PBX Engineering Ltd.

- DoS EV Charging Stations, Tender Drawings, Apr 12, 2018, PBX Engineering Ltd.
- Saanich Fire Station #2, Building Permit Drawings, Feb 22, 2023, Introba
- 1-Year Historical Load Consumption Data, July 2022-2023, BC Hydro

4 Definitions

In this section, industry accepted electric vehicle standards, configurations, and types are defined and explained in detail.

4.1 Abbreviations

A	Amp
AC	Alternating Current
BMS	Battery Management System
BCH	British Columbia Hydro and Power Authority
DC	Direct Current
DCFC	Direct Current Fast Charging
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
GHG	Greenhouse Gas
kW	Kilowatt
PMT	Padmount Transformer
PH	Phase
V	Volts

4.2 EVSE System Configurations

There are varying configurations for EVSE as developed by electric vehicle manufacturers. As a result, they offer a range of charging options. In general, they conform to the standard system configuration shown below.

The EV battery is located on-board the vehicle. Power is delivered to the vehicle battery through an inlet, which is considered a part of the vehicle. A connector with a cord connects the vehicle and makes an electrical connection for the purposes of charging and exchanging information. The connector makes an electrical connection between the vehicle and the utility (or the power source). The utility is known as the Energy Portal. The connector, cord, and associated components that make the connection are collectively known as the Electric Vehicle Supply Equipment (EVSE). The interface between the EVSE and Energy Portal can be as simple as a plug and receptacle interface. The charging configurations vary based on type of connector and charging levels.

4.3 Charging Levels

Four (4) levels of charging comprise charging stations for commercial applications or for public use on private or public property. They are as follows:

- AC Level 1 Charging
- AC Level 2 Charging
- DC Fast Charging (DCFC) (formerly Level 3)
- Mega Watt Charging (MCS)

The amount of time needed to charge an EV battery is a function of charge level, battery size, battery age, the EV Battery Management System (BMS), and the on-board charger specifications. The BMS will communicate with the EVSE to identify the circuit rating and adjust the charge to the battery accordingly.

On-board battery chargers are only used with AC Level 1 and 2 charging. With DCFC and above, the EVSE connection is direct to the battery.

The battery to be considered for charging times is a 65kWh battery, typical of most consumer electric cars currently on the road (e.g. Chevy Bolt). The on-board charger specifications will determine the amount of charge a battery can receive. For example, the Chevy Bolt can accept up to 7.7kW of charging on an AC Level 2 Charging station. For a level 2 station of greater power output, the Chevy Bolt will still only accept up to 7.7kW. Furthermore, charging speed slows via the BMS as the battery gets closer to full to prevent damage to the battery. It can take about as long to charge the last 10 percent of the battery as the first 90 percent.

4.3.1 AC Level 1 Charging

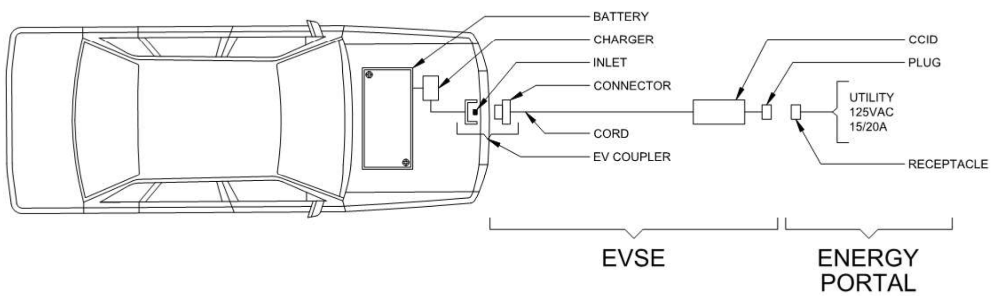

Figure 1 - Standard AC Level 1 Charging Station Configuration

AC Level 1 Charging provides the slowest charging times. Typical charging current for this system is 12 Amps (15 Amp rated circuit) at common Voltage levels (120VAC). Power is delivered to the on-board vehicle battery through an EVSE connected to facility power via plug-in from a standard 3-prong AC Cord Set (120VAC, 15 Amp). AC Level 1 Charging is more common in residential applications and typically provides charge times of 40 to 50 hours to completely charge a typical EV battery when fully depleted.

4.3.2 AC Level 2 Charging

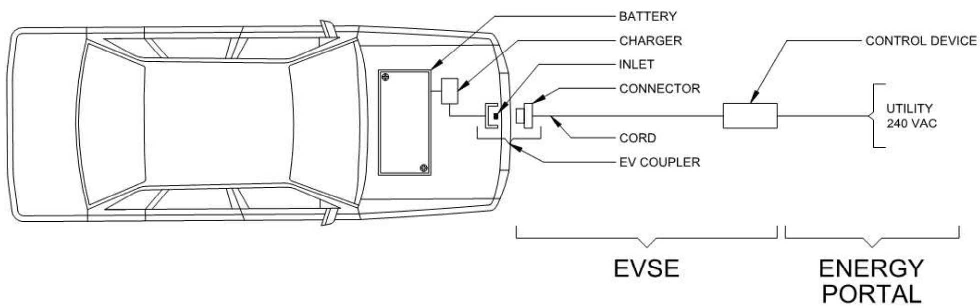

Figure 2 – Standard AC Level 2 Charging Station Configuration

AC Level 2 Charging provides faster charging times than Level 1. Typical charging currents for this system are between 32 Amps (40 Amp rated circuit) and up to 80 Amps (100 Amp rated circuit). Charging currents are delivered at higher Voltages (208VAC or 240VAC, Single-Phase) than Level 1. Power is delivered to the on-board vehicle battery through an EVSE that is hard-wired to the facility electrical distribution system. AC Level 2 Charging is more common in commercial applications and typically provide charge times of 4 to 10 hours to completely charge an EV battery when fully depleted.

The order of magnitude total cost for a single-head AC Level 2 Charging Station is $30,000.00. The cost includes civil infrastructure, conduit and wiring, supporting electrical equipment, and the EVSE. Cost savings can be achieved by using multiple-head charging stations and power sharing technology for multiple charging stalls.

4.3.3 DC Fast Charging

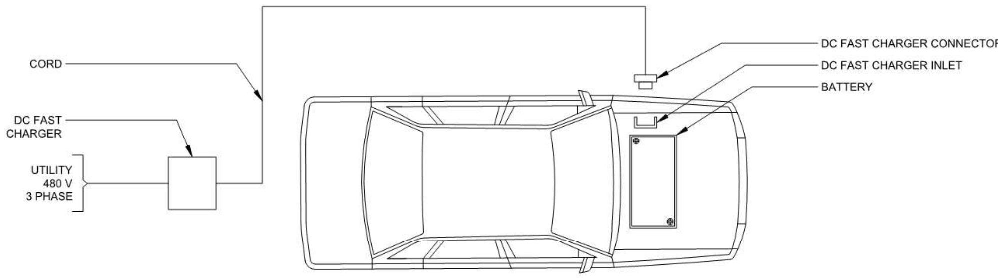

Figure 3 – Standard DC Fast Charging Station Configuration

DC Fast Charging provides the fastest charging times and the installation required is typically the most expensive of the charging options. Typical charging currents for this system are between 65 Amps (100 Amp rated circuit) and up to 130 Amps (200 Amp rated circuit) at higher Voltages (480VAC, Three-Phase) than Level 2. The on-board vehicle BMS will communicate with the EVSE to deliver DC power directly to the vehicle battery. The EVSE is hard-wired to the facility electrical distribution system. DC Fast Charging typically provides charge times of 20 minutes to 1 hour to charge an EV battery from fully depleted to 80 percent charge.

The order of magnitude total cost for a single-head DC Fast Charging Station is $250,000.00. The cost includes civil infrastructure, conduit and wiring, supporting electrical equipment, and the EVSE. Cost savings can be achieved by using multiple-head charging stations and power sharing technology for multiple charging stalls.

4.4 Intelligent Charging Stations

EVSE manufacturers provide intelligent charging solutions. Current technologies allow individual charger connectors to communicate with one another to share a common electrical load. This approach is known as Load or Power Sharing. A single Level 2 Charging Station can share 32 Amps (40 Amp rated circuit) with up to 4 connectors. Each connector can deliver up to 32 Amps. When multiple connectors are used, the power is shared among all connectors up to a total of 32 Amps. For example, with 4 connectors connected to EVs, each connector would deliver 8 Amps. With 2 connectors connected to EVs, each connector would deliver 16 Amps.

4.5 Networked Charging Stations

Networked EV Charging Stations are connected to the internet via cellular communications. EVSE providers charge an annual fee to manage the network. EVSE connected to the network allow facility owners to collect data such as time and location of charging events, energy provided, GHGs avoided, and any applicable billing and revenue. Facility owners can also track charge time, connection time, average and peak power, and total power per event. Networking provides the ability for EVSE to integrate with building management systems to move EV charging to off-peak times or to throttle down the charging output during times of high power demand.

4.6 EVSE Product Options

The following section summarizes the EVSE product options. The EVSE manufacturer that is currently deployed by the District of Saanich and the only to be considered in this report is FLO. For the purposes of Fleet charging, only AC Level 2 and DC Fast Charging will be considered.

4.6.1 AC Level 2 Charging

FLO and ChargePoint both provide an all-purpose networked Level 2 charging solution for property owners, businesses, and municipalities. The charging stations come in standalone or power sharing models.

Technical specifications for the charging stations are summarized in the table below.

Specification	FLO CoRe+	FLO CoRe+ Max
Voltage	208/240VAC, Single-Phase	208/240VAC, Single-Phase
Current	32A (power shared between up to four ports)	80A (power shared between up to two ports)
Power	Up to 6.66/7.68kW @ 208/240V	Up to 16.6/19.2kW @ 208/240V
Wiring	3-wire	3-wire
Enclosure Rating	Type 4X	Aluminum Type 3R per UL 50E
Connector	SAE J1772 (up to 4)	SAE J1772 (up to 2)
Cable Length	6.4m (optional 7.6m)	6.8m (optional 7.6m)
Networking	Cellular 4G LTE	Cellular 4G LTE
Certification	CSA and UL	CSA and UL
Operating Temperature	-40°C to 50°C	-40°C to 50°C
Installation	Pedestal on concrete or wall mounting	Pedestal on concrete or wall mounting

Table 1 - AC Level 2 Charging Station Specifications

Refer to *Appendix A* for *FLO* CoRe+ *and FLO Core+Max Level 2 Fleet Charging Stations Specifications* for more details.

4.6.2 DC Fast Charging

FLO provides robust, reliable, and networked DC Fast Charging Stations complete with CHAdeMO, CCS Type 1, and SAE Combo charging ports.

Technical specifications for the charging stations are summarized in the table below.

Specification	FLO SmartDC	FLO Ultra
Voltage	480VAC, Three-Phase	480VAC, Three-Phase

Current	65A or 130A (100A or 200A Breakers)	Up to 385A (power shared between two ports). (500A Breaker)
Power	50kW or 100kW (54kVA or 108kVA @ 93% PF)	Up to 320kW
Wiring	4-wire	4-wire
Enclosure Rating	Type 3R	Type 3R
Connector	1: SAE Combo and CHAdeMO	2: CCS Type 1 and CHAdeMO
Cable Length	3.7m (optional 6.1m)	(2) 5.4m
Networking	Cellular 4G LTE	Cellular 4G LTE
Certification	CSA and UL	CSA and UL
Operating Temperature	-40°C to 50°C	-40°C to 55°C
Installation	Concrete pedestal	Concrete pedestal

Table 2 -DC Fast Charging Station Specifications

Refer to *Appendix A* for *FLO SmartDC and FLO Ultra Charging Stations Specifications* for more details.

5 Requirements

The following section summarizes the requirements of the proposed EVSE, industry standards, and the electrical code requirements.

5.1 Canadian Electrical Code Requirements

According to the Canadian Electrical Code (CEC) the following requirements must be met:

- Permanent warning sign installed at the connection of the EVSE to the branch circuit warning against operation of the equipment without sufficient ventilation.
- Separate branch circuit protected by appropriately sized breaker, disconnect, and conductors. Located on the supply side of the point of connection for the EVSE, within sight of and accessible to the EVSE, and capable of being locked in the open position.
- Outdoor charging sites shall be permitted to include curbsides, open parking structures, parking lots and similar locations.
- Requires certification from an accredited test agency such as CSA group (or accepted equivalent).

5.2 Canadian EV Infrastructure Deployment Guidelines

The Canadian EV Infrastructure Deployment Guidelines provide essential information and resources to implement EV charging infrastructure. This information includes location selection and lighting recommendations.

The location selected should be such to avoid tripping hazards and allow vehicles to park forwards or backwards in parking space. If EVSE is mounted in front of vehicle, wheel-stops or bollards may be recommended. See the following Figure 4 for a typical EVSE middle placement pedestal mounting in row parking.

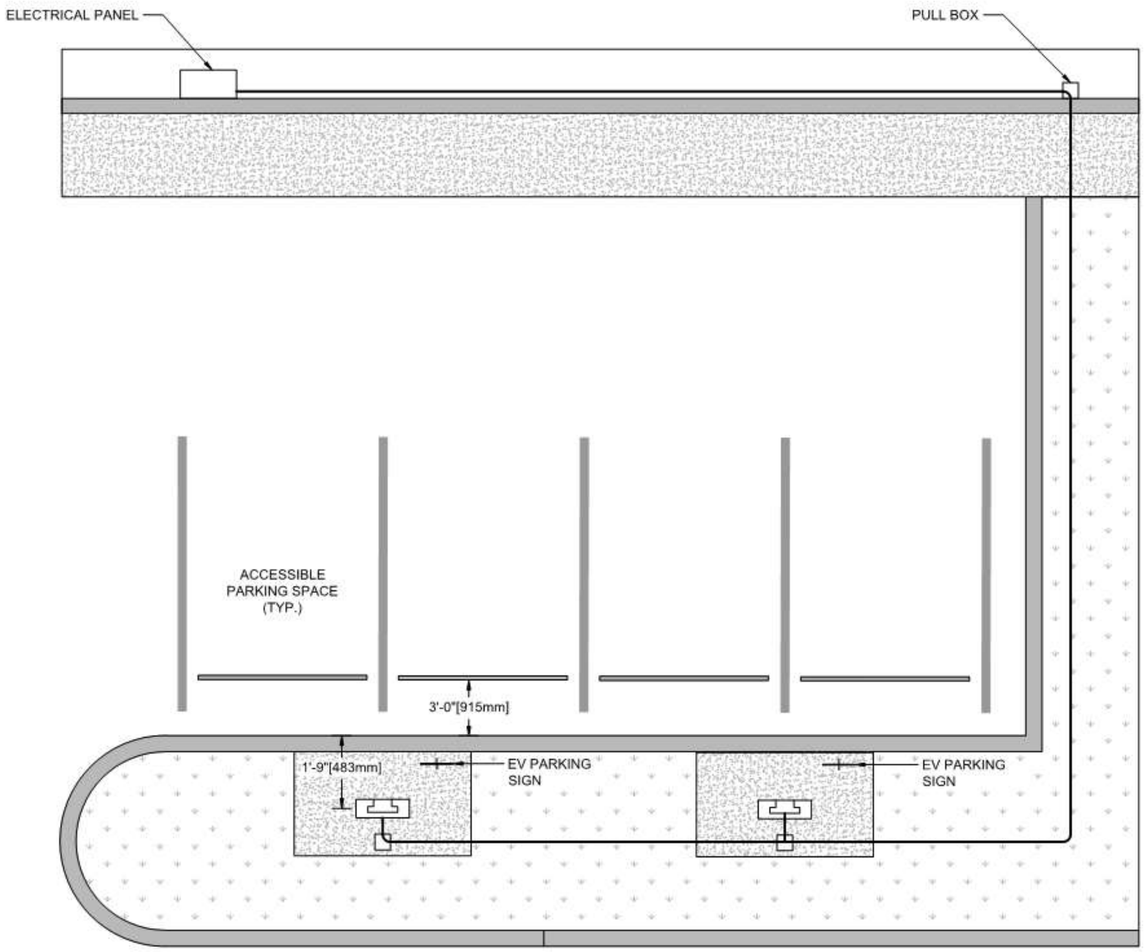

Figure 4 - Typical EVSE Middle Placement Pedestal Mounting in Row Parking

Lighting should be sufficient to read associated signs, instructions, or controls on EVSE and provide visibility around the vehicle for all possible EV inlet locations.

6 Assessment and Findings

The six (6) locations to be considered are the Municipal Hall, 3500 Blanshard, Saanich Operations Centre, Public Safety Building, Fire Hall #1, New Fire Hall #2. The following is a summary of the review of the electrical record information and an electrical capacity assessment of the existing services at the sites.

Refer to *Appendix B: Load Analysis Summary*

PBX ENGINEERING

6.1 Methodology

6.1.1 Existing Electrical Capacity Analysis

The existing peak demand load was ascertained using 1-Year BC Hydro provided load consumption history. The existing peak demand was determined by taking the maximum value of all the demand load data that was provided. Load consumption history provided by BC Hydro was provided as metering data and captured in either 5-min or 1-hour intervals. This is a risk that the peak demand may have occurred within either the 5-min or 1-hour intervals and was not captured. A Demand Load Study performed by a licensed electrician is recommended to confirm results at each of the locations prior to performing any work.

Refer to *Appendix C: BC Hydro 1-Year Historical Consumption Summary*

6.1.2 Minimum Required Demand Load

With the total energy requirement information provided by the BetterFleet analysis, the minimum required demand load was calculated as follows:

$$Min.\ Required\ Demand\ Load\ [kW] = \frac{Annual\ Total\ Energy\ Requirement\ \left[\frac{kWh}{annum}\right]}{Annual\ EV\ Charging\ Time\ \left[\frac{h}{annum}\right]}$$

The annual EV charging time was determined in consultations with Innotech about individual facility daily operations. I was calculated as follows:

$$Annual\ EV\ Charging\ Time\ \left[\frac{h}{annum}\right] = \left(Daily\ EV\ Charging\ Time\ \left[\frac{h}{day}\right]\right) * \left(\#\ of\ Days\ Charging\ per\ Week\ \left[\frac{day}{week}\right]\right) * \left(\#\ of\ Weeks\ per\ Annum\left[\frac{week}{annum}\right]\right)$$

The daily EV charging time and number of days charging per week for each facility is tabulate below:

Location	Daily EV Charging Time [h/day]	# of Days Charging per Week [day/week]
Municipal Hall	13 h/day	5 day/week
3500 Blanshard	13 h/day	5 day/week
Saanich Operations Centre	13 h/day	5 day/week
Public Safety Building (Secured & Unsecured Parking)	5 h/day	7 day/week
Public Safety Building (Fire Hall #1)	13 h/day	5 day/week
Fie Hall #2*	NA*	NA*

*Note: The BetterFleet analysis projected no existing vehicles transitioning to electric for Fire Hall #2.

Table 3 - Summary of typical EV charging times per location.

Refer to *Appendix B: Load Analysis Summary.*

6.1.3 Proposed Equipment & Maximum Demand Load

The BetterFleet analysis provided to PBX the number of vehicles and their types to be transitioned to electric per facility. Based on the typical battery size and daily charge time of the EVs, the recommended EVSE type was determined. The recommended EVSE type per vehicle type is tabulated below.

Vehicle Type	Recommended EVSE Type	Associated EVSE Product
Passenger Vehicle	Level 2 (40A Shared)	FLO CoRe+ Dual
SUV	Level 2 (40A Dedicated)	FLO CoRe+
Light Commercial	Level 2 (100A Shared)	FLO CoRe+ Max Dual
Heavy Commercial	DCFC (50kW Dedicated)	FLO SmartDC 50kW

Table 4 - Recommended EVSE type and product per vehicle type.

The maximum demand load was estimated by taking the sum of the total number of vehicles connected to their associated EVSE product at full output. The maximum demand load was used to determine whether an electrical service upgrade would be required.

Refer to *Appendix B: Load Analysis Summary.*

6.2 Municipal Hall (and Annex)

6.2.1 Location

The District of Saanich Municipal Hall is located at 770 Vernon Ave, Victoria BC, V8X 2W7 and comprises a Hall and Annex Building. The Hall was built in the 1960’s and the Annex in the 1950’s. The Hall is considered a heritage building and will require substantial infrastructure upgrades, such as supplementing the existing gas boiler heating with heat pumps and replacing the lighting with LED technology. The Annex, located to the Southeast of the Hall, is scheduled to be demolished and replaced in future. The electrical service entrance is located in the main electrical room in the basement of the Hall. The Annex is sub-fed from the Hall.

The Hall building has an existing dual Level 2 EVSE serving two public charging stalls. Refer to the Location Plan in Figure 5.

Figure 5 - Municipal Hall Location Plan

The existing fleet EVSE infrastructure at the Annex building is as follows:

- Eight (8) Level 1 charging stalls to the Northeast of the building,
- Two (2) dual Level 2 EVSE serving four (4) charging stalls to the Southeast of the building, and
- Three (3) dual Level 2 EVSE serving six (6) charging stalls at the East of the parking lot.

Refer to the Location Plan in Figure 6.

Figure 6 - Municipal Annex Location Plan

6.2.2 Existing Electrical Infrastructure

The existing incoming electrical utility service to the Hall building is 1200A (100% Rated), 120/208V, 3-phase, and is supplied from a BC Hydro PMT on private property. The service feeds a 1200A, 120/208V, 3-phase, 4-wire, service entrance rated main breaker and distribution panel. From this panel, there is a 1200A subfeed to a central distribution panel. In discussions with the District of Saanich, the existing public charging stalls are served via a 400A, 120/208V, 3-phase, 4-wire panel that also serves Electric Bicycle loads. The panel is supplied via a 400A breaker in the central distribution panel. Refer to the Partial Single Line Diagram in Figure 7.

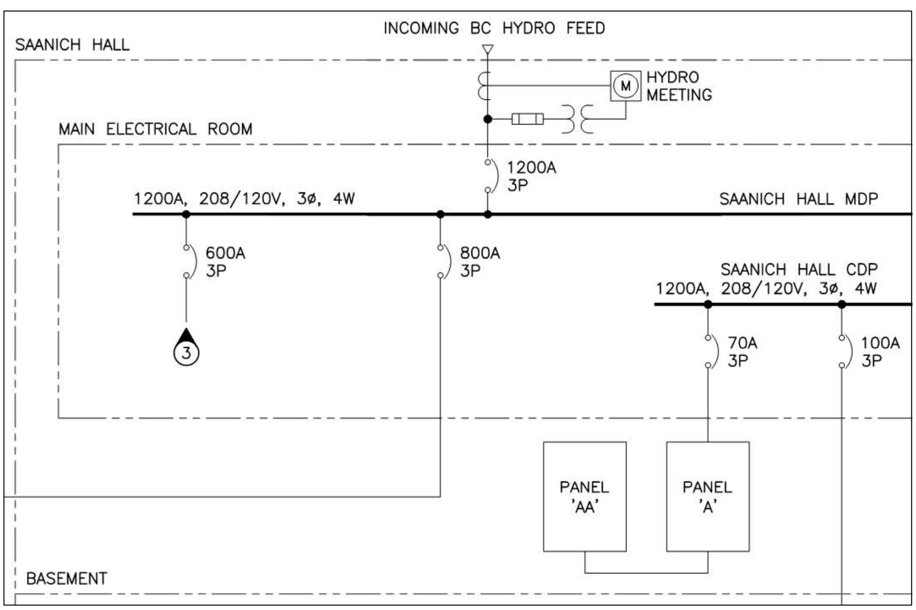

Figure 7 – Municipal Hall Service Entrance Partial Single Line Diagram

The existing incoming electrical service to the Annex building is 400A (80% Rated) 120/208V, 3-phase, 4-wire, and is supplied from the central distribution panel in the main electrical room in the basement of the Hall. The service feeds a 400A, 120/208V, 3-phase, 4-wire, retrofitted central distribution panel. The service is provided backup power via generator. Refer to the Partial Single Line Diagram in Figure 8.

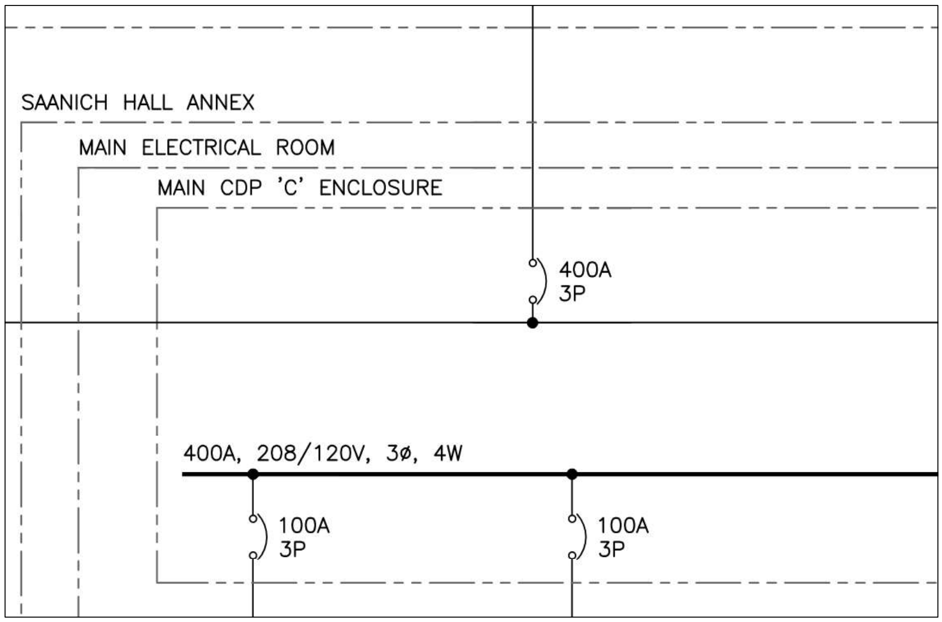

Figure 8 - Annex Building Service Partial Single Line Diagram

6.2.3 Electrical Capacity Assessment

The existing 1200A, 120/208V, 3-phase service base electrical capacity was calculated at 432kVA. The maximum electrical demand load was determined to be 130kVA. The existing service is underloaded at 30% of the base service size and there is a remaining capacity of 302kVA for new loads. Based on information provided by others, there is no physical capacity in the main distribution panel for additional breakers. Further investigation is required to determine whether there is physical capacity in the central distribution panel.

6.2.4 Proposed Equipment & Load Analysis

Based on the fleet assessment performed by Innotech, the facility will require thirteen (13) level 2 FLO CoRe+ Dual by 2025 and through 2040 to support the electrification of the fleet vehicles. The minimum demand load and the maximum demand load of the proposed EVSE was determined to be 6.71kW and 43.26kVA, respectively.

The existing service capacity is sufficient to support the potential EVSE loads and a service upgrade will not be required.

Refer to *Appendix B: Load Analysis Summary.*

6.3 3500 Blanshard

6.3.1 Location

Located at 3500 Blanshard, Victoria, BC, V8X 1W3 is the District of Saanich Engineering building. The building is two floors and primarily composed of offices and meeting rooms for District of Saanich staff. The electrical service entrance is located in the electrical room on the lower floor. In discussions with the District of

Saanich, it was indicated that staff at this location would be migrating to the Saanich Operations Centre by approximately 2028.

The Saanich Engineering building has an existing three (3) dual Level 2 EVSE serving six (6) fleet charging stalls. Refer to the Location Plan in Figure 9.

Figure 9 - 3500 Blanshard Location Plan.

6.3.2 Existing Electrical Infrastructure

The existing incoming electrical utility service to the building is 400A (100% Rated), 120/240V, 1-phase, and is supplied from a BC Hydro PMT on the property line. The service enters a service entrance rated 400A fused disconnect and feeds a 120/240V, 1-phase, 3-wire splitter bus. Refer to the Partial Single Line Diagram in Figure 10.

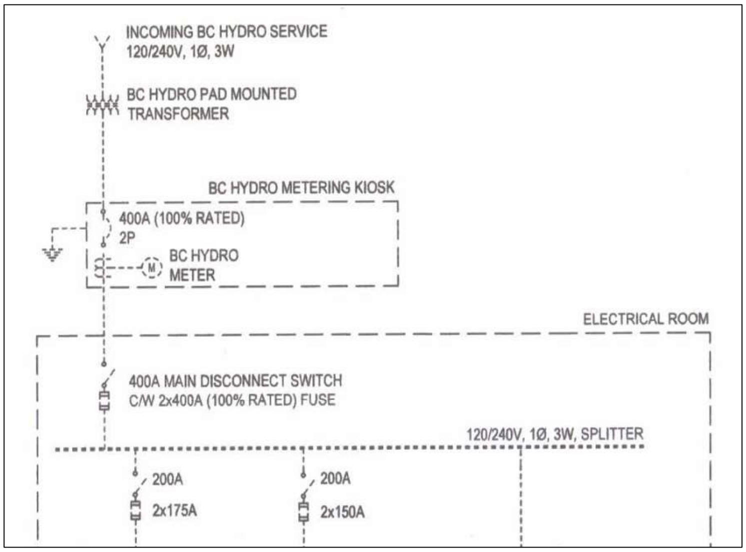

Figure 10 – 3500 Blanshard Service Entrance Partial Single Line Diagram

6.3.3 Electrical Capacity Assessment

The existing 400A, 120/240V, 1-phase service base electrical capacity was calculated at 96kVA. The maximum electrical demand load was determined to be 33kVA. The existing service is loaded at 34% of the base service size and there is a remaining capacity of 63kVA for new loads. At the time of writing this report, physical capacity in the existing splitter bus is unknown.

6.3.4 Proposed Equipment & Load Analysis

Based on the fleet assessment performed by Innotech, the facility will require seven (7) level 2 FLO CoRe+ Dual by 2025 and through 2040 to support the electrification of the fleet vehicles. The minimum demand load and the maximum demand load of the proposed EVSE was determined to be 1.99kW and 26.88kVA, respectively.

The existing service capacity is sufficient to support the potential EVSE loads and a service upgrade will not be required.

Refer to *Appendix B: Load Analysis Summary.*

6.4 Saanich Operations Centre

6.4.1 Location

The Saanich Operations Centre is located at 1040 McKenzie Ave, Victoria, BC. V8P 2L4. The facility houses the District of Saanich's Parks and Public Works operations. It comprises offices, meeting rooms, vehicle service garages, and various outdoor buildings. There are several overhead and underground electrical utility service entrances located throughout the site that makeup a total of nine (9) BC Hydro metering accounts.

The entire site is planned to be redeveloped and all buildings will be replaced. Construction activities will begin in 2026. However, construction will be phased in a manner that allows the District of Saanich to continue delivering services uninterrupted. In tandem with the development will be the ongoing electrification of fleet vehicles. Refer to Location Plan in Figure 11.

Figure 11 - Saanich Operations Centre Location Plan

The existing fleet EVSE infrastructure at the Saanich Operations Centre is as follows:

- Three (3) Level 1 charging stalls at the Parks building, and
- Four (4) dual Level 2 EVSE serving eight (8) charging stalls for Fleets and Solid Waste

6.4.2 Existing Electrical Infrastructure

The largest existing incoming electrical utility service is to the main Administration building. The service is 800A (80% Rated), 120/208V, 3-phase, and is fed via a BC Hydro PMT on private property. The service enters a service entrance rated 400A fused disconnect and feeds a 120/208V, 3-phase, 4-wire splitter bus. Refer to the Partial Single Line Diagram in Figure 12

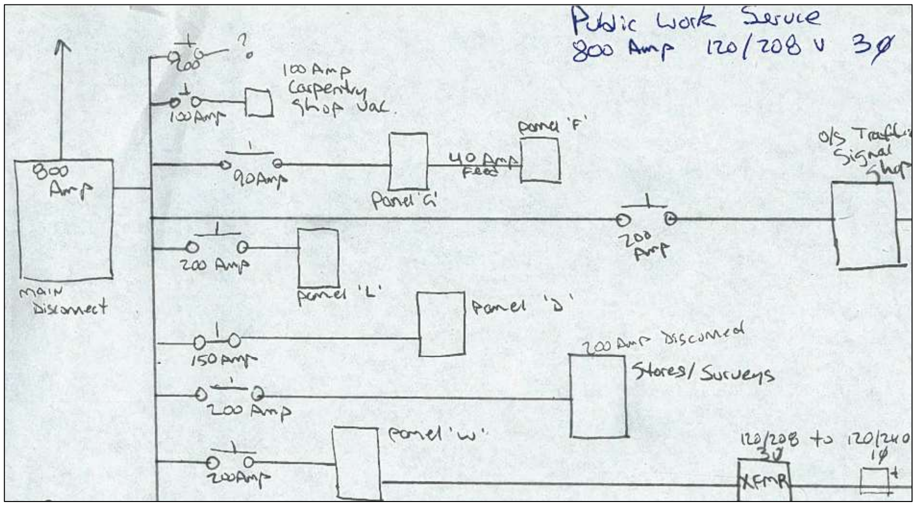

Figure 12 – Saanich Operations Centre Administration Building Service Entrance Partial Single Line Diagram

Furthermore, at the time of writing this report, there is a feasibility study underway to bring an electrical utility service of 1600A (80% Rated), 347/600V, 3-phase to an electrical kiosk from a dedicated BC Hydro PMT on private property. The service will be dedicated to EVSE for fleet electrification. Refer to the Partial Single Line Diagram in Figure 13.

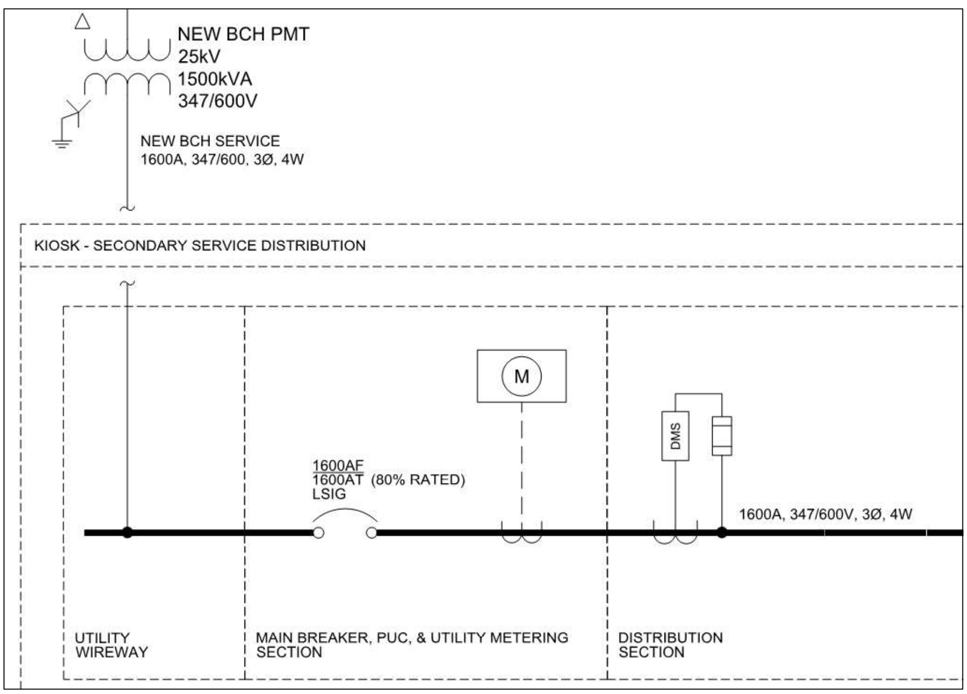

Figure 13 - Saanich Operations Centre EVSE Kiosk Service Entrance Partial Single Line Diagram

6.4.3 Electrical Capacity Assessment

The existing 800A, 120/208V, 3-phase service base electrical capacity was calculated at 231kVA. The maximum electrical demand load was determined to be 84kVA. The existing service is underloaded at 36% of the base service size and there is a remaining capacity of 146kVA for new loads. At the time of writing this report, physical capacity in the existing splitter bus is unknown.

The proposed kiosk 1600A, 347/600V, 3-phase service base electrical capacity was calculated at 1330kVA.

6.4.4 Proposed Equipment & Load Analysis

Based on the fleet assessment performed by Innotech, the facility will require a total number of EVSE at each year as tabulated below:

Year	# of FLO CoRe+ Dual	# of FLO CoRe+ Max Dual	# of FLO SmartDC 50kW
2025	5	7	16
2030	5	15	32
2035	5	32	33
2040	5	45	51

Table 5 - Saanich Operations Centre total proposed EVSE at each year.

The total minimum demand load and the maximum demand load of the proposed EVSE at each year is tabulated below:

Year	Min. Demand Load [kW]	Max. Demand Load [kVA]
2025	36kW	940kVA
2030	78kW	1870kVA
2035	95kW	2065kVA
2040	206kW	3145kVA

Table 6 - Saanich Operations Centre total proposed EVSE loads at each year.

The existing service capacity is deficient to support the potential EVSE maximum demand loads and a service upgrade will be required. The proposed kiosk electrical capacity is sufficient to support the potential EVSE maximum demand loads through 2025; however, to meet the requirements through subsequent years, additional service upgrades will be required. The proposed kiosk electrical capacity is sufficient to support the potential EVSE minimum demand loads in 2025 and through 2040. For the EVSE output to be throttled to the minimum demand load, the EVSE will need to be networked and load balanced via real-time Electric Vehicle Energy Management Systems (EVEMS).

Refer to *Appendix B: Load Analysis Summary.*

6.5 Public Safety Building

6.5.1 Location

The District of Saanich Public Safety Building is located at 760 Vernon Ave, Victoria BC, V8X 2W6 and is to the Northwest of Municipal Hall. The building complex comprises three floors and serves as the operations centre for the Saanich Police Department and Fire Department. The Police Department primarily operates in the South and East wings of the building. The building is composed of offices, meeting rooms, a communications centre, a fitness gym, and holding rooms. The electrical utility service entrance is located in the Comms Electrical Room in the North of the building on the lower level. The service is provided partial backup power via generator.

The Northeast parking lot serves the Police and Municipal fleets. The Police fleets are South of the grass meridian and Municipal fleets are North. There is a second electrical utility service entrance to an EVSE-dedicated electrical kiosk located in the grass meridian of the Northeast parking lot. Refer to the Location Plan in Figure 14.

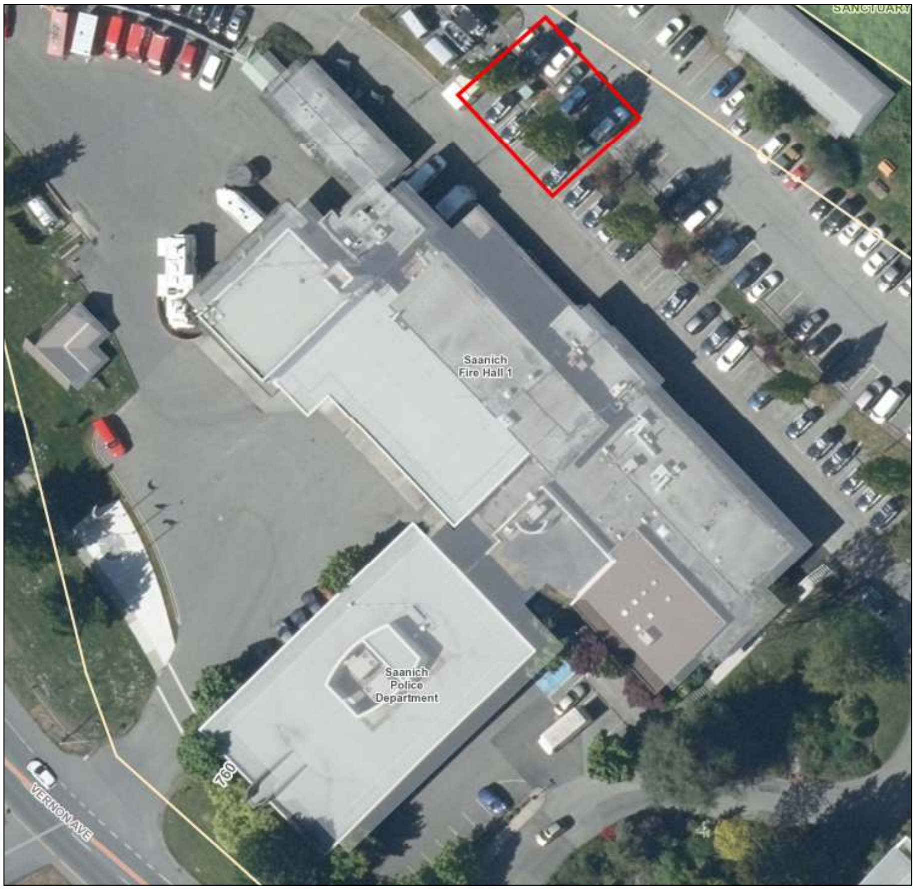

Figure 14 - Public Safety Building Location Plan

The existing fleet EVSE infrastructure at the Public Safety Building is as follows:

- One (1) Level 1 charging stall North of the meridian for a Police Administration vehicle, and
- Four (4) dual Level 2 EVSE serving eight (8) charging stalls for Police and Municipal vehicles.

6.5.2 Existing Electrical Infrastructure

The existing incoming electrical utility service to the Comms Electrical Room is 1600A (100% Rated), 120/208V, 3-phase, and is supplied from a BC Hydro PMT on private property. The service feeds a 1600A, 120/208V, 3-phase, 4-wire, service entrance rated main breaker and main distribution panel MD-2. Refer to the Partial Single Line Diagram in Figure 15.

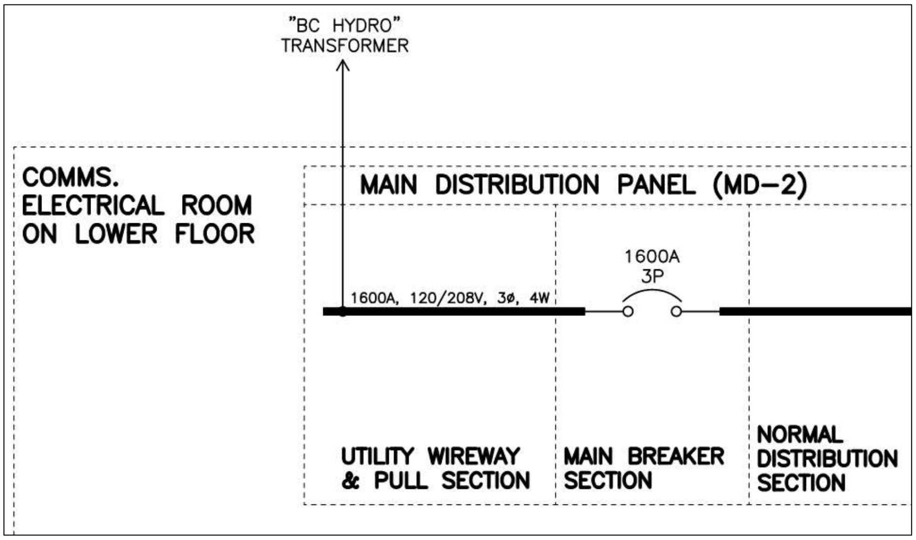

Figure 15 - Public Safety Building Comms Electrical Room Recreation Complex Service Entrance Partial Single Line Diagram

Under construction is an incoming electrical utility service to an EVSE-dedicated electrical kiosk. The service is 1600A (100% Rated), 120/208V, 3-phase, and is supplied from a BC Hydro PMT on private property. The service feeds a 1600A, 120/208V, 3-phase, 4-wire, service entrance rated main breaker and distribution panel. Refer to the Partial Single Line Diagram in Figure 16.

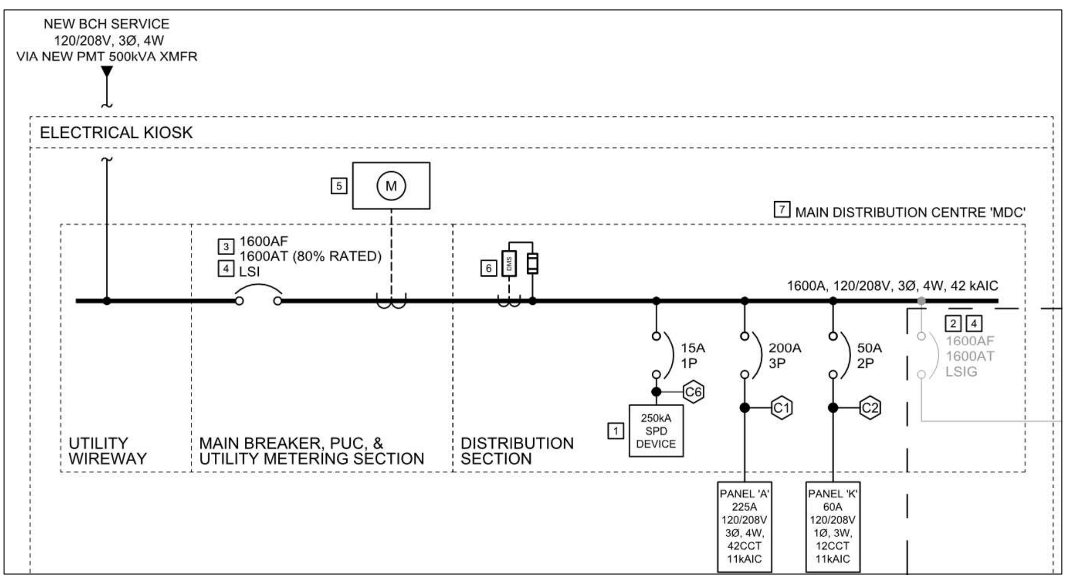

Figure 16 - Public Safety Building EVSE Dedicated Kiosk Service Entrance Partial Single Line Diagram

6.5.3 Electrical Capacity Assessment

The existing 1600A, 120/208V, 3-phase service base electrical capacity was calculated at 576kVA. The maximum electrical demand load was determined to be 151kVA. The existing service is underloaded at 26% of the base service size and there is a remaining capacity of 425kVA for new loads. Although there is physical capacity in the main distribution panel for additional breakers, the District of Saanich has reserved this space for future building expansions and upgrades.

The proposed kiosk 1600A, 120/208V, 3-phase service base electrical capacity was calculated at 576kVA. The maximum electrical demand load was calculated based on the proposed EVSE infrastructure to be connected to the service and determined to be 81kVA. The proposed service is expected to be underloaded at 14% of the base service size and there will be a remaining capacity of 496kVA for new loads.

6.5.4 Proposed Equipment & Load Analysis

Based on the fleet assessment performed by Innotech, the unsecured and secured parking at the Public Safety Building will require a total number of EVSE at each year as tabulated below:

Year	# of FLO CoRe+ Dual	# of FLO CoRe+	# of FLO CoRe+ Max Dual
2025	19	0	2
2030	35	9	2
2035	35	12	4
2040	35	13	4

Table 7 - Public Safety Building unsecured & secured parking total proposed EVSE at each year.

The total minimum demand load and the maximum demand load of the proposed EVSE at each year is tabulated below:

Year	Min. Demand Load [kW]	Max. Demand Load [kVA]
2025	49kW	80kVA
2030	85kW	193kVA
2035	88kW	230kVA
2040	89kW	236kVA

Table 8 - Public Safety Building unsecured & secured parking total proposed EVSE loads at each year

The proposed kiosk service capacity is sufficient to support the potential EVSE loads and additional service upgrades will not be required.

Refer to *Appendix B: Load Analysis Summary.*

6.6 Fire Hall #1 (Public Safety Building)

6.6.1 Location

The District of Saanich Fire Hall #1 makes part of the building complex that contains the Public Safety Building located at 760 Vernon Ave, Victoria BC, V8X 2W6. The Saanich Fire Department primarily operates in the North wing of the building. The Fire Hall is composed of offices, meeting rooms, apparatus bays, dispatch, and an emergency operations centre. The District of Saanich has indicated future building upgrades include the addition of a 2-ton heat pump. The electrical service entrance is in the Penthouse Electrical Room located on the floor above the Administrative wing in the South. Refer to Location Plan in Figure 17.

Fire Department light and medium duty fleet vehicles are located in the West and Northwest parking lots. Heavy duty fleet vehicles are stored in the apparatus bay.

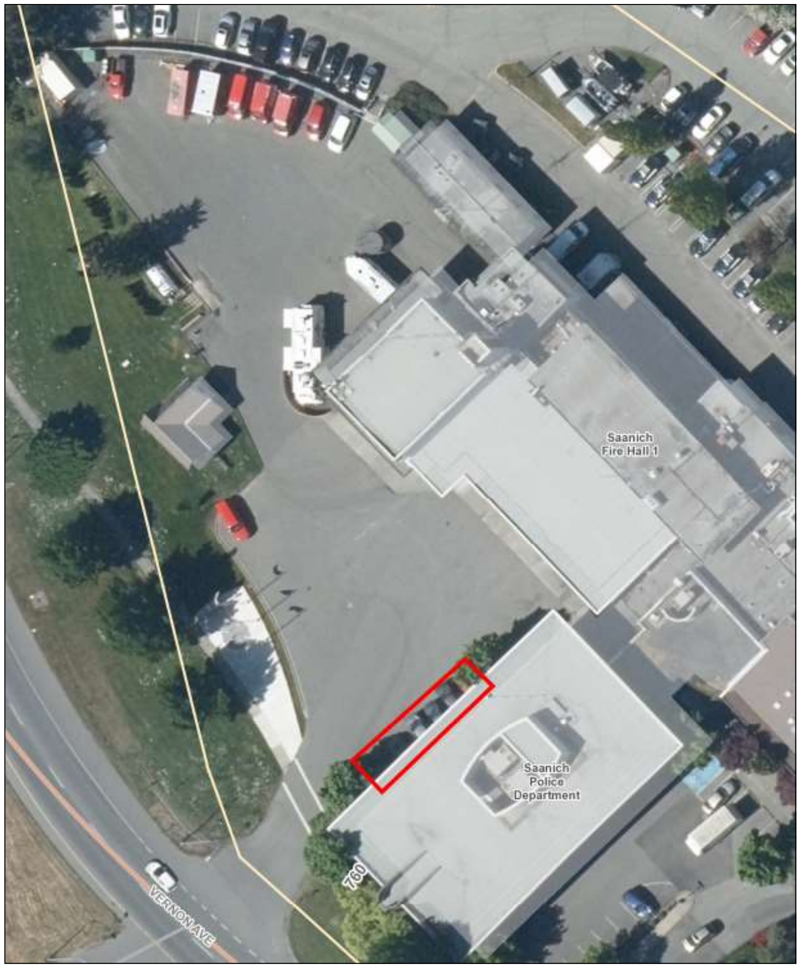

Figure 17 - Fire Hall #1 Location Plan

The existing fleet EVSE infrastructure at the Fire Hall #1 is as follows:

- Three (3) dual Level 2 and one (1) single Level 2 EVSE serving (7) charging stalls in the West parking lot.

6.6.2 Existing Electrical Infrastructure

The existing incoming electrical service to the Penthouse Electrical Room is 800A (80% Rated) 120/208V, 3-phase and is supplied from the central distribution panel in the main electrical room in the basement of the Hall. The service feeds an 800A, 120/208V, 3-phase, 4-wire, main distribution panel MD-1. Refer to the Partial Single Line Diagram in Figure 18.

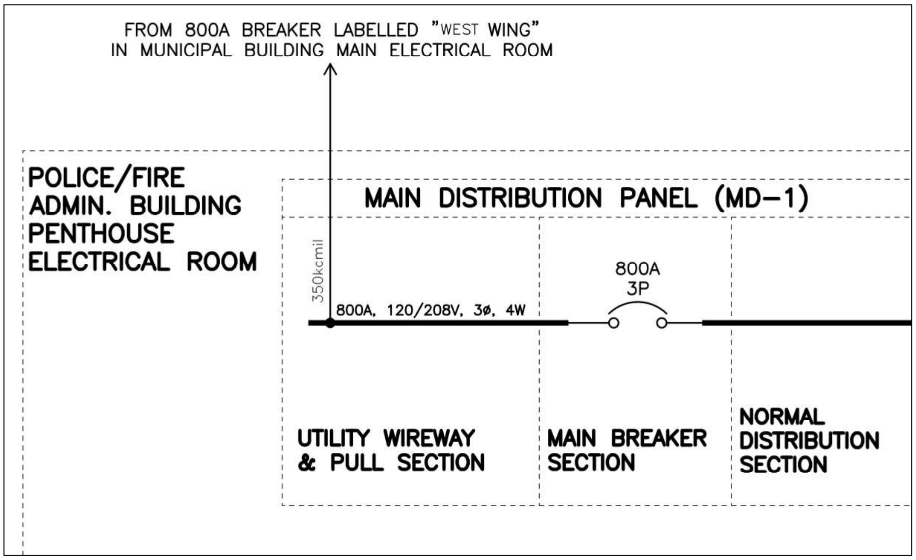

Figure 18 - Penthouse Electrical Room Service Entrance Partial Single Line Diagram.

6.6.3 Electrical Capacity Assessment

No BC hydro meter was present on the electrical service feed to the Penthouse Electrical Room (from the Municipal Hall) to allow for an analysis. Assessment of the electrical capacity will require a demand load study from a qualified contractor. However, any additional load added to the Penthouse Electrical Room distribution will remove capacity from the Municipal Hall.

For the purposes of this report, the main service to the Public Safety Building will be considered. The existing main service capacity was presented in report section 6.5.3.

6.6.4 Proposed Equipment & Load Analysis

Based on the fleet assessment performed by Innotech, the Fire Hall #1 at the Public Safety Building will require a total number of EVSE at each year as tabulated below:

Year	# of FLO CoRe+	# of FLO CoRe+ Max Dual
2025	1	3
2030	1	3
2035	1	3
2040	1	8

Table 9 - Fire Hall #1 (Public Safety Building) total proposed EVSE at each year.

The total minimum demand load and the maximum demand load of the proposed EVSE at each year is tabulated below:

Year	Min. Demand Load [kW]	Max. Demand Load [kVA]
2025	2kW	32kVA

Year	Min. Demand Load [kW]	Max. Demand Load [kVA]
2030	2kW	32kVA
2035	2kW	32kVA
2040	4kW	73kVA

Table 10 - Fire Hall #1 (Public Safety Building) total proposed EVSE loads at each year.

The existing main service capacity is sufficient to support the potential EVSE loads and additional service upgrades will not be required.

Refer to *Appendix B: Load Analysis Summary.*

6.7 Fire Hall #2

6.7.1 Location

The District of Saanich Fire Hall #2 is located at 4595 Elk Lake Drive, Victoria, BC, V8Z 6L3. The existing building is to be replaced and the entire site is to be redeveloped. Construction is expected to begin in late 2023 and will be performed in a phased manner to allow continuous operations. The new building will be constructed to net zero carbon, LEED Gold, and Energy Step Code level 2. The facility will feature two floors of offices, meeting rooms, a community room, dorms, training area, an expanded apparatus bay, roof top photovoltaics, and increased electrical capacity. The electrical service entrance will be in Electrical Room 109 on the first floor. Refer to Concept Location Plan in Figure 19.

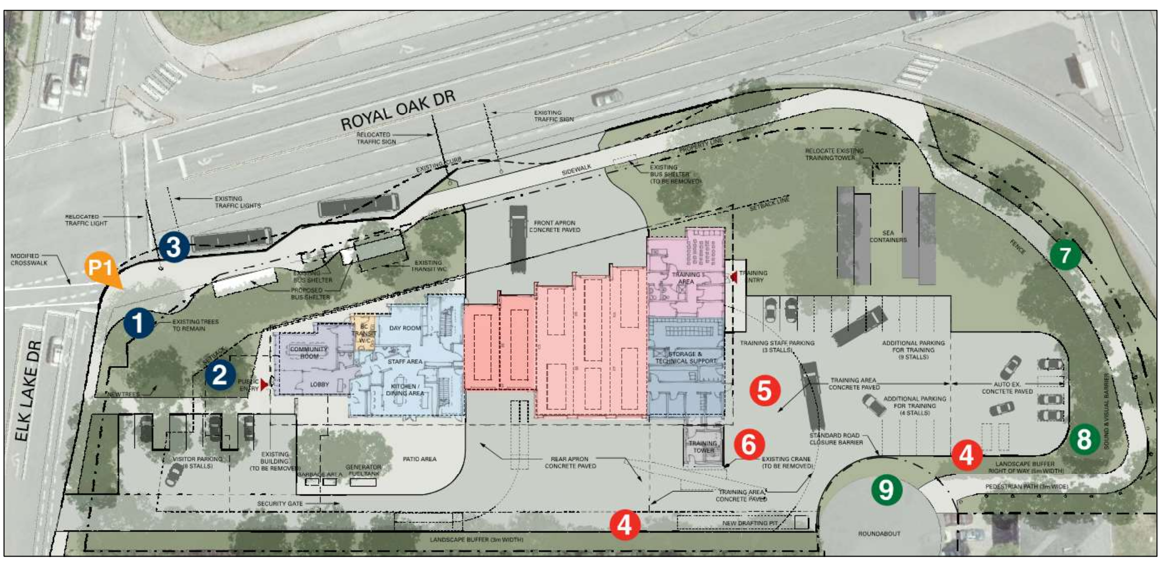

Figure 19 - Fire Hall #2 Concept Location Plan

There is no existing fleet EVSE at the Fire Hall #2.

6.7.2 Existing Electrical Infrastructure

Proposed for the facility is an incoming electrical utility service of 1200A, 347/600V, 3-phase to Electrical Room 109 supplied from a BC Hydro PMT on private property. The service will feed a 1200AF/1000AT, 347/600V, 3-phase, 4-wire, service entrance rated main breaker and main distribution panel. The service is provided backup power via generator. Refer to the Partial Single Line Diagram in Figure 20.

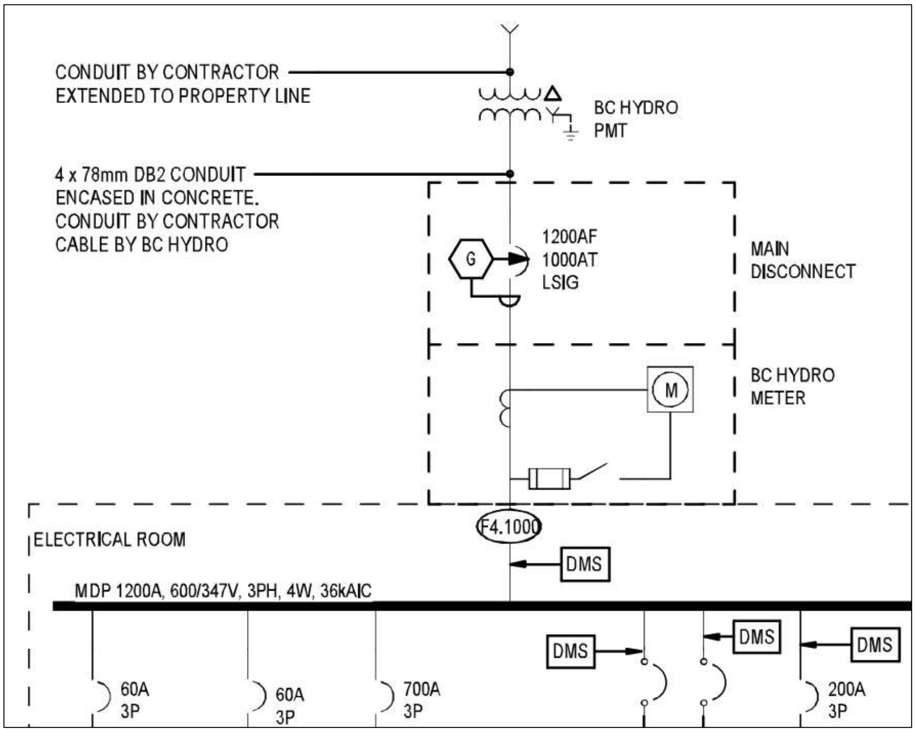

Figure 20 - Fire Hall #2 Service Entrance Partial Single Line Diagram

In addition, proposed for the facility are dedicated EVSE panels to support fleet electrification. Panel 'FEV' is 200A, 347/600V, 3-phase, 4-wire, and is dedicated to light and medium duty fleet vehicles. Panel 'EV1' and 'EV2' are both 400A, 347/600V, 3-phase, 4-wire, on backup generator power, and are dedicated to heavy duty fleet vehicles in the apparatus bay. Refer to the Partial Single Line Diagrams in Figure 21 and Figure 22.

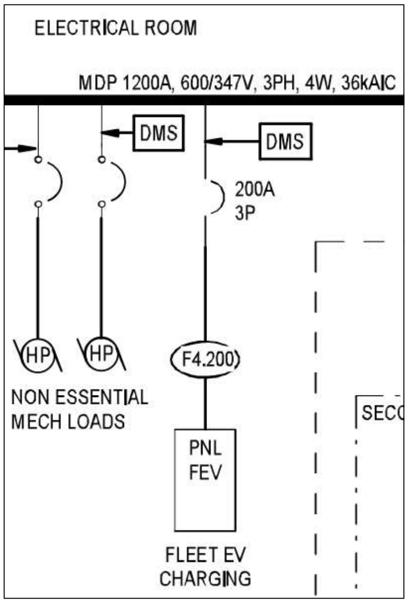

Figure 21 - Panel 'FEV' Partial SLD

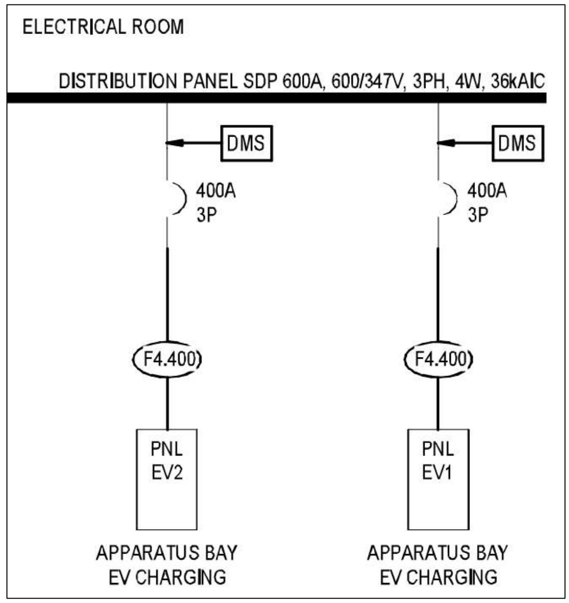

Figure 22 - Panel 'EV1' & 'EV2' Partial SLD

6.7.3 Electrical Capacity Assessment

For the purposes of this report, only the dedicated EVSE panels will be considered. The Panel 'FEV' 200A, 347/600V, 3-phase base electrical capacity was calculated at 166kVA. The Panels 'EV1' and 'EV2' each at 400A, 347/600V, 3-phase, have a base electrical capacity calculated at 333kVA.

6.7.4 Proposed Equipment & Load Analysis

The BetterFleet analysis projected no existing vehicles transitioning to electric for Fire Hall #2. No additional EVSE infrastructure is required.

7 Conclusion and Recommendation

We request this document and attachments be reviewed in their entirety.

For the six (6) locations, it is recommended the EVSE infrastructure be provided as noted herein.

8 Closure

This document has been prepared based upon the information referenced herein. It has been prepared in a manner consistent with good engineering judgement. Should new information come to light, PBX Engineering Ltd. requests the opportunity to review this information and our conclusions contained in this report. This document has been prepared for the exclusive use of the District of Saanich, and there are no representations made by PBX Engineering Ltd. to any other party. Any use that a third party makes of this document, or any reliance on or decisions made based on it, are the responsibility of such third parties.

Prepared By:

PBX ENGINEERING LTD.

Darren Gervais-Harrison, E.I.T.
Design Engineer

p. 250.388.7222 Ext. 128
c. 778.677.8245
e. darren.harrison@pbxeng.com

Reviewed By:

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
S. S. ATWAL
33063
2023-12-22

PBX ENGINEERING LTD.

Raj Atwal, P.Eng.
Principal & Senior Design Engineer

p. 250.388.7222 Ext. 114
c. 250.882.3240
e. raj.atwal@pbxeng.com

Attachments:

- Appendix A: EVSE Technical Specifications
- Appendix B: Load Analysis Summary
- Appendix C: BC Hydro 1-Year Historical Consumption Summary

Appendix A: EVSE Technical Specifications

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Appendix B: Load Analysis Summary

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ELECTRICAL LOAD ANALYSIS SUMMARY

Equipment Schedule

Description	Connected Load [VA]	Demand Factor [%]	Demand Load [kVA]
BEV Heavy - FLO SmartDC 50kW (65A, 480V, 3Ø)	54,040	100%	54.04
BEV Light - FLO Dual CoRe+Max (80A, 208V, 1Ø)	16,640	50%	8.32
BEV SUV - FLO CoRe+ (32A, 208V, 1Ø)	6,656	100%	6.66
BEV Passenger - FLO Dual CoRe+ (32A, 208V, 1Ø)	6,656	50%	3.33

EV Adoption Schedule Load Summary

Description	Total Annual Energy [kWh]	Min. Req. Demand Load[1] [kW]	Max. Demand Load [kVA]
Total proposed EVSE load 2025	22,687	6.71	43.26
Total proposed EVSE load 2030	22,687	6.71	43.26
Total proposed EVSE load 2035	22,687	6.71	43.26
Total proposed EVSE load 2040	22,687	6.71	43.26

Municipal Hall - Existing Electrical Service Capacity Analysis

Electrical service (208V, 3Ø)	1,200 A
Electrical service 100% rated (208V, 3Ø)	1,200 A
Electrical service capacity	432 kVA
Maximum electrical demand load[2]	130 kVA
Electrical service load percentage	30%
Remaining capacity for new loads	302 kVA
Main service spare capacity after EVSE installation 2025	259 kVA
Main service spare capacity after EVSE installation 2030	259 kVA
Main service spare capacity after EVSE installation 2035	259 kVA
Main service spare capacity after EVSE installation 2040	259 kVA

Therefore, the electrical service has capacity for the proposed load.

Notes:

1. The minimum required demand load is determined based on the total annual energy requriement and a daily charge time of 13-hrs per 5-days per week.
2. Data retrieved from BC Hydro provided 1-year historical load information. Metering data provided at 1-hr intervals. This is a risk that the maximum demand load was not captured (within 1-hr). All metering data shall be confirmed via demand load study.

ELECTRICAL LOAD ANALYSIS SUMMARY

Equipment Schedule

Description	Connected Load [VA]	Demand Factor [%]	Demand Load [kVA]
BEV Heavy - FLO SmartDC 50kW (65A, 480V, 3Ø)	54,040	100%	54.04
BEV Light - FLO Dual CoRe+Max (80A, 240V, 1Ø)	19,200	50%	9.60
BEV SUV - FLO CoRe+ (32A, 240V, 1Ø)	7,680	100%	7.68
BEV Passenger - FLO Dual CoRe+ (32A, 240V, 1Ø)	7,680	50%	3.84

EV Adoption Schedule Load Summary

Description	Total Annual Energy [kWh]	Min. Req. Demand Load[1] [kW]	Max. Demand Load [kVA]
Total proposed EVSE load 2025	6,727	1.99	26.88
Total proposed EVSE load 2030	6,727	1.99	26.88
Total proposed EVSE load 2035	6,727	1.99	26.88
Total proposed EVSE load 2040	6,727	1.99	26.88

3500 Blanshard - Existing Electrical Service Capacity Analysis

Electrical service (240V, 1Ø)	400 A
Electrical service 100% rated (240V, 1Ø)	400 A
Electrical service capacity	96 kVA
Maximum electrical demand load[2]	33 kVA
Electrical service load percentage	34%
Remaining Capacity for new loads	63 kVA
Main service spare capacity after EVSE installation 2025	36 kVA
Main service spare capacity after EVSE installation 2030	36 kVA
Main service spare capacity after EVSE installation 2035	36 kVA
Main service spare capacity after EVSE installation 2040	36 kVA

Therefore, the electrical service has capacity for the potential load.

Notes:

1. The minimum required demand load is determined based on the total annual energy requriement and a daily charge time of 13-hrs per 5-days per week.
2. Data retrieved from BC Hydro provided 1-year historical load information. Metering data provided at 1-hr intervals. This is a risk that the maximum demand load was not captured (within 1-hr). All metering data shall be confirmed via demand load study.

ELECTRICAL LOAD ANALYSIS SUMMARY			
Equipment Schedule			
Description	Connected Load [VA]	Demand Factor [%]	Demand Load [kVA]
BEV Heavy - FLO SmartDC 50kW (65A, 480V, 3Ø)	54,040	100%	54.04
BEV Light - FLO Dual CoRe+Max (80A, 208V, 1Ø)	16,640	50%	8.32
BEV SUV - FLO CoRe+ (32A, 208V, 1Ø)	6,656	100%	6.66
BEV Passenger - FLO Dual CoRe+ (32A, 208V, 1Ø)	6,656	50%	3.33
EV Adoption Schedule Load Summary			
Description	Total Annual Energy [kWh]	Min. Req. Demand Load[1] [kW]	Max. Demand Load [kVA]
Total proposed EVSE load 2025	120,009	36	940
Total proposed EVSE load 2030	263,483	78	1,870
Total proposed EVSE load 2035	322,416	95	2,065
Total proposed EVSE load 2040	695,444	206	3,145

BC Hydro Acccount #099956321701 - Existing Electrical Service Capacity Analysis

Electrical service (208V, 3Ø)	800 A
Electrical service 80% rated (208V, 3Ø)	640 A
Electrical service capacity	231 kVA
Maximum electrical demand load[2]	84 kVA
Electrical service load percentage	36%
Remaining Capacity for new loads	146 kVA
Main service spare capacity after EVSE installation 2025	-793 kVA

Therefore, a service upgrade is required.

1500kVA Dedicated BCH PMT[3] - Electrical Capacity Analysis

Electrical service size (600V, 3Ø)	1,600 A
Electrical service 80% rated (600V, 3Ø)	1,280 A
Electrical service capacity	1,330 kVA
Main service spare capacity after EVSE installation 2025	391 kVA
Main service spare capacity after EVSE installation 2030	-540 kVA
Main service spare capacity after EVSE installation 2035	-735 kVA
Main service spare capacity after EVSE installation 2040	-1,815 kVA

Therefore, further service upgrades will be required.

Notes:

1. The minimum required demand load is determined based on the total annual energy requriement and a daily charge time of 13-hrs per 5-days per week.
2. Data retrieved from BC Hydro provided 1-year historical load information. Metering data provided at 1-hr intervals. This is a risk that the maximum demand load was not captured (within 1-hr). All metering data shall be confirmed via demand load study.
3. At the time of writing this report, there is a feasibility study to bring a dedicated BCH PMT for EVSE to support fleet electrification. The analysis is for informational purposes only.

ELECTRICAL LOAD ANALYSIS SUMMARY

Equipment Schedule

Description	Connected Load [VA]	Demand Factor [%]	Demand Load [kVA]
BEV Heavy - FLO SmartDC 50kW (65A, 480V, 3Ø)	54,040	100%	54.04
BEV Light - FLO Dual CoRe+Max (80A, 208V, 1Ø)	16,640	50%	8.32
BEV SUV - FLO CoRe+ (32A, 208V, 1Ø)	6,656	100%	6.66
BEV Passenger - FLO Dual CoRe+ (32A, 208V, 1Ø)	6,656	50%	3.33

EV Adoption Schedule Load Summary

Description	Total Annual Energy [kWh]	Min. Req. Demand Load[1] [kW]	Max. Demand Load [kVA]
Total proposed EVSE load 2025	89,062	49	80
Total proposed EVSE load 2030	154,848	85	193
Total proposed EVSE load 2035	160,838	88	230
Total proposed EVSE load 2040	161,838	89	236

Public Safety Building (Secured & Unsecured Parking) - Existing Electrical Service Capacity Analysis

Kiosk electrical service size (208V, 3Ø)	1,600 A
Electrical service 100% rated (208V, 3Ø)	1,600 A
Electrical service capacity	576 kVA
Maximum electrical demand load[2]	81 kVA
Electrical service load percentage	14%
Remaining capacity for new loads	496 kVA
Main service spare capacity after EVSE installation 2025	416 kVA
Main service spare capacity after EVSE installation 2030	303 kVA
Main service spare capacity after EVSE installation 2035	266 kVA
Main service spare capacity after EVSE installation 2040	259 kVA

Therefore, the electrical service has capacity for the potential load.

Notes:

1. The minimum required demand load is determined based on the total annual energy requriement and a daily charge time of 5-hrs per 7-days per week.
2. Due to infrastructure being under construction, maximum demand load is taken as the known load of the existing EVSE to be connected to the service.

ELECTRICAL LOAD ANALYSIS SUMMARY

Equipment Schedule

Description	Connected Load [VA]	Demand Factor [%]	Demand Load [kVA]
BEV Heavy - FLO SmartDC 50kW (65A, 480V, 3Ø)	54,040	100%	54.04
BEV Light - FLO Dual CoRe+Max (80A, 208V, 1Ø)	16,640	50%	8.32
BEV SUV - FLO CoRe+ (32A, 208V, 1Ø)	6,656	100%	6.66
BEV Passenger - FLO Dual CoRe+ (32A, 208V, 1Ø)	6,656	50%	3.33

EV Adoption Schedule Load Summary

Description	Total Annual Energy [kWh]	Min. Req. Demand Load[1] [kW]	Max. Demand Load [kVA]
Total proposed EVSE load 2025	5,505	2	32
Total proposed EVSE load 2030	5,505	2	32
Total proposed EVSE load 2035	5,505	2	32
Total proposed EVSE load 2040	12,980	4	73

Fire Hall #1 (Public Safety Building) - Existing Electrical Service Capacity Analysis

Building electrical main service size (208V, 3Ø)	1,600 A
Electrical service 100% rated (208V, 3Ø)	1,600 A
Electrical service capacity	576 kVA
Maximum electrical demand load[2]	151 kVA
Electrical service load percentage	26%
Remaining capacity for new loads	425 kVA
Main service spare capacity after EVSE installation 2025	393 kVA
Main service spare capacity after EVSE installation 2030	393 kVA
Main service spare capacity after EVSE installation 2035	393 kVA
Main service spare capacity after EVSE installation 2040	352 kVA

Therefore, the main electrical service has capacity for the proposed load.

Notes:

1. The minimum required demand load is determined based on the total annual energy requriement and a daily charge time of 13-hrs per 5-days per week.
2. Data retrieved from BC Hydro provided 1-year historical load information. Metering data provided at 5-min intervals. This is a risk that the maximum demand load was not captured (within 5-mins). All metering data shall be confirmed via demand load study.

ELECTRICAL LOAD CAPACITY SUMMARY

Fire Hall #2 - Existing Electrical Service Capacity Analysis

Electrical service size (208V, 3Ø)	400 A
100% of electrical service (208V, 3Ø)	400 A
Electrical service capacity	144 kVA
Maximum electrical demand load[1]	43 kVA
Electrical service load percentage	30%
Remaining capacity for new loads	101 kVA

Panel 'FEV' - Electrical Capacity Analysis

Electrical panel size (600V, 3Ø)	200 A
80% of lectrical panel size (600V, 3Ø)	160 A
Electrical panel capacity	166 kVA

Panel 'EV1' & 'EV2' - Electrical Capacity Analysis

Electrical panel size (600V, 3Ø)	400 A
80% of lectrical panel size (600V, 3Ø)	320 A
Electrical panel capacity	333 kVA

Notes:

1. Data retrieved from BC Hydro provided 1-year historical load information. Metering data provided at 5-min intervals. This is a risk that the maximum demand load was not captured (within 5-mins). All metering data shall be confirmed via demand load study.

Appendix C: BC Hydro 1-Year Historical Consumption Summary

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Location	1-Year Net Consumption (kWh)	Max of Demand (kW)	Average of Power Factor (%)	Sum of Net Consumption (kVAh)	Max of Demand (kVA)
Municipal Hall	1191631	128	99.33	1200693	129.5
3500 Blanshard	89594	33.1	100	89594	33.1
Public Safety Building	731356	151	99.88	732165	151.4
Fire Hall #1	Unknown[2]	Unknown[2]	Unknown[2]	Unknown[2]	Unknown[2]
Fire Hall #2	120270	43.0	99.94	120316	43.1
SOC - ACT#000001356827	43474	19.5	Unknown[1]	Unknown[1]	Unknown[1]
SOC - ACT#000001803947	29287	12.1	Unknown[1]	Unknown[1]	Unknown[1]
SOC - ACT#000005098723	27975	15.8	Unknown[1]	Unknown[1]	Unknown[1]
SOC - ACT#000006845115	6633	13.1	Unknown[1]	Unknown[1]	Unknown[1]
SOC - ACT#099956321651	26510	16.3	Unknown[1]	Unknown[1]	Unknown[1]
SOC - ACT#099956321701	303480	84.1	99.98	303558	84.18
SOC - ACT#099956321751	48654	17.4	Unknown[1]	Unknown[1]	Unknown[1]
SOC - ACT#099956321851	97825	25.9	Unknown[1]	Unknown[1]	Unknown[1]
SOC - ACT#099956321951	5889	1.6	Unknown[1]	Unknown[1]	Unknown[1]

Notes:

1. Data was not made avaialble by BC Hydro.
2. Fire Hall #1 is subfed from the Municipal Hall via a feed to the Penthouse Electrical Room. No BC Hydro meter was present on this feed. Capacity of this feed will require a demand load study from a qualified contractor.
3. The Saanich Operations Centre comprises nine (9) BC Hydro metering accounts.

APPENDIX C: INDUSTRY BEST PRACTICES

District of Saanich – Zero Emission Fleet Strategy

Best Practices Review

Completed By: Steven Wiebe

Date: May 30, 2023

To assist the District of Saanich in its goal to reduce fleet emissions and develop a zero-emission fleet strategy, Innotech Fleet Strategies has contacted numerous municipalities of various sizes across Canada. It's anticipated that this will give a broad understanding of what other municipalities have implemented and where they have observed success. During this best practices review it was apparent that a matrix or table style comparison was not suitable to accurately convey which best practices are successful, nor would it be useful in completing an "apples to apples" comparison as the municipalities vary in size, operational scope and many do not accurately track the data from these best practices. The approach used is to list each municipality that was contacted and outline a program they have found successful. Specific carbon emission reductions from each program have also been difficult to quantify as the municipalities do not have data systems where they can directly track and correlate each initiative and the associated carbon reduction. However, where feasible, qualitative reduction targets have been provided. The population of each municipality is also provided for reference.

Green Procurement Policy – City of Burlington
Public Works Fleet size - 250
Population – 183,000

The City of Burlington has implemented a Green Procurement Policy as well as Green Procurement Guidelines. These documents outline the practices of all departments and sections within the city that wish to procure goods and services. The Policy outlines the objectives to ensure the City acquires sustainable products and services and references several standards by which the sustainability of a product or service can be measured. The Guidelines provide information to employees to educate them on what Green Procurement means, why it's important and misleading or false information that respondents may provide as part of their bids.

Impact: *Low*
Cost/Resources: *Low*
Ease of Implementation: *Moderate*

Anti - Idle Policy and Practices – City of Saskatoon
Public Works Fleet size - 850
Population – 273,000

The City of Saskatoon, like many other municipalities, has an antiquated anti-idle policy that is not monitored or enforced. As they work to reduce their emissions, they have decided to revise this policy and invest in anti-idle technologies. Anti-idle technology and monitoring usually require a high amount of effort for staff change management. However, considering some of the challenges and range reduction of electric vehicles in cold climates, such as theirs, they have deemed anti-idle a good investment. As electric vehicle technology improves for cold climates and supporting infrastructure is implemented they expect to shift focus back to zero-emission vehicles. In an effort to resurrect the anti-idle policy they have implemented GPS systems on their fleet and developed an idle report for Operational Managers. This will allow Managers to create awareness with staff, understand their department idling behaviours and work one on one with staff who may not be following the policy. At this point in time, they are in the initial stages of rolling out the reporting. Despite the lack of emission reduction data or organizational feedback, a good anti-idling program can typically reduce emissions by 5-10%.

Impact: *Low*
Cost/Resources: *High*
Ease of Implementation: *Moderate*

Green Fleet Plan – City of Victoria
Public Works Fleet size - 216
Population – 92,000

The City of Victoria's Green Fleet Plan was completed in 2021. This Plan outlines their roadmap to electrification, City wide charging infrastructure requirements, funding requirements, and other fleet focused carbon reduction strategies. This report outlined recommended actions throughout 2022 and 2023 to help the City meet its emission targets. The actions are smart goals based on industry best practices that have been aligned with the City's current state. The fleet electrification plans are very aggressive and target a 707 tonne reduction in carbon emissions by 2030. This Plan is still in its infancy so long-term success is difficult to measure, but it gives clear objectives that have been adopted into work plans.

Impact: *High*
Cost/Resources: *High*
Ease of Implementation: *High*

Fleet Procurement Committee – Metro Vancouver
Public Works Fleet size - 500
Population – 2.5 million

Metro Vancouver has taken steps to implement a Fleet Procurement Committee. This is a widely popular approach by a number of other municipalities that generally includes representatives from Fleet, Sustainability, Operations and Finance. This Committee makes recommendations on vehicles, fuel type, specifications, and others when a municipality is either replacing one of its vehicles or purchasing additional vehicles. Historically, Operations and Fleet defined the vehicles to be purchased and the decisions had a very operational-centric focus, however, this Committee approach ensures that corporate priorities and good business cases are considered as part of the decisions.

Impact: *Moderate*
Cost/Resources: *Low*
Ease of Implementation: *Low*

Employee Carpool Program – City of Richmond
Public Works Fleet size - 450
Population – 216,000

The City of Richmond established an employee carpool program in 1997. The program uses 17 City vehicles and allows carpool program applicants to use a City vehicle to commute to and from work. There must be a minimum of three employees per vehicle to be considered. The program has 80 participants and 70 additional on a waitlist. While this does not directly reduce corporate carbon emissions, it does reduce community emissions and reduces the number of nighttime parking spaces required for fleet vehicles at municipal facilities.

Impact: *Low*
Cost/Resources: *Moderate*
Ease of Implementation: *Moderate*

Telematics – City of Vancouver
Public Works Fleet size – 1,400
Population – 675,000

The City of Vancouver has had telematics installed on its municipal vehicles for over 5 years. The telematics system has allowed them to gain insight and data on the use of the fleet and idling behaviour. With this data, they have been able to develop targeted behaviour-based programs such as anti-idling and driver training with a focus on fuel-efficient driving practices. While the data allows them insight into driver behaviour, changing driver behaviour requires significant and consistent effort and management. One of the more effective uses for telematics from a carbon reduction perspective is its use for route optimization. Route optimization can easily result in ten percent or greater fuel savings. It also has the added benefit of reducing vehicle mileage which reduces maintenance, reducing the time operators spend driving which leads to higher productivity, and more consistent service times for customers. In the City of Vancouver, the management of driver behaviour data and route optimization is managed by departments responsible for the service, not the Fleet department. While the installation and use of telematics requires a joint effort from many departments, including fleet, the key to the successful use for carbon reduction initiatives is that the departments responsible for the services must take an active role in reviewing and managing both the data and their operators.

Impact: *High*
Cost/Resources: *Medium*
Ease of Implementation: *Low*

The best practices and behaviour-based programs showcased above demonstrate what other municipalities have implemented. In addition to the municipalities listed above, the City of Calgary, the District of North Vancouver, and the City of Hamilton were also contacted with no additional programs or practices to add. In conducting this research, it was apparent that municipalities on the west coast are much more progressive in the carbon reduction initiatives they undertake. Some of these initiatives are a result of the mild climate, but much of it seems to be a result of provincial government policies as well as the progressive nature of the municipalities and general population. The District of Saanich already has an excellent foundation. Specific policies and practices that are in place include telematics, social and economic declarations for procurement, fleet procurement committees, and pool vehicles for staff use. Some gaps where there could be additional effort to develop policies and procedures include anti-idle, more robust green procurement policies, and route optimization for operations that follow required routing (ie. street sweeping, water meter reading, garbage collection, etc.).

APPENDIX D: LOW CARBON FUELS

District of Saanich – Zero Emission Fleet Strategy

Low Carbon Fuels

Completed By: Steven Wiebe

Date: December 27, 2023

Aligning with market sentiment and Government policies, many fleets are setting aggressive carbon reduction targets. The Government of Canada has set a mandatory target of all new light-duty cars and passenger truck sales to be zero-emissions by 2035[1]. They have also set a target for 35% of all new medium and heavy-duty vehicles to be zero-emissions by 2030[2]. The Province of British Columbia has developed a similar target with some key differences to advance Zero-Emission adoption in the interim. Notably, a Zero-Emission first policy will be developed for public sector fleets (does not include municipalities, however, noted for awareness) with 100% of light-duty vehicles purchased to be zero-emissions by 2027[3]. In addition, the Province of British Columbia has a Zero Emission Vehicles Act that sets interim targets of escalating annual percentage of light-duty vehicles that must be zero emission[4]. For medium and heavy-duty vehicles, a consultation paper has been prepared and feedback has been requested. Finally, the Environmental Protection Agency (EPA) proposed new emissions standards starting in 2027 for light, medium and heavy vehicles. These mandates, acts, and targets are projecting the end of internal combustion engines using conventional fuels and resulting in increased funding for numerous carbon reduction initiatives across Canada in the Zero-Emission vehicle industry. Zero-Emission vehicles are typically defined as battery electric or hydrogen, and to meet mandated Zero-Emission targets the industry needs time to not only develop feasible technology solutions but also for fleets to adopt them. The good news is that in addition to Zero-Emission vehicles, there are also numerous low-carbon fuels that are available today. These fuels are propane, compressed natural gas

[1] "Building a Green Economy," Government of Canada, accessed at https://www.canada.ca/en/transport-canada/news/2021/06/building-a-green-economy-government-of-canada-to-require-100-of-car-and-passenger-truck-sales-be-zero-emission-by-2035-in-canada.html
[2] "2030 Emissions Reduction Plan – Transportation," Government of Canada, accessed at https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/erp/factsheet-06-transportation.pdf
[3] "Clean BC Roadmap to 2030," Province of British Columbia, accessed at https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf
[4] "Zero Emission Vehicles Act," Province of British Columbia, accessed at https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/clean-transportation-policies-programs/zero-emission-vehicles-act

(CNG), renewable natural gas (RNG), biodiesel, and renewable diesel. However, these low carbon fuels still rely on combustion processes and result in tailpipe emissions that impact local air quality.

In an effort to quantify the Canadian targets, and provide insight into that broader industry, a review of the market in the United States was also conducted. California is regarded as the leader in carbon emission reductions within North America, and it's prudent to understand their regulations as British Columbia has been following closely in their footsteps. The State of Sustainable Fleets is an initiative by several industry-leading companies to produce a technology-neutral report with information from over 225 fleets across the US. Gladstein, Neandross & Associates author the report and are headquartered in California so are well positioned to provide the latest information from across the US, including a California perspective. The 2023 report outlines the carbon reduction potential across several fuel types and Zero-Emission vehicle technologies.

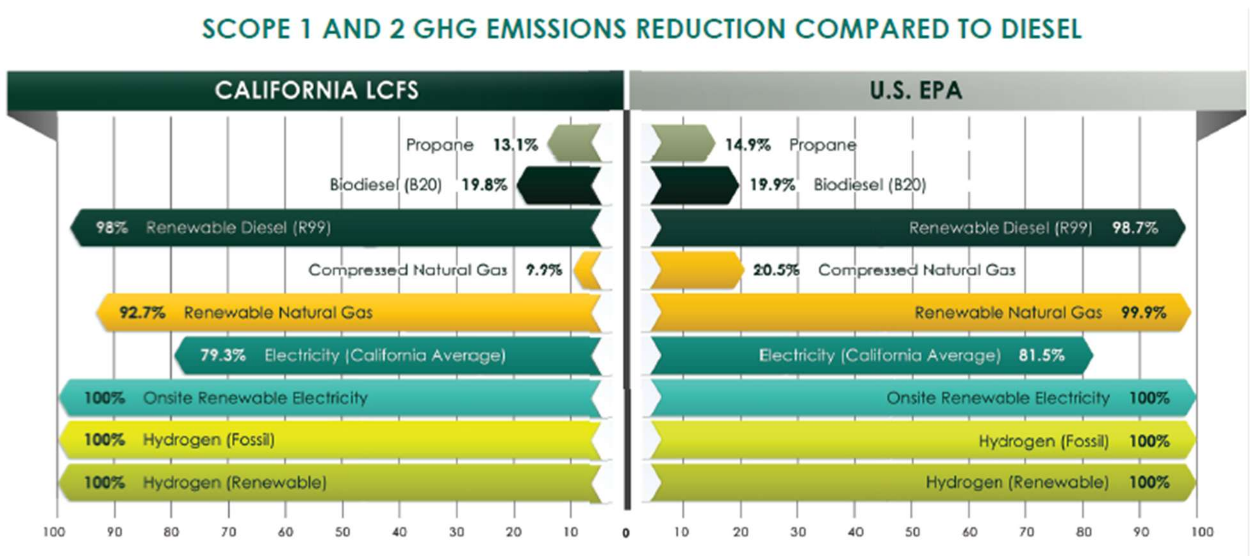

Figure 1: Carbon reduction potential by fuel and technology type compared to diesel.[5]

The reduction potentials align well with the Province of British Columbia's Methodology for Quantifying Greenhouse Gas Emissions and British Columbia's Low Carbon Fuel Standard. While there are minor differences between British Columbia carbon methodologies, the US EPA and California's greenhouse gas (GHG) methodologies, the only notable difference is that British Columbia's methodology considers electricity to be a Zero-Emission technology whereas California's electricity is only considered a low carbon fuel with only an 80% reduction as shown in Figure 1. Despite Figure 1 being from a United

[5] Gladstein, Neandross & Associates (GNA), "State of Sustainable Fleets 2022 Market Brief", May 2022, Santa Monica, CA. Accessed at: www.StateofSustainableFleets.com

States study, it was chosen for this report as it provides a suitable visual summarizing the reduction potentials of each fuel type.

Electricity

Various forms of battery electric vehicles, including hybrid and plug in hybrid, are some of the most popular and prevalent forms of future vehicle propulsion and investment in the industry today. Governments at all levels are providing significant incentives and programs to assist individuals and businesses convert their vehicles to electric. While the vehicle technology is not yet advanced enough for all duty cycles and market segments, return-to-based fleets, such as Municipalities, provide the optimal operation and duty cycles for electric vehicles. Light duty vehicles, including class 1 and 2, are the most advanced with numerous options from all manufacturers. These vehicles have been providing lower maintenance costs, good performance in mild climates, and long battery life. Light-duty vehicles have been successfully used in business operations for many years.

Heavy duty, including class 6-8, vehicles are lagging behind light-duty vehicles in terms of technology readiness and product maturity. Many heavy-duty vehicle manufacturers only offer a few electric options with production vehicles just being introduced in 2021 and 2022. They are generally well suited to predictable regular operational use such as delivery services. Unpredictable operations such as municipal where vehicles are used 24/7 for snow clearing, emergency infrastructure repairs, and the requirement for complex bodies present some real challenges and risks. While this technology is progressing rapidly, organizations need to consider the risks to their service levels before introducing these vehicles to their fleet. However, these risks should not prevent organizations from assessing the suitability of this technology and beginning to develop a plan for implementation.

Medium-duty vehicles, including class 3-5, are lagging both light duty and heavy duty for electric options. There are very limited options available from any manufacturers and those that are available are generally from new vehicle manufacturers that have recently entered the vehicle manufacturing space in North America. If planning to purchase from a new manufacturer, organizations should assess risk and understand the availability of after-sales support and the reliability of the vehicles. Similar to heavy-duty vehicles, this market segment is expected to progress quickly and businesses should begin assessing the technology and begin planning for implementation.

Charging infrastructure is readily available with numerous level 2 and DC fast charging options from many manufacturers. Utility providers are investing heavily in the planning and implementation of infrastructure to support charging networks and businesses' transitions to electric vehicles. BC Hydro is offering incentives and encouraging businesses to develop EV Fleet Strategies that will assist BC Hydro in understanding power needs and planning for infrastructure to support the power requirements[6].

[6] "Electric Fleets", BC Hydro, accessed at: https://www.bchydro.com/powersmart/electric-vehicles/industry/fleets.html

Finally, all levels of government are offering significant rebates and incentives for both vehicles and charging infrastructure. In British Columbia, the provincial and federal vehicle rebates can be as high as $200,000 for a vehicle alone. These incentives drastically help to offset the increased capital cost of electric vehicles and charging infrastructure when compared to traditional gasoline or diesel vehicles.

The carbon reduction potential for electric vehicles is high, especially in British Columbia where most of the electricity is hydroelectric. Many other provinces and states still use coal and natural gas for electricity generation which means higher carbon emissions when used as a power source for electric vehicles. Another environmental consideration for battery electric vehicles is battery recycling. Recycling has seen significant technological advancement over the past few years. Companies, such as Li-Cycle, have developed safe battery recycling technology that can recover up to 95% of the raw materials[7]. The Province of British Columbia has also added electric vehicle batteries to its recycling regulations which are expected to help increase investment in recycling technology and facilities within British Columbia.

Vehicle Availability: *Medium*
Fueling Infrastructure Simplicity: *Medium*
Carbon Reduction Potential: *High*

Propane

Propane has been a small-scale alternative fuel for vehicles for decades. It's been particularly popular in the school bus and minibus segments. Outside of this segment It requires a third party to convert vehicles. This conversion means additional complexity and risk for vehicle failures, denied warranty and complex repairs. The Alternative Fuels Data Center alternative fuel vehicle list shows no light-duty vehicles, a few medium-duty vehicles with propane prep packages and one heavy-duty vehicle that would be suitable for municipal use[8]. Propane as a fuel has less energy density than diesel or gasoline which means that vehicles using propane burn larger volumes of fuel. Combining the larger volume that is burned with the carbon emission factor in the BC Methodology for Quantifying Greenhouse Gas Emissions reveals minimal carbon emission reduction potential.

Vehicle Availability: *Low*
Fueling Infrastructure Simplicity: *Medium*
Carbon Reduction Potential: *Low*

Biodiesel

[7] "Services", Li-Cycle, accessed at: https://li-cycle.com/services/
[8] "Propane Vehicle Availability", Alternative Fuels Data Center, accessed at https://afdc.energy.gov/vehicles/propane_availability.html

Biodiesel is another fuel that has been around for decades. It is typically refined from vegetable oils, animal fats, rapeseed oil, sunflower oil and palm oil.[9] In fact, biodiesel is already part of the diesel fuel supplied to the majority of customers in British Columbia. The BC Low Carbon Fuel Standard mandates a minimum of 4% renewable content in diesel fuel.[10] While the renewable content is not defined, it's typically biodiesel, with renewable diesel gaining popularity. Where biodiesel is limited is with its ability to meet fuel quality standards required by engine manufacturers and low-temperature performance. Diesel engine manufacturers have designed engines to be compatible with a 20% mix of biodiesel which means engine reliability and warranty are not impacted with up to 20% biodiesel mix. However, because of the refining process for biodiesel, it has solids that begin to form above the cloud point temperature. This is despite the fact that the cloud point is supposed to be the temperature at which the fuel solidifies in cold weather. These solids result in what is typically called "gelling" which means the fuel will no longer flow.

Biodiesel can be mixed with standard diesel and disensed using the same tanks and pumps. There are no infrastructure upgrades required for it.

Vehicle Availability: *High (maximum 20% blend only)*
Fueling Infrastructure Simplicity: *High*
Carbon Reduction Potential: *Low*

Renewable Diesel

Renewable diesel is also known as Renewable Hydrogenated Diesel (RHD) or R100 in it's pure form. It uses similar feedstock to biodiesel but differs in two key areas: its ability to meet standard diesel fuel quality standards, and its refining process. This fuel has been in commercial production since 2007 with the number of refining facilities across the world slowly increasing, and a number refining facilities now located in North America, including one in the lower mainland of British Columbia. These facilities use the manufacturer's proprietary refining processes to develop renewable diesel that meets ASTM D975, EN 590 and CGSB 3.517. These are the relevant fuel quality standards in the United States, Europe and Canada for number 2 diesel fuel.[11] As a result of the renewable diesel's ability to meet these standards, it's compatible with all current diesel fueling infrastructure including storage tanks, dispensers and

[9] "Biofuels explained", US Energy Information Administration, accessed at https://www.eia.gov/energyexplained/biofuels/biodiesel-rd-other-basics.php#:~:text=Vegetable%20oils%20(mainly%20soybean%20oil,and%20yellow%20grease%20from%20restaurants.

[10] "Low Carbon Fuel Standard", Province of British Columbia, accessed at https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/renewable-low-carbon-fuels/requirements

[11] "Study of Hydrogenation Derived Renewable Diesel as a Renewable Fuel Option in North America", Natural Resources Canada, March 2012, accessed at https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/files/pdf/transportation/alternative-fuels/resources/pdf/HDRD_Final_Report_eng.pdf

vehicle engines. For this reason, it's considered a drop in replacement fuel and can be mixed with #2 diesel. This means it can be supplied regularly as a diluted percentage, such as R20 (20 percent RHD), or periodically at its full strength. Discussions with the District's fuel supplier would be required to determine the optimal supply method and frequency. While this fuel is refined using renewable feedstock, there are still tailpipe emissions from the vehicles that use it. These tailpipe emissions are similar to that of non-renewable diesel and still contribute to local pollution and air quality concerns. For this reason, renewable diesel is recommended as a way to supplement or accelerate carbon emission reduction but is not an optimal long-term solution on its own.

Because there are limited worldwide refining facilities and limited volume there may be logistical challenges depending on the location of the customer. However, there is already supply to the Greater Vancouver region, including a local refining facility, which means this is not a barrier. In the case of Saanich, the fuel is already in use.

The price of renewable diesel remains a barrier with costs ranging from 1.5 to 2 times that of standard diesel. In the United States, there are significant incentives for reviewable diesel which brings it almost to cost parity with standard diesel. Unfortunately, Canada does not have any incentives for this fuel.

Vehicle Availability: *High*
Fueling Infrastructure Simplicity: *High*
Carbon Reduction Potential: *High*

Compressed Natural Gas

Modern reliable, engine technology has made compressed natural gas (CNG) quite viable for certain applications including refuse, long haul trucking and transit. While pricing for this fuel is typically more stable than diesel fuel, the total cost of ownership is only lower with economies of scale. To implement a CNG fleet a fueling station is required (either private or public) along with maintenance facility upgrades for air handling and leak detection. These fueling station costs, facility upgrade costs and increased vehicle costs (when compared to a diesel equivalent) can be upwards of several million dollars to implement for small fleets such as Saanich. Vehicles available with CNG options include medium and heavy vehicles only and based on Saanich's fleet the only vehicles where the duty cycle and available vehicles would likely be a good match are the refuse trucks. This fuel is also considered an interim fuel on the way to zero emissions. This means the infrastructure upgrades and/or fueling station would be sunk costs and expected to be obsolete in 10-15 years.

Fueling stations require a significant footprint of space and based on Saanich's lack of available land at its Operations Center, either a different piece of land would be required for the fueling station or a partnership with another agency that already has a fueling station would need to be established. Considering the fueling station costs, facility upgrades, low number of vehicles with suitable duty cycles and relatively low carbon emission reduction a business case for CNG is not likely to show CNG as a feasible solution.

Vehicle Availability: *Medium*
Fueling Infrastructure Simplicity: *Low*
Carbon Reduction Potential: *Low*

Renewable Natural Gas

Renewable natural gas has the same considerations as compressed natural gas with the exception that it's made from a renewable source. Local renewable sources that are integrated with Fortis BC infrastructure include landfill gas, agriculture, and wastewater[12]. Depending on the source that is used, RNG can actually have a negative carbon emission[13].

Vehicle Availability: *Medium*
Fueling Infrastructure Simplicity: *Low*
Carbon Reduction Potential: *High (only for a small subset of the fleet)*

Hydrogen (green)

Hydrogen is a gaseous fuel similar to CNG and propane. It has green, blue and grey designations which indicate how it is produced. Grey hydrogen is typically generated using natural gas or methane; Blue is generated using steam reforming and is considered a carbon-neutral form of creating hydrogen; Green uses hydrolysis and is produced using clean energy forms such as hydroelectricity, solar, etc.[14] The production and use of green hydrogen in vehicles is less efficient than battery electric vehicles. In this case electricity is used to produce the hydrogen, the hydrogen is transferred to the vehicle where it is converted back into electricity through a chemical reaction in a fuel cell, then used to operate an electric motor. In battery electric this conversion does not take place in the vehicle or fueling infrastructure.

There are two distinct methods of using hydrogen in vehicles: fuel cell and hydrogen combustion. When a fuel cell is used, the hydrogen undergoes a chemical reaction as it passes through the fuel cell. In this reaction electricity is produced and powers an electric drive motor in the same way that a full battery electric vehicle is powered. For hydrogen combustion, an internal combustion engine is used and hydrogen is injected into the engine along with a traditional fossil fuel, such as diesel. The addition of hydrogen results in a cleaner burn of the fossil fuel resulting in increased fuel efficiency and reduction of emissions. In hydrogen combustion, there are still tailpipe emissions and carbon emissions from the

[12] "Meet Our Renewable Gas Suppliers", Fortis BC, accessed at: https://www.fortisbc.com/services/sustainable-energy-options/renewable-natural-gas/meet-our-renewable-natural-gas-suppliers
[13] "BC Renewable and Low Carbon Study", Fortis BC, January 2022, accessed at https://www.cdn.fortisbc.com/libraries/docs/default-source/news-events/bc-renewable-and-low-carbon-gas-supply-potential-study-2022-03-11.pdf
[14] World Economic Forum, "Grey, blue, green – colors of hydrogen", accessed at https://www.weforum.org/agenda/2021/07/clean-energy-green-hydrogen/

use of fossil fuel, whereas in a fuel cell, there are no tailpipe emissions, and carbon emissions are dependent on the colour of hydrogen used.

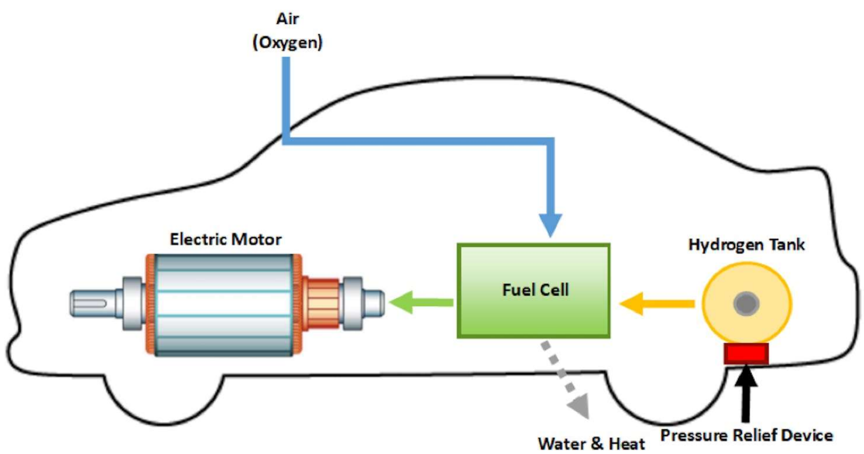

Figure 2: Block diagram of Hydrogen *Fuel Cell in a Vehicle (image from: https://www.firehouse.com/rescue/article/12385113/hydrogen-fuel-cell-vehicles-what-first-responders-need-to-know-firehouse)*

Leading sectors and vehicle segments for hydrogen use include transit and long-haul trucking[15]. The industry has focused almost solely on these segments and as a result, there are next to no suitable vehicle options for municipal operations and very limited hydrogen fueling stations and supply. The Alternative Fuels Data Center database lists only three medium and heavy-duty hydrogen fuel cell vehicles,[16] British Columbia's SUVI program lists one[17], and the California HVIP incentive program, which is by far the largest Zero-Emission vehicle market in North America, lists seven[18]. Of the vehicles listed in the previous resources, only one was not a long-haul truck or transit bus.

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[15] Gladstein, Neandross & Associates (GNA), "State of Sustainable Fleets 2022 Market Brief", May 2022, Santa Monica, CA. Accessed at: www.StateofSustainableFleets.com
[16] "Hydrogen Fuel Cell Vehicle Availability," Alternative Fuels Data Center, accessed at https://afdc.energy.gov/vehicles/fuel_cell_availability.html
[17] "On Road Medium and Heavy Duty – SUVI Program", Province of British Columbia, accessed at https://www.suvibc.ca/eligible-vehicles?category=On+road+Medium-+and+Heavy-Duty&fuel_type%5B%5D=Hydrogen+Fuel+Cell+Vehicle+%28FCV%29&base_msrp=%2449499+-+%241400001&match=
[18] "Hydrogen Vehicles," California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project, accessed at: https://californiahvip.org/vehicles/?t_type=379

Despite its carbon emission reduction potential, the fueling infrastructure and vehicle industry have not advanced in a manner where this technology would be considered a feasible option at this time for a municipality such as Saanich. However, the popularity of hydrogen is increasing in recent years with additional vehicles being offered for long-haul trucking and the build-out of fueling infrastructure. There is a possibility that with the advancement of this technology, options may become available and feasible for municipal use. It's too early in the development of this emerging market to state this with certainty though and Saanich should continue to monitor hydrogen as an option for its fleet in the future.

Vehicle Availability: *Low*
Fueling Infrastructure Simplicity: *Low*
Carbon Reduction Potential: *High*