CITY OF SAMMAMISH

FLEET ELECTRIFICATION STUDY

JUNE 2024

ACKNOWLEDGMENTS

CITY OF SAMMAMISH

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TABLE OF CONTENTS

PROJECT OVERVIEW

In December 2023 the City of Sammamish (City) adopted their first Climate Action Plan (CAP) as a collaborative effort between the City Council, Sammamish Planning Commission, CAP Community Advisory Group (CAG), City staff, and community stakeholders. One of the overarching goals of the CAP is to reduce 2019 greenhouse gas emissions by 96% by 2050, with an interim milestone of 50% reduction by 2030.

A 2019 greenhouse gas (GHG) emissions inventory study for Sammamish found that transportation emissions account for 14% of total city emissions.

To reduce transportation emissions, the CAP outlines two key strategies:

- Goal 1: "Reduce per capita vehicle miles traveled 30% by 2035 and 50% by 2050."
- Goal 2: "Increase EV adoption with 100% light-duty adoption by 2050, 60% medium-duty adoption by 2050, and 40% heavy-duty adoption by 2050. EV adoption should be at 20% by 2030 in alignment with the K4C joint commitment letter[1]."

In response to these goals, the City commissioned MAKERS architecture and urban design (MAKERS) and McKinstry to develop this Fleet Electrification Study (study).

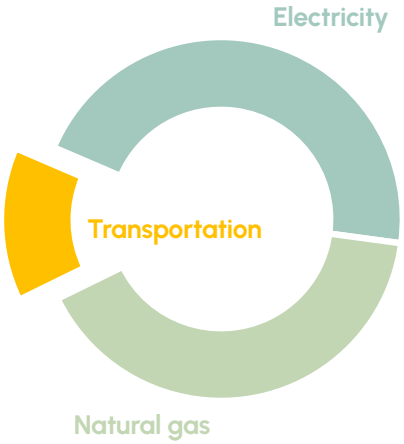


Figure 1. Sammamish 2019 community emissions in $MTCO_2e$ by sector

FLEET ELECTRIFICATION STUDY

The goals of this study are to:

- Identify City of Sammamish relevant targets and review electrification context
- Assess system-wide fleet, small tool, charging, and backup power needs
- Develop electrification approach and identify cost to reduce emissions
- Create an investment strategy to meet electrification commitments
- Research electric vehicle adoption and public charging trends

This study's recommendations outline investments in electric service and charging infrastructure that will unlock the carbon savings offered by electrification.

DOCUMENT ORGANIZATION

The Fleet Electrification Study is organized into seven sections:

- **Fleet and Small Tool Assessment.** Existing City of Sammamish fleet distribution, types, and eligibility for electrification.
- **Electric Vehicle Industry**. Trends in municipal electric fleet transition, public electric vehicle adoption, and public charging in Sammamish.
- **Fleet Replacement**. Near- and long-term fleet replacement recommendations.
- **Equipment and Infrastructure**. Recommended charging equipment, electrical infrastructure, and backup power investments.
- **Cost to Electrify**. Summary of electrification cost assumptions and estimates.
- **Phasing Strategy**. Recommended investments through 2050.
- **Potential Incentives**. Federal, state, and local electrification incentive programs.

Electrical design details, cost estimates, and electrical one-line diagrams are included in Appendix A. Electrical Infrastructure.

1 *Sammamish is part of the King County Cities Climate Collaboration (K4C), which sets an additional goal of 20% EV adoption by 2030*

FLEET AND SMALL TOOL ASSESSMENT

DISTRIBUTION

The City's fleet consists of 165 fleet and 164 small tools at three in-scope facilities: City Hall, Maintenance and Operations Center (MOC), and Beaver Lake Shop; see Figure 2 and Figure 3. The City recently purchased the South Yard site; future space needs and fleet composition may be assessed in a separate study. Off-site parking and storage areas were not evaluated for charging infrastructure in this study.

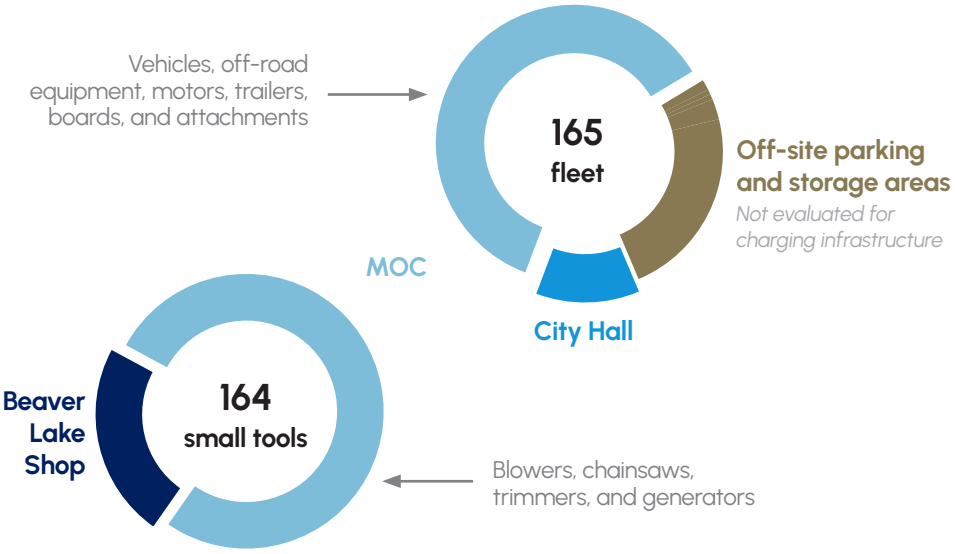


Figure 3. City fleet distribution by facility

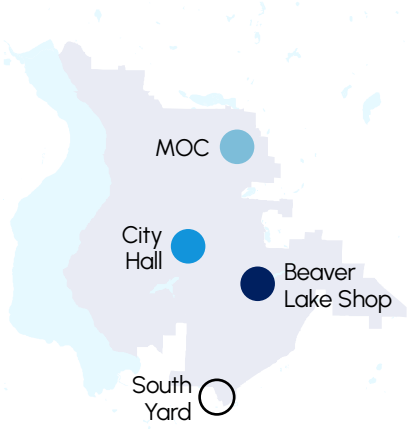


Figure 2. City fleet locations
No fleet are currently stored at South Yard

TYPES

The City's fleet includes a variety of small tools, motorized and non-motorized equipment, and vehicles; see Figure 4. Vehicle types, including light-, medium-, and heavy-duty vehicles are defined at right.

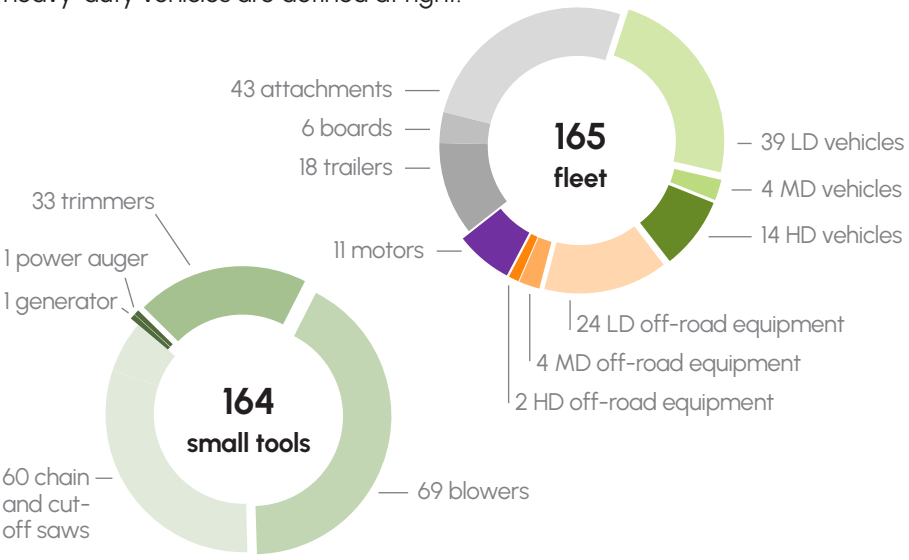


Figure 4. 2024 City fleet by type[1]

1 *Rolling stock are divided into three sub-categories as defined by the Federal Highway Administration (FHWA) and Department of Energy (DoE)*

CITY-OWNED VEHICLE TYPES INCLUDE[1]:

Light-duty (LD): Class 1-3 vehicles with a manufacturer's gross vehicle weight rating (GVWR) less than 6,001 pounds, including passenger cars (minivans, sedans, sport utility vehicles, and small pickup trucks) and off-road vehicles intended to operate on non-paved roads (mowers, golf carts, etc.).

Medium-duty (MD): Class 4-6 vehicles with a GVWR between 6,001 and 14,000 pounds, including mid-sized trucks and vans that have two to three axles and/or six tires.

Heavy-duty (HD): Class 7-9 vehicles with a GVWR greater than 14,000 pounds, including those with four or more axles such as dump trucks, vactor trucks, and larger service vehicles.

ELECTRIFICATION ELIGIBILITY

About 60% of the City's fleet and 100% of its small tools are eligible for electrification.

ELIGIBLE

Fleet eligible for electrification include light-, medium-, and heavy-duty vehicles, as well as motorized off-road equipment, motors, and small tools. This includes 98 out of 165 of the City's fleet and 164 small tools; see Figure 5. Although small tools and motors are eligible for electrification, converting to electric may impact level of service[1].

Three (or 3%) of the 98 eligible fleet and 14 (or 9%) of the 164 small tools are electric today.

CRITICAL RESPONSE FLEET

The City's fleet includes 14 vehicles and six off-road equipment used for critical emergency response, which have specific operational and performance standards. While some electric alternatives to the City's critical response fleet have been developed, they are not widely available for purchase in North America. Additionally, existing technology fails to meet operational needs and electrification may impact desired levels of service.

NON-ELIGIBLE

Non-motorized fleet, including truck attachments, boards, and trailers, are not eligible for electrification.

Figure 6. EV charging at Sammamish City Hall

Figure 7. Medium-duty electric fleet with towing capability
Source: General Motors

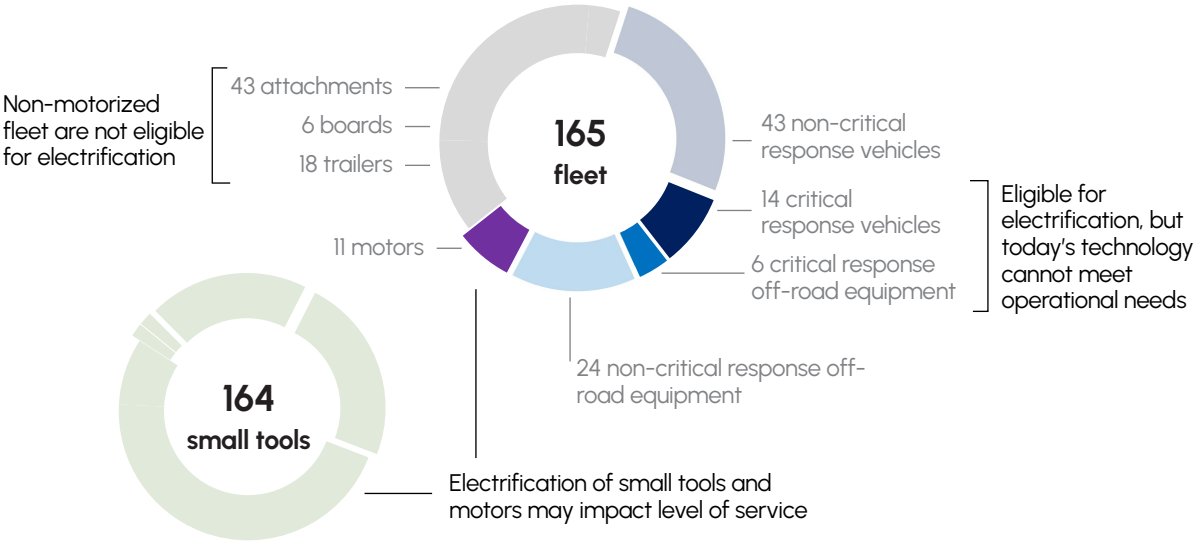


Figure 5. City fleet by electrification eligibility

1 *City staff to review operational impacts of converting to electric and estimate cost and emission reduction impacts as a follow-on effort*

ELECTRIC VEHICLE INDUSTRY

The transportation industry is at an early stage of radical re-invention that will impact all aspects of mobility—how people and goods move, how vehicles are controlled and fueled, and how transportation is paid for. To understand this transition in context, this study reviews trends in municipal EV fleet transition, public EV adoption, and public charging in Sammamish.

MUNICIPAL EV FLEET

EVs derive all or part of their power from electricity and use batteries to power an electric motor. Commercial EV and plug-in hybrid (PHEV) sales increased by 31% globally in 2023[1]. Key reasons for increased adoption include reduced upfront costs, lower battery and maintenance costs, increased tax credits, and government policies. However, challenges remain for consumers due to unreliable and inaccessible charging infrastructure, higher upfront costs over an average car with an internal combustion engine (ICE), and recent slowdowns in EV production.

LIGHT- AND MEDIUM-DUTY VEHICLES

As of May 2024, there are multiple light- and medium-duty EVs suitable for municipal fleet use that are cost-comparable with ICE vehicles and have longer drive ranges than previous electric models. Despite increased availability, EVs remain a fraction of total light-duty vehicle models currently available to fleet buyers[2]. Manufacturers anticipate broader availability for light- and medium-duty EVs by 2027.

HEAVY-DUTY AND EMERGENCY RESPONSE VEHICLES

Heavy-duty and emergency response EVs are being developed but are not yet widely available in North America. Most manufacturers expect wider availability for heavy-duty EVs by 2029 and predict comparable costs to ICE vehicles in the longer-term. Schedules are based on available information and may be impacted by supply chain conditions, technological developments, and production schedules.

Electric alternatives to heavy-duty and emergency response vehicles currently cannot compete with the operational performance of ICE-equivalents, including range and power capabilities to provide required levels of service. However, drop-in diesel replacements such as R-99 renewable diesel fuel are becoming an increasingly popular option to reduce near-term emissions[3].

MARKET REVIEW SUMMARY

Based on current available information, most light- and medium-duty vehicles are available for purchase by 2025, but procurement delays will likely impact actual deployment.

Electric variants of heavy-duty and emergency response fleet are not available for purchase in North America today and require further technology improvements to meet desired level of service requirements.

Figure 8. Ford F-150 Lightning
Source: Ford

Figure 9. Volkswagen ID.4
Source: Volkswagen

1 *"Global electric car sales rose 31% in 2023 - Rho Motion", by Nick Carey. 2023, Reuters.*
2 *"Electric Transportation". 2023, Edison Electric Institute.*
3 *R99 is a blend of diesel derived from sustainability sourced renewable materials such as vegetable oils and animal fats. It functions identically to conventional petroleum-based diesel, produces approximately 66% less greenhouse gas emissions (US Department of Energy) and can be used as a drop-in replacement for diesel fleet without major performance or maintenance impact.*

PUBLIC EV ADOPTION TRENDS

MAKERS reviewed trends in public EV adoption as of May 2024; key takeaways are summarized below. EV adoption trends in Sammamish are summarized at right.

Approximately 1.2 million EVs were sold in the US in 2023, accounting for 7.6% of total US auto sales in 2023[1], an increase of 0.6% from 2017. EVs accounted for 5.6% of all vehicle sales in Washington state, the fourth highest in the US after California, Florida, and Texas. Approximately 23% of new cars registered in the Seattle metropolitan area were EVs, the sixth highest in the US and the highest among all metropolitan areas outside California.

Increased EV adoption in Washington state is partially due to aggressive zero emission regulations. Paired with federal guidelines, Washington state, along with California and Oregon, announced in 2022 that starting in 2026 35% of new sales must be zero emissions[2]. This will increase 6-9% per year to reach 100% by 2035.

EVs costs have decreased considerably over the years, but EVs are not yet price comparable to ICE counterparts. Excluding federal tax credits, average upfront cost for all EVs sold is $60,000[3], about $3,000 more than their ICE counterparts. Based on current availability of light-duty vehicles, future EVs are expected to be price comparable to ICE vehicles[4]. A recent study by the National Resources Defense Council found mass-market EVs cost 18% more than ICE counterparts over five years; this increases by 0.4% for luxury cars, which typically cost over $75,000. This price difference could help explain the recent slowdown in EV adoption.

SAMMAMISH EV ADOPTION TRENDS

- BEVs made up 29% of new car registrations in 2023
- Sammamish had higher adoption rates than the US (7.6%), Washington state (5.6%), and the Seattle metro area (23%)
- 75% of BEVs registered in Sammamish are a Tesla; this is important as manufacturer dictates charger compatibility
- 25% of BEVs in Sammamish are luxury cars

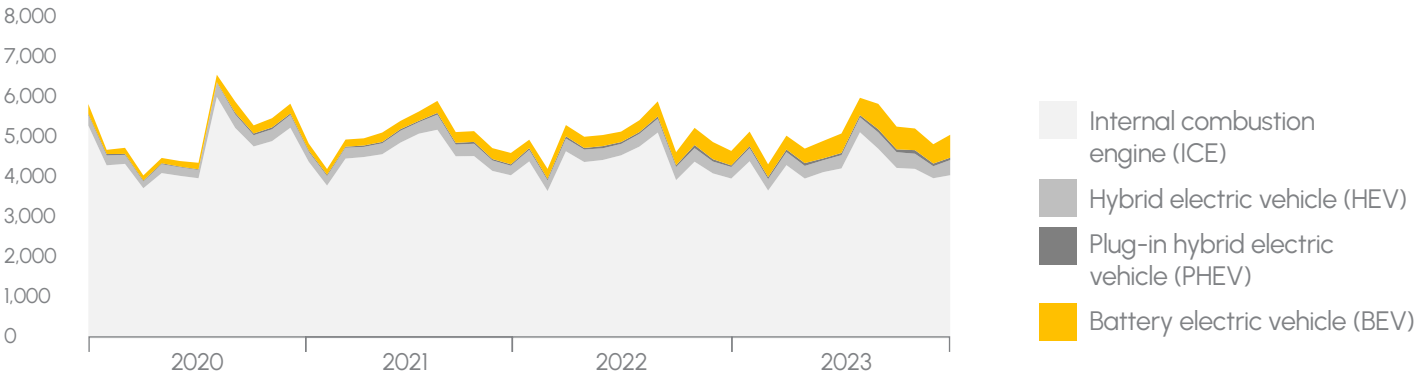


Figure 10. Sammamish EV adoption trends by vehicle type

1 *J.D. Power*
2 *Zero emission vehicles include battery electric, fuel cell electric, or plug-in electric vehicles with over 50 miles of electric-only range*
3 *Edmunds*
4 *International Council on Clean Transportation*

CHARGING TRENDS

The EV charging industry has gone through a period of rapid maturation and consolidation of companies in the last few years. A significant development in the North American charging industry was the standardization of the North American Charging Network (NACS) by the Society of Automotive Engineers in 2023[1]. Most major automakers have since committed to adopting NACS charging standards for all models starting in 2025.

Based on research by industry observers, charging options and locations are expected to increase. US chargers are likely to grow from 4 million to 35 million by 2030, 80% of which are expected to be located at people's homes.

PUBLIC CHARGING IN SAMMAMISH

MAKERS analyzed currently available public charging stations in and around Sammamish in May 2024. Findings of this analysis are summarized below, and in Figure 11 and Figure 12.

- Level 2 chargers are widely available in Sammamish and adjacent cities, including Redmond and Issaquah, 80% of which are operated by ChargePoint.
- Two Tesla Superchargers are available in the area[2]. These chargers are compatible with 80% of EVs registered in Sammamish.
- 20 additional Level 3 chargers are located on commercial sites in Sammamish, Issaquah, and Redmond.

SUGGESTIONS

Currently available information indicates low utilization rate for existing Level 2 chargers at City Hall. Due to the likely adequate access to home charging and presence of public chargers in and around Sammamish, the City should continue monitoring existing City Hall charger utilization rates and consider adding Level 2 or Level 3 chargers if there is sufficient demand in the future.

EV ADOPTION AND PUBLIC CHARGING SUMMARY

EV adoption is on the rise at the local, national, and global level. As a community, Sammamish is ahead of the EV adoption curve.

The relatively high median household incomes, home ownership rates, and luxury EV ownership rates in Sammamish likely indicate adequate access to home charging[3].

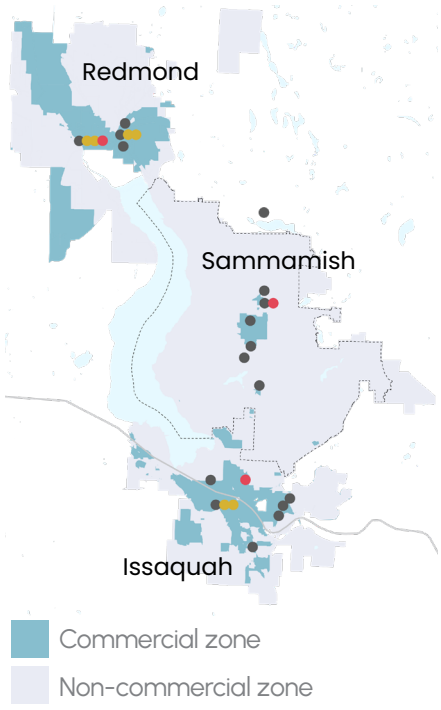


Figure 11. Publicly available charging in and around Sammamish
Source: Electrify America, PlugShare, Tesla

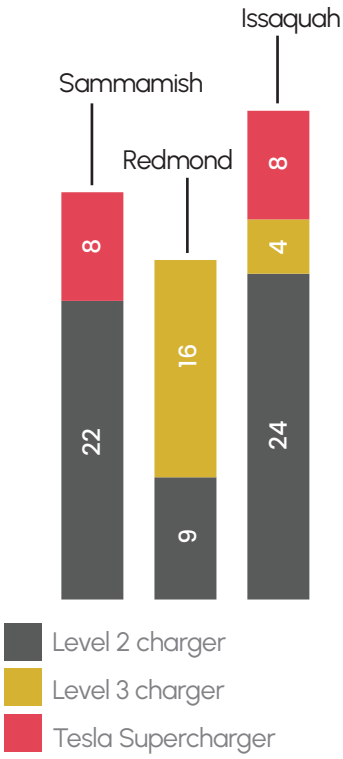


Figure 12. Publicly available chargers in Sammamish and surrounding cities

1 *NACS is the charging connector system developed by Tesla, the leading manufacturer of electric vehicles in North America*
2 *Tesla Superchargers provide several Level 3 fast charging stations compatible with Tesla, Ford, and Rivian vehicles*
3 *Per US Energy Information Administration research, 67% households with an EV have household income over $100K, typically own more than one vehicle, and have access to home charging*

FLEET REPLACEMENT

The fleet replacement approach outlined in this study is a two-pronged approach, intended to serve as a roadmap for the City's fleet electrification efforts. Fleet replacement identifies near-term solutions to be incorporated by 2030, and long-term solutions for implementation in 2050. This approach can be adjusted as technology and funding opportunities evolve.

NEAR-TERM

Near-term priorities invest in readily available EVs that meet operational requirements and emission targets by 2030; see Figure 14. Near-term solutions convert 55 vehicles to EVs (including three that are electric today) and 16 vehicles to HEVs or PHEVs. As this study is a snapshot in time of a rapidly evolving industry, exact makes and models may change over the next five to six years.

Near-term solutions also switch 16 vehicles to R99 drop-in diesel replacement. R99 functions identically to fossil fuel, with about 66% lower emissions[1] and without major performance or maintenance impacts. Further evaluation by the City's facilities team will be required to review sourcing, pricing, distribution, and storage of R99 fuel.

LONG-TERM

In the long-term, the strategy recommends electrification of alternative fuel fleet when up for replacement or when suitable electric options are available that will meet operational requirements.

MODEL SELECTION APPROACH

Recommended EV models were chosen for availability, ability to meet operational needs, and the City's existing fleet count.

EV alternatives for critical response and heavy-duty fleet are not yet able to meet operational requirements. In these cases, interim transition to R99 fuel, HEV, or PHEV is recommended.

		Light-duty	Medium-duty	Heavy-duty
Near-term				
Vehicle	Electrified	2 Nissan Leaf S		
	Converts to EV	3 Ford E-Transit; 14 Ford F150 Lightning; 3 Toyota bZ4X Limited; 11 Volkswagen ID.4		
	Converts to HEV		4 Toyota Tundra	6 Hino 195H
	Converts to PHEV	6 Ram Ramcharger		
	Switches to R99			4 Ford F550 Hook/Bucket Truck; 3 Intl. Dump Truck; 1 Ram 2500
Off-road	Electrified	1 Cushman Hauler Pro-x		
	Converts to EV	1 Dynapac CA5000; 2 Gravely Pro-Turn 60; 5 John Deere TE; 8 John Deere Z370R ZTrak; 2 John Deere Z994R; 1 Solectrac e25 Compact Tractor; 2 Toyota 8BNCU20		
	Switches to R99	2 John Deere XUV 855D Gator	1 John Deere 35G Excavator; 2 John Deere 50D Excavator; 1 Kubota Tractor MX5800HST	1 John Deere 410L Backhoe Loader; 1 Kubota Tractor M62TLB

Figure 14. Near-term fleet replacement recommendations

EV, or electric vehicle

AFV, or alternative fuel vehicle - HEV, PHEV, R99

1 *US Department of Energy*

EQUIPMENT AND INFRASTRUCTURE

The City's transition to electrical vehicles will require investments in charging equipment, electrical infrastructure, and backup power. See Appendix A. Electrical Infrastructure for electrical design details, cost estimates, and electrical one-line diagrams.

FACILITY CHARGING NEEDS

Charging needs were determined in collaboration with City staff and informed this plan's recommendations. Recommended charger types and quantities are based on the City's current electric fleet; see Figure 15.

Near-term investments add capacity for light-duty fleet and small tools, with charger installation at City Hall and service upgrades and partial build-outs at MOC and Beaver Lake Shop. Long-term investments add capacity for medium- and heavy-duty fleet with service upgrades and charger installations at MOC and South Yard.

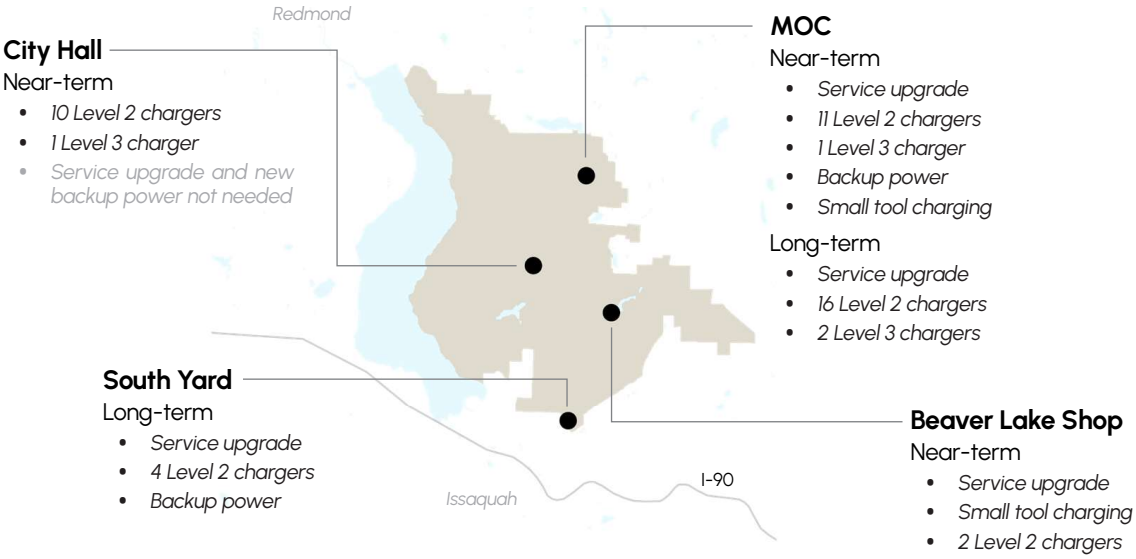


Figure 15. Recommended new EV chargers at City facilities

KEY ASSUMPTIONS

- Alternative current (AC) Level 2 chargers are appropriate for most fleet parked at City facilities, which typically have low miles traveled and long dwell times.
- Level 3 chargers, or direct-current (DC) fast chargers, are more suitable for fleet that must be recharged quickly, and can support opportunity charging by providing a quick and efficient charge between work activities.
- AC Level 1 chargers that utilize wall outlets are most suitable for residential charging and could support some City Hall fleet, but would not be able to support extreme use conditions and have not been considered in this study.
- Sharing one charging spot between multiple vehicles can reduce costs, but is not desirable for operational needs.
- Charging for visitors, employees, and police/fire fleet was excluded from this study; impacts to facility power needs if additional charging is needed should be evaluated.
- Assumes ChargePoint chargers, same as current chargers at City Hall.
- Power management software can minimize costs and allow for fleet use monitoring, and has been considered in this study's recommendation.

UPGRADING TRANSFORMER CAPACITY

The first step to ensure City facilities are prepared to support EV charging is to determine current and desired transformer capacity. Based on review of existing use at City facilities and desired charging needs, this study estimates that no service upgrade is required at City Hall, but a service upgrade will be required at other City facilities. Service upgrades often require utility-side costs typically passed on to customers (the City) through their monthly bill. Estimating this cost will require coordination with PSE, and was not part of the scope of this study.

Figure 16. Level 2 chargers

ELECTRICAL INFRASTRUCTURE

Electrical infrastructure investments will ensure sites can support the electrical load of EV charging equipment. This infrastructure includes transformers, junction boxes, switch gears, etc. Installation often requires removal of pavement to lay conduits or install transformers. As the property owner, the City is responsible for infrastructure and site improvements. See Appendix A. Electrical Infrastructure.

Figure 17. Level 3 chargers

CHARGING EQUIPMENT

Charging equipment considers a mix of 7.7 kilowatt (kW) and 12kW Level 2 chargers based on fleet use. Level 3 charger selected includes a modular 60kW charger. See Appendix A. Electrical Infrastructure for additional information about recommended charging equipment to support vehicles at each site.

BACKUP POWER

As the City transitions to EVs, reliable backup power sources will be needed to ensure operations can continue through electrical disruptions. Diesel generators are recommended as they are readily available, reliable, and relatively inexpensive at about $70,000 per unit based on current available information.

Despite recent investments in "green" energy sources such as battery storage units or solar power, these technologies are not currently recommended as back-up power solutions due to their high cost and/or limited charging capacity. This should be reassessed in the future as this technology is also rapidly progressing.

COST TO ELECTRIFY

The rough-order-of-magnitude cost to electrify 100% of eligible City of Sammamish fleet and to provide recommended charging infrastructure is $15.7 million in 2024 dollars; see Figure 18. This includes fleet vehicle/asset replacement, City-side infrastructure upgrades, and charging equipment and installation costs.

- **Near-term fleet acquisition** accounts for $5.2 million through 2030.
- **Long-term fleet acquisition** accounts for the largest portion, at $7.2 million between 2031 and 2050.
- **Infrastructure** investments total $1.4 million for design, trenching and excavation, cable and conduit installation, site restoration, and equipment distribution.
- **Equipment** investments account for $990,000 for Level 2 and 3 chargers, and generators to provide backup power.
- **Software and maintenance** investments are estimated to cost approximately $17,000 and $18,000 per year, respectively - a total of $900,000 through 2050.

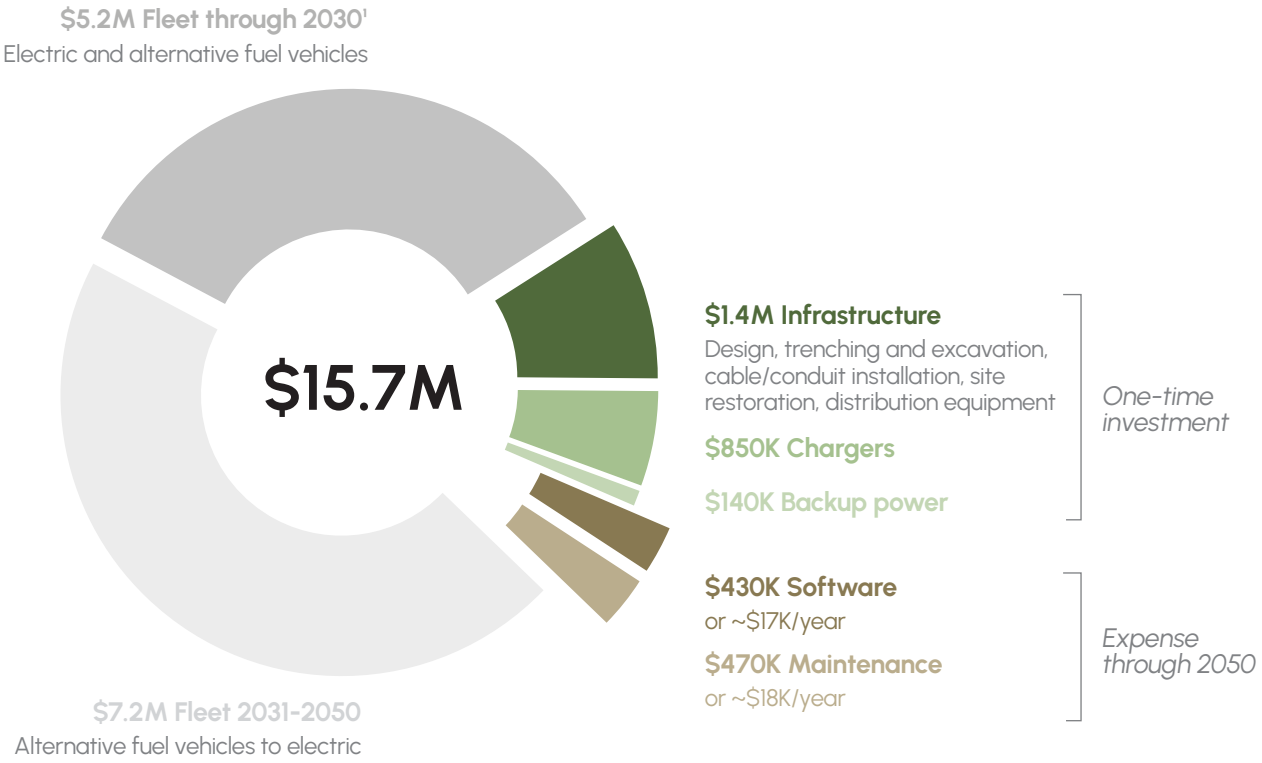


Figure 18. Total ROM project costs in 2024 dollars, not escalated to year of purchase

KEY ASSUMPTIONS

Project costs exclude utility-side service upgrades for the MOC, Beaver Lake Shop, and South Yard; future purchase costs for fleet electrified through 2030; cost benefit from surplussing fleet at end of life; R99 fuel sourcing, pricing, distribution, and storage; increased electricity use; and additional dedicated parking space for vehicles and off-road equipment charging.

1 *For reference, the City spent about $4.5 million for current vehicles and off-road equipment in year of purchase*

PHASING STRATEGY

The recommended phasing strategy prioritizes near-term investments in infrastructure upgrades and chargers to ensure the success of EVs upon their arrival. Acquisition of electric heavy-duty and critical response vehicles is delayed until they are more widely available. This strategy achieves the CAP goal of 50% reduction in GHG emissions by 2030. It electrifies 100% of eligible City fleet and reduces 100% of GHG emissions by 2050.

This strategy will require about $5 million (or $700,000 per year) in investment to meet near-term targets by 2030. Additional investments totaling $10.7 million will be required after 2030, when spending will return to typical average levels of $432,000 annually, based on fleet acquisition data since 2013.

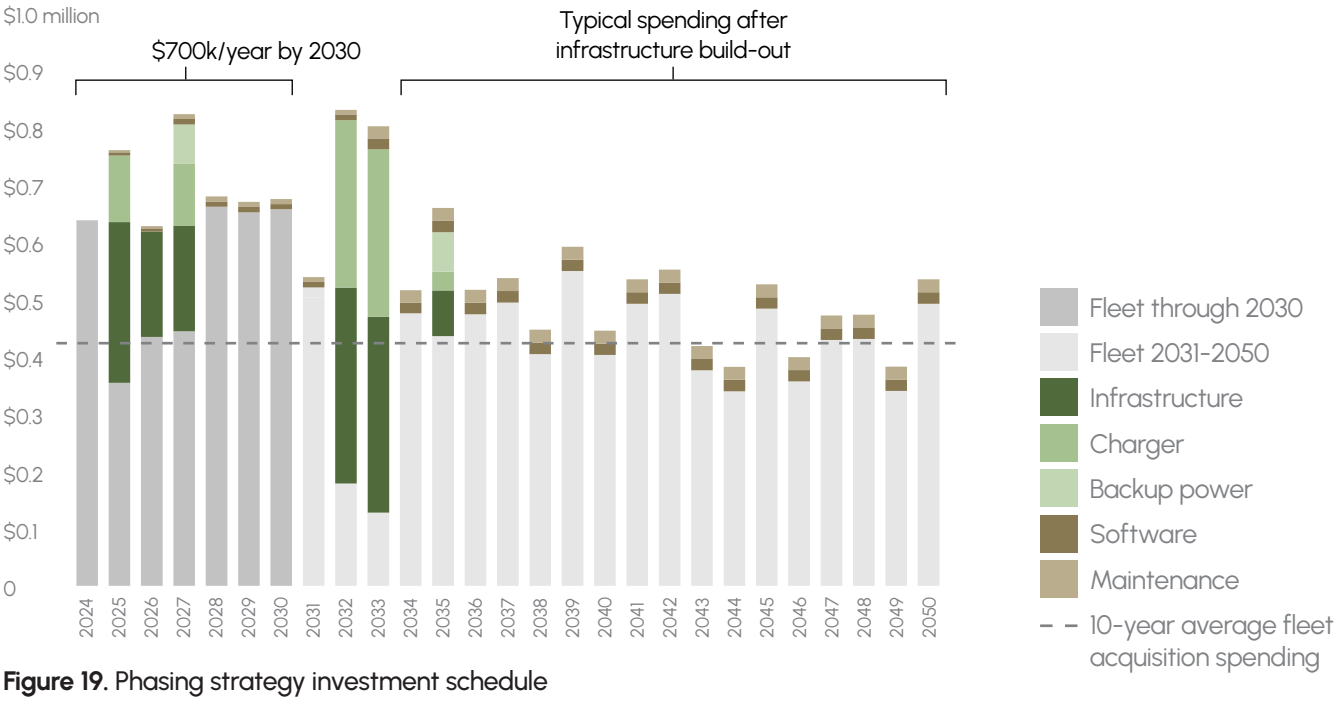


Figure 19. Phasing strategy investment schedule

KEY ASSUMPTIONS

- Assumes fleet are replaced using typical City replacement cycles[1].
- All costs are shown in 2024 dollars and are not escalated to year of purchase.

1 *Subject to City budget levels and successful procurement, delays up to one year are typical*

STRATEGY BENEFITS

The recommended electrification strategy balances investment while helping the City reach its electrification goals; see Figure 20.

Key benefits include the following:

- Prioritizes charging infrastructure to ensure sites are ready to support EVs before they are acquired
- Converts light-duty vehicles in the near-term, aligned with market availability
- Meets near- and long-term CAP goals
- Reduces greenhouse gas emissions 50% by 2030 and exceeds 96% emission reduction goal by 2050
- Exceeds K4C 20% EV adoption commitment by 2030
- Meets 100% zero emission light-duty fleet by 2035 per Department of Ecology Clean Vehicles Program Initiative
- Tracks with Washington's Clean Energy Transformation Act (CETA) goals to provide GHG-free electricity by 2045[1]

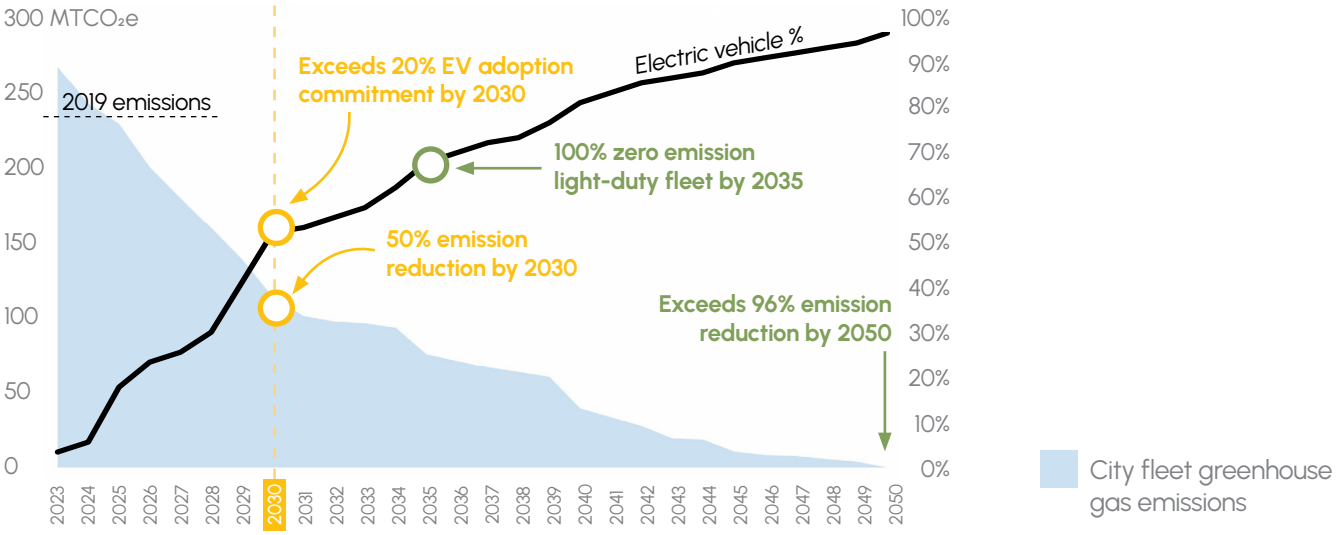


Figure 20. Recommended electrification strategy emission reduction schedule

1 *Per the Clean Energy Transformation Act (CETA), utilities must be GHG neutral in electricity sourcing by 2030 and supply 100% electricity from renewable and non-emitting sources by 2045*

POTENTIAL INCENTIVES

Incentives for fleet electrification are offered through a range of federal, state, and local programs. Although there are multiple incentives available, Sammamish is not a low income or historically under-represented community, and therefore is not eligible for most incentives due to demographic, income, or access-to-opportunity requirements.

The list below identifies electrification incentive programs that may be available to Sammamish as of May 2024. See Appendix A. Electrical Infrastructure for a summary of eligible and non-eligible incentives.

PUGET SOUND ENERGY UP & GO FLEET PROGRAM

Eligibility for this program requires City to install Puget Sound Energy's (PSE) approved charging vendors (EnelX and Shell Greenlots) or adding a new service and dedicated utility meter for fleet use. The program offers a lump-sum incentive based on number of Level 2 or Level 3 charger ports with a cap of $250,000 per facility. The incentive amount is higher if the City opts for PSE-owned turnkey service. City Hall does not require service upgrades and is not eligible for this incentive unless the City opts for PSE's approved charging vendors and repurposes existing ChargePoint chargers for other uses. MAKERS and McKinstry's preliminary calculations estimate the City could offset their charging infrastructure costs by a maximum of $650,000; however, **City staff should coordinate with PSE to confirm eligibility and potential offsets.**

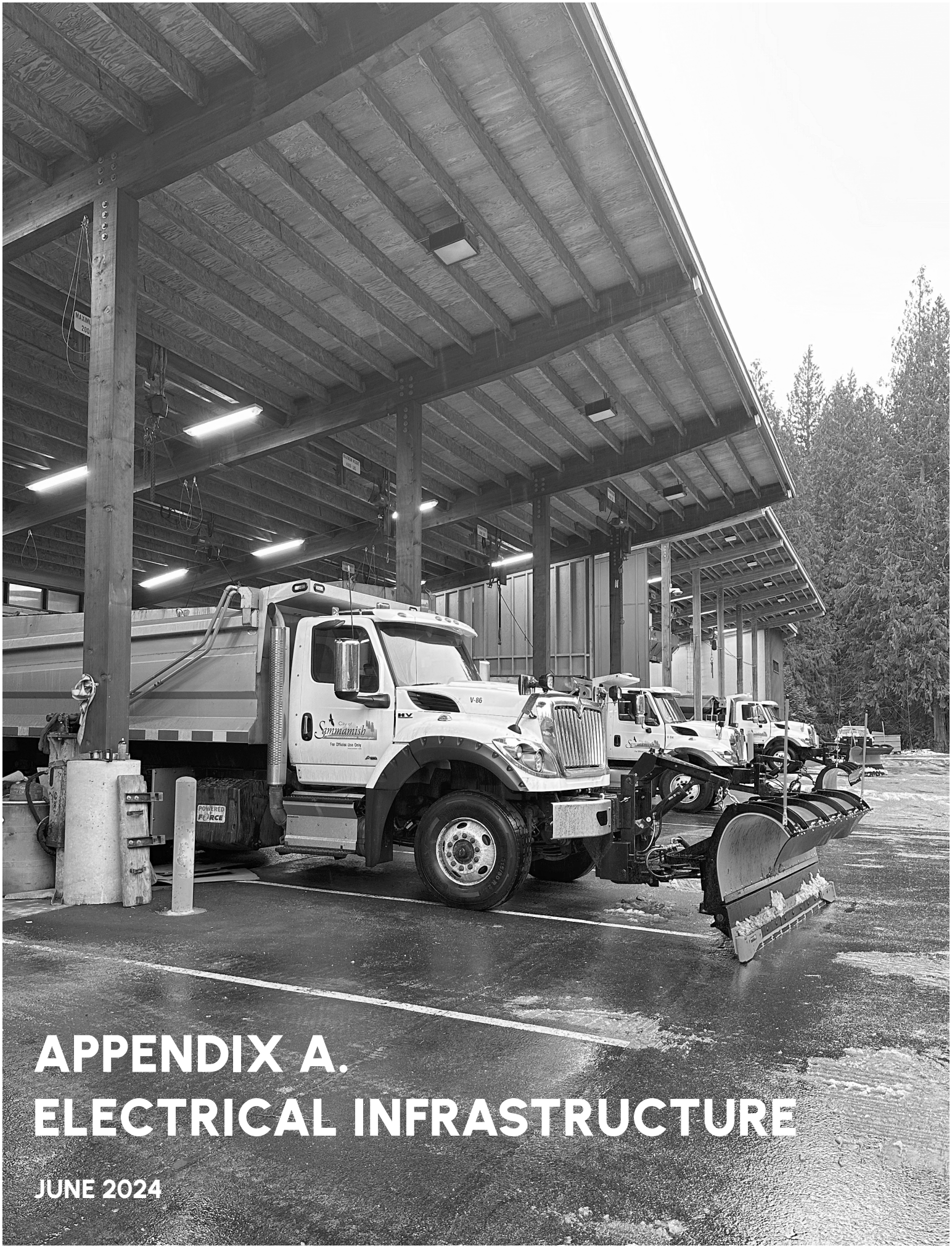
PUGET SOUND ENERGY EV LOAD MANAGEMENT INCENTIVE

This incentive would allow the City to receive a monthly bill credit for adopting off-peak charging between 11am-5pm and 10pm-6am. This requires using a power management software with the ability to schedule charging.

ADDITIONAL INCENTIVES

Additional incentives that should be reviewed to determine eligibility include the **Low Carbon Fuel Standard Credits** (per Washington State Clean Fuel Standard Law) and the **Internal Revenue Service Modified Accelerated Cost-Recovery System.**

Washington State Commerce and Ecology grants do not have currently available opportunities, but City staff should periodically review.



APPENDIX A. ELECTRICAL INFRASTRUCTURE

JUNE 2024

Appendix A. Electrical Infrastructure includes charging infrastructure analysis by McKinstry to support recommendations described in the Sammamish Fleet Electrification Study.

It includes:

- EV Charging System Basis of Design
- Battery Electric Small Tools

Electrical one-line diagrams for City Hall and the Maintenance and Operations Center (MOC), and detailed power and cost estimation for chargers and handheld equipment analysis are provided separately.

EV CHARGING SYSTEM BASIS OF DESIGN

INTRODUCTION AND SUMMARY

As the City of Sammamish is evaluating options to expand their electric vehicle fleet, the chargers for those vehicles must be considered in parallel and designed with the use of the vehicles in mind.

This document, in conjunction with electrical one-line diagrams and equipment schedule documents, is meant to explain each of the decisions and options that form the basis of engineering design and permitting documents for planned electric vehicle charging projects.

In order to meet near-term emissions-reduction and fleet electrification targets, the City will have to convert all of the City's light-duty and non-critical medium-duty vehicles to electric. The installation of appropriate EV charging systems and associated electrical upgrades are estimated (on a Rough Order of Magnitude basis) to be $350K at City Hall and $550K at MOC. This excludes utility-side costs which require an engineering study by the electricity provider Puget Sound Energy. For smart-charging software subscriptions and annual operations & maintenance costs, the City should budget an additional $20K annually.

To defray these costs, the City is eligible for an estimated $500K in incentives from Puget Sound Energy ($250K per site at City Hall and MOC), as well as $1,500-4,500 per year in ongoing revenue from Low Carbon Fuel Standard credits. The City is also likely to be eligible for grant funding through the WA Commerce Department totaling tens of thousands per site, though this grant program is not open at the time of this document.

PARKING ARRANGEMENTS

Parking lots, garages, and other parking areas can have parking assigned in a variety of ways which may affect the approach to providing charging for electric vehicles. Value engineering an electric vehicle charging project may require a change to a different parking approach.

- Option 1: The parking spaces at the location may be completely open so that any vehicle/driver can park in any location without restrictions.

  This arrangement requires that every charger at every parking space can serve every vehicle, but allows for the easiest and most flexible experience for drivers and other stakeholders because there is not a possibility of parking at a charger that is too powerful or not powerful enough for the vehicle. This is appropriate and desirable if there are not wide variations in the charging needs of vehicles, for example a fleet of very similar delivery vans for a delivery company, or a fleet of very similar heavy duty trucks at a drayage charging depot, or a section of the parking lot meant for employee vehicle charging at the workplace. This would not be appropriate if there were vehicles that had drastically different charging needs within one parking location; i.e. light-duty short-distance fleet vehicle charging (low power needs) in the same area as medium-duty long-distance fleet vehicle charging (high power needs) in the same area as employee charging (medium power needs).

- Option 2: Each vehicle/driver has one exact assigned parking space.
  This option allows for chargers to be matched exactly to the vehicle and driving needs of each vehicle/driver. However, matching chargers too exactly to today's needs may create some risk for future changes to the use of each vehicle and parking space. At City Hall, there is already assigned parking for fleet vehicles. At the MOC, parking is organized more closely with Option 3.
- Option 3: Blocks of parking spaces are reserved for various categories of vehicles/drivers. i.e. employees can park in any parking space within a designated employee parking area, fleet vehicles can park in any parking space within a designated fleet vehicle parking area, visitors can park in any parking space in a designated fleet vehicle parking area.
  This option is generally the best balance of flexibility and value engineering, as it allows for individual vehicles and parking spaces to change gradually over time without over-building the charger for each parking space. Within each designated parking zone, there may be subsidiary areas designated to different types, sizes, uses, or departments of fleet vehicles, or different departments of employee vehicles/drivers. For example, fleet vehicles from departments that generally drive longer distances may be parked in one area, vs fleet vehicles from departments that generally drive shorter distances.

RECOMMENDATION

The City is already using a mix of the second and third arrangement (vehicle/driver groups can park in any space within a given assigned area), which allows for some charger specification. Employee / visitor charging spaces can have different chargers than light-duty light-use fleet spaces, allowing for cost and feature optimization.

CHARGER POWER RATING

In order to select the power rating for the chargers in each set of parking areas, we will consider the charger that would be required in a scenario when the vehicle returns late in the day (5pm) with a mostly empty battery (~20% state of charge), and needs to be ready with a full battery the following morning (7am). We will also consider the charger power that would be required for the average daily energy needs of the average vehicle in the fleet, with the average amount of time to charge.

ON-ROAD FLEET VEHICLES

- For the pickup trucks used by the Parks and Public Works teams, they would need a 12kW (50A@240V) charger to recharge overnight from a 20% state of charge. Based on their average use, the pickup trucks could be supported by 7.7kW (32A@240V) chargers.
- For the cars (of likely electric makes/models that will be used) in the motor pool and community development fleet (primarily at City Hall), some would need a 7.7kW (32A@240V) charger and others would need a 12kW (50A@240V) charger to recharge overnight form a 20% state of charge. Based on their average use, the chargers could be 1.4kW (12A@120V) chargers.

Selecting a charger rated to support the average daily use is less costly, but comes with the risk that the vehicle may not be charged to adequately support its needs on the next trip. This may be an acceptable risk if the vehicle rarely completes an activity that is different than the average trip (i.e. if the vehicle is used with very regular expectations like a fixed-distance route in a location with a temperate climate), or if the vehicle is never used on consecutive days (and therefore has ample time to recover from a trip that requires more battery energy than average), or if the vehicle has access to a fast charger on site or at a publicly-accessible fast charging location. To account for this, the City could modify existing parking spots with higher charger ratings for department pool vehicles that have more variable milage.

Selecting a higher power charger can contribute to higher electricity bills, if smart charging software is not used, or not configured properly. Smart charging software can actually cause electricity bills from higher power chargers to be lower than electricity bills from lower power chargers without smart charging capabilities, by avoiding charging during times when electricity is most expensive.

Selecting a higher power charger may also be advisable if there are utility incentives available to offset the cost of a higher power charger, as these incentives can allow for roughly the same capital cost but with the added capability and flexibility of a higher-powered charger.

RECOMMENDATION

As the City is planning to install a DC Fast Charger at City Hall and the MOC, at both sites it may be possible to use a charger sized for the average use of the vehicles, and use the on-site fast charger to quickly make-up for a situation where a vehicle was not fully charged overnight. However, because the utility has a generous incentive to defray the up front cost of higher-powered chargers, as well as on-going incentives for off-peak charging which are only viable with Level 2 chargers, using Level 2 chargers is most suitable.

OFF-ROAD VEHICLES

Two UTVs (currently, John Deere Gators) are used for snow plowing. Charging for future battery electric UTVs will require a 208/240V outlet for each vehicle. The cost of these outlets may not be justified since this equipment is used primarily in emergency situations. This means there are times they sit and times they are used heavily.

POWER MANAGEMENT SETTINGS

For each site, we have considered the average daily energy needs of the entire fleet on an average day of the year. This determines the overall power supply requirements of the fleet in order to minimize the electrical infrastructure needed to power the fleet.

Reference the fleet spreadsheet model for additional information on daily energy and power requirements, and the equipment schedule for additional detail on chargers and power management settings.

CITY HALL

At City Hall, the power management settings will be configured to 90kW total; 65kW shared by the fast charger and the two dual-cable L2 chargers for public works vehicles, which will be tied into the backup generator, and 25kW for all new and existing non-critical fleet vehicle chargers and employee vehicle chargers which will not be tied into the backup generator. The nameplate power of all chargers on this site is 338.5kW, meaning there is a 3.76:1 over-subscription ratio of nameplate power to power management setting. This power management setting reflects that the chargers are not expected to be operating at full power, all at once, by the smaller and intermittently-driven vehicles at City Hall.

MOC

At the MOC, the power management settings will be configured to 200kW. The nameplate power of all chargers on this site is 326.5kW, meaning there is a 1.63:1 over-subscription ratio of nameplate power to power management setting. This relatively low power management setting reflects that the chargers are more fully utilized by the larger and more actively driven vehicles at the MOC when compared with the vehicle fleet at City Hall.

BEAVER LAKE AND SOUTH LOT

At Beaver Lake and South Lot, power management will not be used. The quantity of chargers is too small to take advantage of the benefits of power management settings, and it adds expense to monthly software fees.

USER ADMINISTRATIVE NEEDS

- The City has been operating two dual-port ChargePoint CP6000-series EV Chargers, and has recently added two more. The first two chargers are now dedicated to the parking spaces where the existing Nissan Leaf EVs are parked, and the two new chargers are located in carpool parking spaces.
- The City is pleased with ChargePoint's equipment and software, and doesn't desire a change of vendor unless there is a very compelling reason.
- City employees who charge their personal vehicles at City facilities will have to pay for charging.
- Fleet vehicles are authenticating to charge at no cost, using an RFID tag which is attached to the motor pool vehicle key chain. This arrangement is working well.

INCENTIVES AND UTILITY PROGRAMS

There are several incentive programs offered by Federal and State entities, as well as the electricity utility that serves the site. The programs with a * are recommended for Sammamish to pursue for this project.

FEDERAL INCENTIVES

Alternative Fuel Vehicle Refueling Property Tax Credit. None of the City's sites under consideration for vehicle electrification are currently deemed eligible for the 30C Alternative Fuel Infrastructure Tax Credit, commonly referred to as the federal tax credit or the IRA tax credit which can offset 30% of project costs up to $100K, because they are not in an eligible rural or low-income area (eligibility map available at this link). The City should revisit this tax credit as it proceeds with construction, as the IRS is continuing their rule-making on this incentive and some areas that are currently not deemed eligible, may become eligible with new rules expected to be released later this year.

MACRS[1]**.** The City can speak with their accountant about applying accelerated depreciation treatment to their EV Charging equipment, as part of the Modified Accelerated Cost-Recovery System (MACRS) in US tax code.

Other Federal Programs. There are other federal incentives – including the DOT's RAISE Grant Program, the EPA's Clean Ports Program, the EPA's Clean School Bus Program, and the National Electric Vehicle Infrastructure Program – which are not a fit for this project.

STATE INCENTIVES

Low Carbon Fuel Standard Credits[1]**.** Washington's Clean Fuel Standard law requires fuel suppliers to gradually reduce the carbon intensity of transportation fuels to 20% below 2017 levels by 2034. One way they can meet this obligation is by purchasing credits generated by low-carbon fuel providers, including owners of electric vehicle charging stations. Considering the amount of electricity that would be used to charge all of the non-critical Light- and Medium-Duty vehicles in the City's fleet, and the current trade pricing of LCFS trading levels, these credits would be worth $1500-4500 per year to the City*. LCFS credits are a commodity, whose value is subject to change. The scarcity and value of LCFS credits may change if fuel producers in WA choose to make actual changes to the carbon intensity of the fuel they distribute as opposed to purchasing credits; if other entities deploy EV Charging stations that generate LCFS credits; or if state legislators opt to increase or decrease the target fuel intensity of the state's transportation fuels. For the City to sell their credits directly, it would require a $268 participation fee, 1-2 days of training and administrative set-up for a City staff member to begin participation, and approximately one half day per quarter to submit reporting to the State Department of Ecology. Alternatively, the City can transfer their LCFS credits to an aggregator (such as TRC) in exchange for a portion of the credit revenue, which still requires about half the effort of directly administering the program.

1 *Note that if the City chooses to participate in PSE's programs with utility-owned equipment, the utility will retain ownership of LCFS credits.*

Sales Tax Exemption[1]. Washington's 6.5% State sales and use taxes do not apply to the labor and services for purchasing and installing EV infrastructure, per RCW 82.08.816. This tax exemption expires July 1st, 2025.

Other[1]. Washington's Commerce and Ecology departments periodically administer Grant opportunities to distribute State and Federal funds that may support EV Charging projects. There are no open opportunities at this time that are a fit for this project, but as the City prepares for project implementation, they should check the Commerce Department's EV Council website (link) for new funding programs.

UTILITY PROGRAMS

The programs offered by Puget Sound Energy are likely the most impactful funding opportunity available to the City (up to $12K in value per charger installed), for both its fleet and potential future employee charging needs. Because PSE's programs stem from legislation, and because they are a heavily-regulated public utility, their programs come with some important conditions summarized below. These conditions should not be a barrier to participation based on the City's plans for fleet electrification. PSE publishes basic details on their website, but there are still some areas of ambiguity that can only be addressed once the City applies to participate in the program.

Puget Sound Energy – Up & Go Fleet Program[1]. PSE offers up to $12K per charging port for L2 chargers, and up to $125K for DC Fast Chargers Fast chargers (capped at $250K per site) if the utility owns the charging equipment. Or, $4K per port for L2 chargers and $60K for DC Fast Chargers if the City owns the charging equipment.

Customers who plan to own their properties for the full ten year term of the incentive agreement are best served to accept the utility-owned option. Customers who lease their property, or otherwise would not prefer the encumbrance of utility-owned equipment and a utility easement on their property that inhibits their ability to modify or sell the property, should pursue a customer-owned option.

The City is likely to be able to accept the full value of the utility-owned incentive option - $250K per site – at City Hall and MOC, $48K at the Beaver Lake shop, and $96K for the South Lot. This is a total of $644K for all four sites for fleet charging.

PSE requires access to vehicle charging usage data for chargers funded through this program, which data can come directly from certain charging networked providers (Enel X and Shell ReCharge/Greenlots), or by installing a new meter to support only the chargers. Because the city prefers to use ChargePoint, they'd have to have a new utility meter and service installed to support the EV Chargers, which would absorb some of the value of the incentive (must apply to PSE program to determine exact financial parameters). At MOC, Beaver Lake, and South Lot, a new utility service will be required regardless, so its not an added burden for the project.

To participate, the City has to operate at least two new EVs to use the chargers by the time they are installed, and the City has to agree to operate the charging equipment for 10 years.

1 *Note that if the City chooses to participate in PSE's programs with utility-owned equipment, the utility will retain ownership of LCFS credits.*

Puget Sound Energy – Up & Go for Workplace[1]. Similar to the Fleet Program, PSE offers the same $12K per port (capped at $120K per site) for chargers meant for employee charging. PSE staff have indicated that Fleet and Workplace incentives could both be used at one site with separate funding caps, but published program literature from PSE does not confirm that, and the City will have to apply in order to get a commitment from PSE.

Puget Sound Energy – Up & Go for Public Charging Program. PSE is planning to offer funding for chargers that would be used by the public, perhaps visitors to City Hall and other facilities. However, this program is not yet active and details are not available. The City should continue to monitor PSE's offerings as they evaluate offering publicly-accessible charging for visitors to City hall.

Puget Sound Energy – Incentive for Off-Peak Charging[1]. The City can be rewarded for charging when it's better for the environment and electrical grid. This is a monthly on-bill credit of up to $10 per L2 charger (a total of $6720 per year across all four sites) if all charging occurs during off-peak hours of 11am-5pm and 10pm-6am. This is expected to be possible under normal circumstances for the City's fleet. The bill credit is pro-rated for the share of charging that occurs off-peak. This will require a networked charging system that is capable of scheduling charging to occur during off-peak hours, which ChargePoint is capable of doing.

PHASING

Incentives for EV charging are currently very substantial, and are expected to decrease over time as electric vehicle technology becomes more widespread and economies of scale negate the need for incentives. The City's contemplated schedule for electrification is within the next five years, and a charging project will take several months to deliver at City Hall and likely a year or more at MOC. The chargers will quickly become the limiting factor in converting to electric vehicles. We recommend immediately pursuing all the chargers needed for near-term emission reduction and electric vehicle requirements, including the required service upgrades at MOC. As the WA Commerce Grants become available, the City should apply for those grants to improve project economics.

1 *Note that if the City chooses to participate in PSE's programs with utility-owned equipment, the utility will retain ownership of LCFS credits.*

BATTERY ELECTRIC SMALL TOOLS

SUMMARY

Battery electric tools are desirable due to their drastically lower sound output and lack of exhaust emissions, near-zero maintenance requirements, and increased reliability when compared to gasoline-powered tools. Electric motors are also desirable because they can create greater power than a gasoline motor of equivalent size, and they are available in smaller formats (i.e. gasoline motors aren't available below the size of a line trimmer engine). However, commercially-available batteries are a less dense form of energy storage than gasoline, and this is a fundamental challenge for the use of batteries as a power supply for power-intensive equipment.

The performance characteristics of some categories of electric tools (i.e. air speed and volume for a blower, RPMs and torque for a line trimmer, etc.) can match (±15%) those of internal combustion tools. For some tools (namely handheld blowers, power augers, and trimmers that are used for shorter periods of time), the electric replacement can also match (±15%) the internal combustion tool.

However, for other tools (namely backpack blowers and trimmers that are used for an entire day of heavy use), sustaining the performance characteristics for an entire day as required for commercial or municipal maintenance, would in some cases require a 4x increase in cost to invest in the quantity of batteries needed to last an entire day, and therefore gasoline tools may be more appropriate.

The performance characteristics of heavy chainsaws (i.e. bar length, torque, power, chain speed) currently can't be matched (±15%) by electric tools.

McKinstry has completed a market review for each tool type to evaluate the specifications of available battery electric tools vs internal combustion incumbents. The following sections explain considerations and availability of suitable replacement tool models.

MARKET DYNAMICS

BRAND ALLIANCES

The City is currently operating a fleet of small tools that consists primarily of two brands traditionally known for their high quality and commonly preferred by outdoor equipment professionals; Stihl and Husqvarna.Stihl and Husqvarna have launched battery electric alternatives for most tool types, and the City has begun using several of these models. However, battery-electric specific manufacturers have entered the market and are offering tools that come with higher user ratings, longer warranties, and significantly lower cost than products from Stihl and Husqvarna. The leading battery-electric tool manufacturer is EGO, and one key difference between EGO vs Stihl and Husqvarna is EGO's higher-voltage battery architecture that allows for higher performance from the same size and weight of battery. EGO also has a more simplistic battery system, with only one battery format for all tools. Stihl and Husqvarna both have adopted a strategy to use batteries that are more specific to each tool type, which reduces interoperability between tool types and requires additional investment in batteries compared to EGO's universal battery format. Given these factors, the City may want to consider adopting EGO as a third tool manufacturer in addition to Stihl and Husqvarna.

FUTURE INNOVATION

While there will continue to be advancements in battery technology, most innovation in energy density and weight of batteries is expected to have been exercised already, with only modest increases going forward. However, significant continued improvement in cost reduction is expected for battery technology, and competition from additional manufacturers, as well as general growth in the battery manufacturing industry globally as driven by electric vehicle manufacturing, should further help to drive down prices.

AVAILABILITY OF BATTERY ELECTRIC SMALL TOOLS

BACKPACK LEAF BLOWERS

Backpack Leaf Blowers are a challenging type of tool to cost-effectively replace with battery electric models, because they are used for very long periods of time without stopping, and are operated at full power for most of the time they are in use to move large volumes of leaves and debris over significant distances. The gas-powered Husqvarna 580BTS currently operated by the City weighs 27lbs, costs $640, and offers 1000 cubic feet per minute (cfm) of leaf blowing capability. As with all gasoline tools, with refueling it can operate indefinitely with only the added cost of fuel. The nearest battery electric replacement is the EGO LPX8006, which weighs 42lbs, cost $949 (incl. battery and charger), and offers 800cfm. To operate for an eight hour shift with reasonable breaks, the operator would need to have three sets of batteries so that two sets could be charging while one is in use. The additional two sets of batteries would cost $1,100, bringing the total cost to approximately triple that of the gasoline incumbent, with 20% less performance.

HAND-HELD LEAF BLOWERS

Hand-Held Leaf Blowers are a good opportunity for electrification, as the higher power density of an electric motor compared to a gasoline motor has an advantage when the tool has to be held with one hand as opposed to backpack-mounted. For example the gas-powered Husqvarna 525BX currently operated by the City weighs 10lbs, costs $300, and offers 459 cfm of leaf blowing capability. A battery electric alternative is the EGO LB5300, which weighs 7.4lbs and costs $159 (incl. battery and charger), and offers 530cfm.

CHAINSAWS

The City's heavy-duty chainsaws which may be used for an entire day are currently impossible to replace with battery electric chainsaws. The largest battery electric chainsaws have a 16" bar, while some gas-powered chainsaws used by the City have a 24" or longer bar. However, for light-duty limbing saws, pole-mounted chainsaws, or a portion of the chainsaw fleet that are used for a few intermittent cuts where lower sound impact is desirable, could be cost-effectively replaced with battery electric models from Husqvarna, Sthil, or EGO. However, due to size limit for battery-powered chainsaws, larger sized chainsaws may be required to meet current needs.

LINE TRIMMERS AND HEDGE TRIMMERS

As with backpack leaf blowers, the City's heavy-duty line trimmers which may be used for brush clearing and lawn edging over the course of an entire day, are very difficult to cost-effectively replace with battery electric alternatives. For example, the Husqvarna 525LS has a cutting radius of 19.3in and costs $319, while its electric equivalent costs $720 with only one battery (an additional two batteries that would allow for all-day use would raise the all-in price to $1360, a premium of more than 4x.

However, light-duty trimming and edging, as well as hedge trimming with both hand-held and pole-mounted hedge trimmers, could be cost-effectively replaced with battery electric models from Husqvarna, Sthil, or EGO – the City currently operates a small number of Husqvarna trimmers and pole saws for smaller tasks.

PORTABLE POWER

Portable power – generators – can be challenging to replace with battery electric if used for multi-day power supply to heavy-duty equipment. However, there are many alternatives for battery-powered portable power supplies that are silent to operate, and can power lighting or hand tools or small electronics for a full day on just a single battery bank. If the City is using its Generac XG8000E gas-powered generator for partial-day light-duty power in areas where extension cords and wall-outlets won't reach, a battery-powered alternative would be feasible. If the City is using its generator to provide emergency power for 240V equipment for days on end, battery electric is not a good fit. Public Works purchased two portable battery banks in 2023 that are being used on certain maintenance tasks in place of gasoline-powered generators.

POWER EARTH AUGERS

Power Augers for digging holes require significant power, but generally not for extremely long periods of time. Accordingly, their use cases are approachable using battery electric tools. For example, the EGO800 Power Auger can dig 90 holes on a single charge, and costs $526 vs the alternative Stihl BT131 at $499. A battery electric power auger is much less difficult to use thanks to lack of engine noise and vibration even while generating more torque than a gasoline alternative, though it does weigh more at 34lbs vs 22lbs.

CUT-OFF SAWS

As with other tool types discussed here, if the City uses a Cut-Off Saw for large jobs that require it to operate for most of the day, a battery electric alternative will be difficult to justify. The Husqvarna K1PACE with 12" blade and a battery sized for half a day's work costs $3025, compared to the Stihl TS410 gasoline model that costs $1200. However, for light-duty cutting or just a few cuts, the 9" saws available from most manufacturers are approximately equal in cost.

REQUIRED ELECTRICAL INFRASTRUCTURE, EQUIPMENT LAYOUT AND OPERATIONAL AREAS

In order to describe the electrical infrastructure that is required, McKinstry has considered the following assumptions and generalizations.

- In the long-term future, the City will operate a fleet of entirely battery electric tools, even if this may not be financially viable in the near term.
- We will assume that there is one battery charger for each tool. Each tool that is used for an entire day at some point in the year will require three batteries. All three batteries will be charged overnight, and during the day two batteries will be charging while one is being used, so that the tool can be used indefinitely without a work stoppage. However, many tools are used sparingly throughout the year, and can share a battery with another tool that is not being used. This assumption may be challenged if the City adopts tool brands/types that have a wide variety of battery formats.
- Some charging will occur in the field during times of the year when the tools and batteries are being heavily used. Field charging will be via power outlets located on City properties adjacent to work areas, or power outlets in electric trucks (such as those in the F150 Lightning).
- All tools for the Parks department are charged at Beaver Lake, while all tools for the Public Works department are charged at the MOC.
- Staff will not switch batteries from one charger to another throughout the off-hours; i.e. every battery needs its own charging location.
- The power requirement for each battery charger will be <4 Amps at 120V, allowing four chargers to be installed on each 20 Amp circuit per National Electrical Code requirements.
- To allow for future flexibility to do more charging at the home base (i.e. MOC or Beaver Lake Shop) and less charging in the field, assume a 50% buffer in the required amount of charging circuits.
- Battery sizes vary, but in general a wall space of 8" x 10" will be required for each battery charging location.

CHARGING AT MOC

The MOC will require 100 battery charging locations, which will require (25) new 20A circuits at 120V. As noted above, a 50% margin for potential future scenarios would bring the required number of new circuits to 38.

This power supply will be supported by 125kVa of transformer capacity, which significantly exceeds the current spare electrical capacity of the site's aging electrical system.

The charging area at the MOC will require 100 sq.ft. of wall space to mount all the chargers if all mounted in one location, though it may be desirable to have some separation between charging to avoid heat build-up.

The HVAC system and fire protection system will need to be evaluated for adequacy given this concentration of charging equipment.

CHARGING AT BEAVER LAKE

The MOC will require 48 battery charging locations, which will require (12) new 20A circuits at 120V. As noted above, a 50% margin for potential future scenarios would bring the required number of new circuits to 18.

This power supply will be supported by 50kVa of transformer capacity, which significantly exceeds the current spare electrical capacity of the site's electrical system.

The charging area at Beaver Lake will require 50 sq.ft. of wall space to mount all the chargers if all mounted in one location, though it may be desirable to have some separation between charging to avoid heat build-up.

Additionally, there is no fire protection or ventilation system in the shop area to accommodate this concentration of charging equipment and will require additional evaluation by the city.

PROJECT COSTING

The cost to add electrical infrastructure for future charging needs for an entirely electric fleet of small tools will vary based on whether it is incorporated into a project to add charging for the City's planned fleet of electric vehicles, or done independently and separately. Electric vehicle charging projects are eligible for significant funding by the electricity utility, which would significantly reduce the cost of the upgrades to the utility's and the City's electrical infrastructure serving each site.

CHARGING AT MOC

As an add-on to the electric vehicle charging system upgrades, the MOC tool charging electrical infrastructure would be an additional cost on the order-of-magnitude of $40K. If done independently, with the tool charging electrical infrastructure upgrade bearing all costs of new service and switchgear, it would be a cost on the order of magnitude of $150K.

CHARGING AT BEAVER LAKE

As an add-on to the electric vehicle charging system upgrades, the Beaver Lake tool charging electrical infrastructure would be an additional cost on the order-of-magnitude of $30K. If done independently, with the tool charging electrical infrastructure upgrade bearing all costs of new service and switchgear, it would be a cost on the order of magnitude of $100K.