ELECTRIC VEHICLE SUPPLY EQUIPMENT SYSTEMWIDE ASSESSMENT

CITY OF SEATTLE

Department of Finance and Administrative Services

FEBRUARY 2020

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EXECUTIVE SUMMARY

PROJECT OVERVIEW

Leading local government efforts to battle climate change, the City of Seattle (City) recently adopted policies to reduce greenhouse gas emissions (GHG) and reach carbon neutrality by 2050. The Green Fleet Action Plan (GFAP) is a cornerstone of this strategy; it commits to 50% GHG emission reduction and a 100% fossil-fuel-free fleet by 2030. Electrification of City fleet vehicles is a key component of this initiative.

The Electric Vehicle Supply Equipment (EVSE) systemwide assessment (assessment or study) leverages the rapid technological advancements of the electric vehicle sector with Seattle's access to low cost, green electricity. The study anticipates the increased availability of light, medium, and heavy duty fleet options and fast charging systems, increased vehicle driving ranges, and reduced vehicle ownership costs (FIGURE 1).

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

WHERE THE CITY STANDS TODAY

The City currently operates approximately 4,000 fleet vehicles, of which 3,194 are rolling stock. Most (76%) are light duty vehicles. The fleet is located on 136 different City-owned or leased sites, including several sites outside Seattle city limits. More then 70% of the City's fleet are located on just 15 sites and three sites, Airport Way Center, Charles Street, and Haller Lake contain about 17% of the fleet. See FIGURE 3. Haller Lake and Charles Street also provide 53% of the fuel used by the fleet as a whole. These critical sites are a special focus of the EVSE systemwide assessment.

This study addresses a portion of the 3,194 rolling stock - 2,195 fleet that are located on sites owned or leased by general fund departments. Enterprise funded departments (Seattle City Light and Seattle Public Utilities) are coordinating with this effort as they plan for electric vehicle supply infrastructure on their properties.

Seattle has already started investing in electric vehicles and building charging infrastructure. 14% percent of the existing fleet are electric and the City has capacity to charge 15% of the fleet. See FIGURE 2.

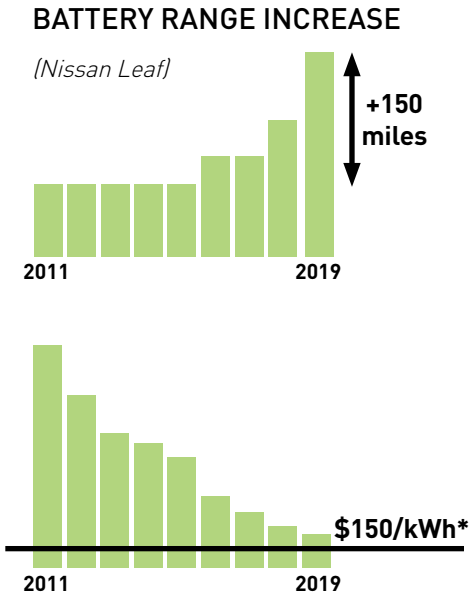


FIGURE 1. BATTERY RANGE INCREASE AND REDUCED COSTS

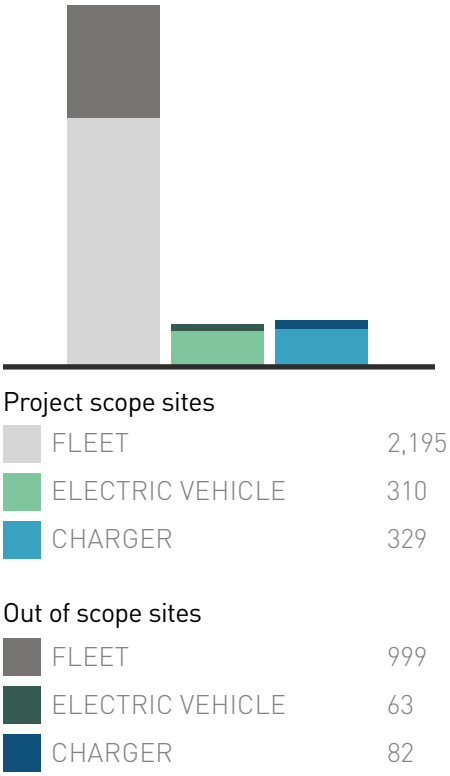


FIGURE 2. ELECTRIC VEHICLES AND CHARGERS (2019)

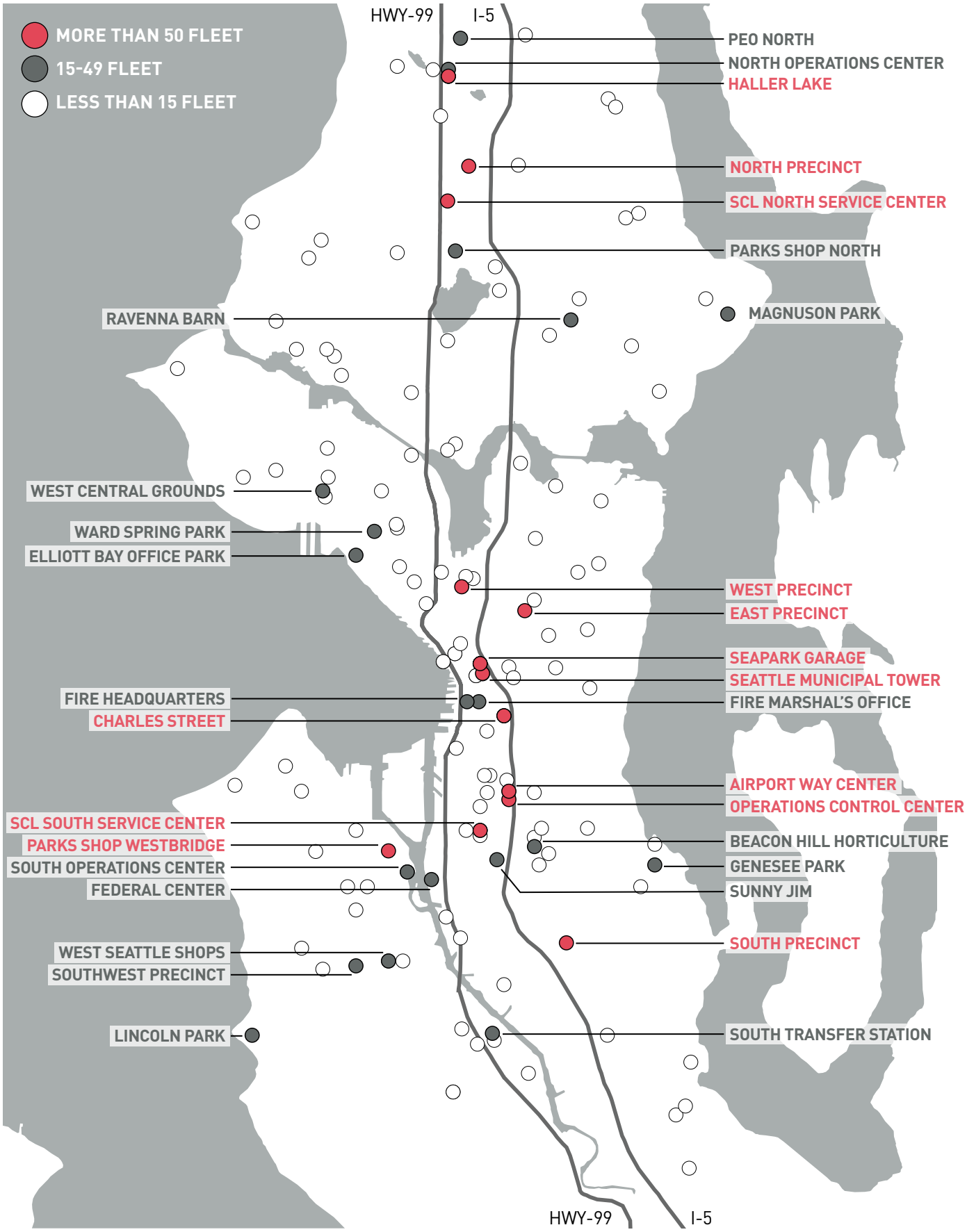


FIGURE 3. EXISTING FLEET LOCATIONS

EVSE VISION

The EVSE systemwide assessment envisions providing citywide charging infrastructure for each fleet vehicle to charge where it parks. It builds in system resiliency and response efficiencies by upgrading some sites with fast charging infrastructure. This creates a clear path to GHG emission reduction, reduces the total cost of ownership of each vehicle, ensures citywide emergency response capabilities, and eliminates refueling travel time.

BASELINE

The study first explores a baseline scenario which provides a dedicated charger for every vehicle, converts existing fuel sites into fast charging sites, and increases all sites' electrical capacity to meet future electrical load demand. Implementation of the baseline is estimated to cost $227 million (2019 dollars).

The estimate results in a significant budget gap. The 2019 GFAP allocates $5.5 million to EVSE in Fiscal Year (FY) 19-21, with an additional $4 million projected for EVSE investment between FY 22-25 (pending budget approval). To meet policy objectives, implementing the baseline scenario by 2030 would require $44 million per year (2019 dollars) between FY 26-30. See FIGURE 4.

BASELINE COST

$227 M

2019 dollars; includes project contingency and soft costs

$314 M

Escalated dollars, assuming 5% annualized escalation

RECOMMENDATIONS

Implementing the recommendations is estimated to save $76 million over the baseline (2019 dollars). See FIGURE 5. The recommendation's three key cost saving strategies are summarized below.

OPTIMIZE INVESTMENT AT EACH SITE

Adopt cost reduction strategies aligned with fleet use at each site through strategic load management and charger sharing.

INVEST IN A SYSTEM OF FAST CHARGERS

Build fast charging hubs at Charles Street and Haller Lake as the foundation of the entire system's resilience and efficiency. Reduce fast charging capacity and generators needed at fire stations by adopting a district-based approach, robust on-site charging, and high powered mobile charging capabilities.

ALIGN INVESTMENTS WITH VEHICLE ACQUISITION

Install chargers where and when you need them, aligned with the City's EV deployment. Defer investment for fleet not planned to be electrified by 2030.

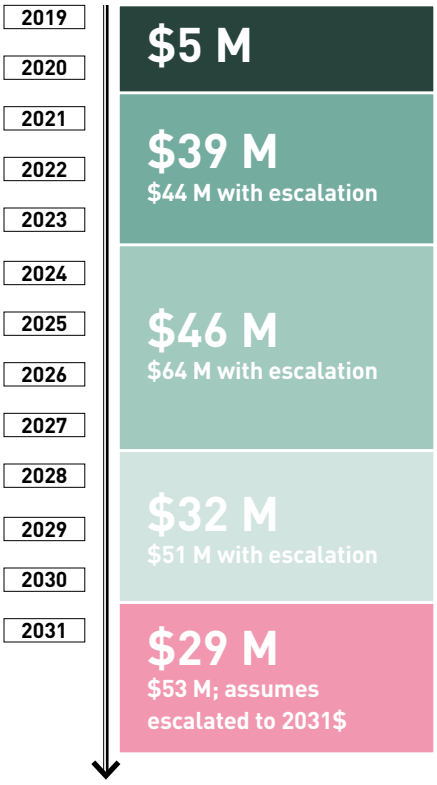
RECOMMENDATIONS COST

$151 M

2019 dollars; includes project contingency and soft costs

$217 M

Escalated dollars, assuming 5% annualized escalation



IMPLEMENTATION STRATEGY

A five-phase implementation strategy outlined below. See FIGURE 5.

IMMEDIATE (FY 19-20)
Complete ongoing and planned investments and begin planning the complex investment strategies at Airport Way Center, Charles Street, and Haller Lake.

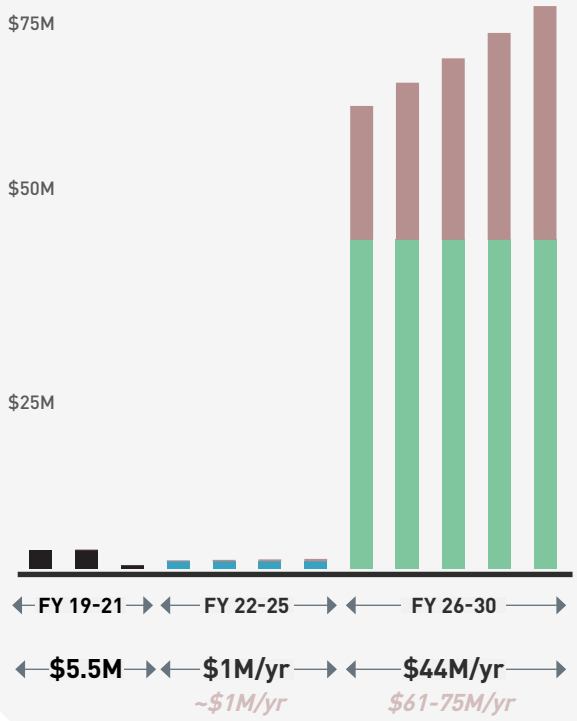
NEAR-TERM (FY 21-23)
Invest in fast charging hubs at Charles Street and Haller Lake and sites with high fleet count and/or high percent of light duty fleet.

MEDIUM-TERM (FY 24-27)
Build out the police precincts, training facilities, and key parks maintenance facilities.

LONG-TERM (FY 28-30)
Invest in sites with low fleet count and/or high percent of medium/ heavy duty fleet and in backup capabilities in key fire stations.

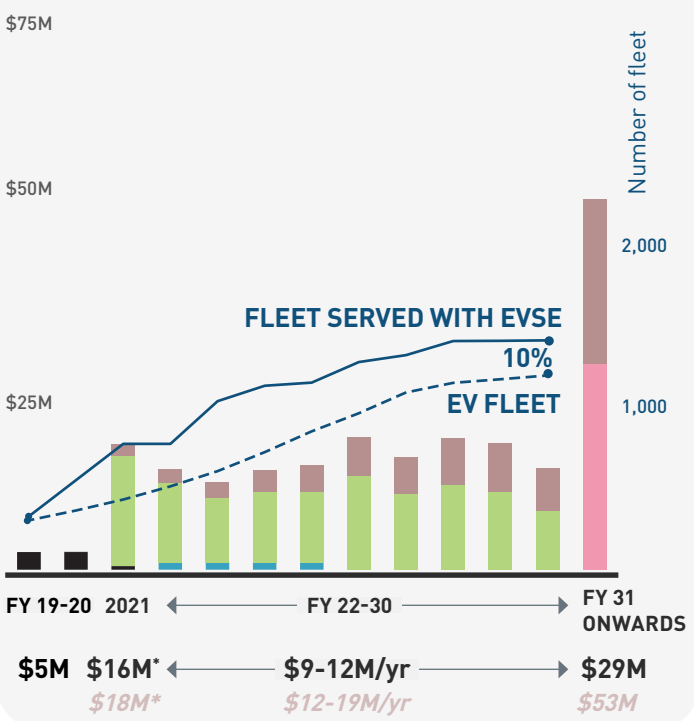
DEFERRED (FY 31 AND ONWARDS)
Install chargers for fleet to be electrified after 2030.

FIGURE 4. BASELINE IMPLEMENTATION



FUNDING ALLOCATED — Per 2019 GFAP — $5.5M
FY 22-25 FUNDING — Pending budget approval — $4M
BASELINE ADDITIONAL — $217M

FIGURE 5. RECOMMENDED IMPLEMENTATION



RECOMMENDED ADDITIONAL — $113M
DEFERRED INVESTMENT — FY 31 onwards — $29M
INVESTMENT IN ESCALATED $ — 5% annual escalation

**Includes FY 21 allocated funds - $0.5 million*

PRIORITY ACTIONS

The following summarizes the recommendation's priority actions; investment sites are identified in FIGURE 6.

Complete ongoing and planned investments at Seattle Municipal Tower, SeaPark Garage, Charles Street, and North Precinct.

Develop fast charging capabilities and electrical infrastructure upgrades at the critical hub sites - Charles Street and Haller Lake.

- Launch master planning efforts to anticipate City and tenant needs and incorporate EVSE fast charging hubs.
- Assess the feasibility and cost-benefit of developing an EV fleet parking maintenance garage that reuses captured heat.
- Invest in on-site energy storage to augment resiliency capabilities, e.g., mobile chargers, solar powered microgrids, and battery storage banks.

Upgrade electrical infrastructure and install chargers for applicable fleet at Airport Way Center. Pilot a study on telematics, fleet user behavior, and optimum load management strategy at Airport Way Center.

Invest in fast charging capabilities, infrastructure upgrades, and chargers for applicable fleet at Parks maintenance sites, City training facilities, fire stations with light duty fleet, and police precincts.

A FLEXIBLE TOOL

The electric vehicle industry is evolving rapidly. As conditions change and new opportunities arise, the City should update this assessment to take advantage of technology that reduces costs and improves performance.

STUDY BENEFITS

This study's recommendations align investment to support fleet use and EV deployment, build resiliency and emergency response capacity into the system, and reduce overall costs, energy use, and greenhouse gas emissions. Allocating adequate and timely resources to implement the recommendations will create the infrastructure needed to realize Seattle's commitment to carbon neutrality.

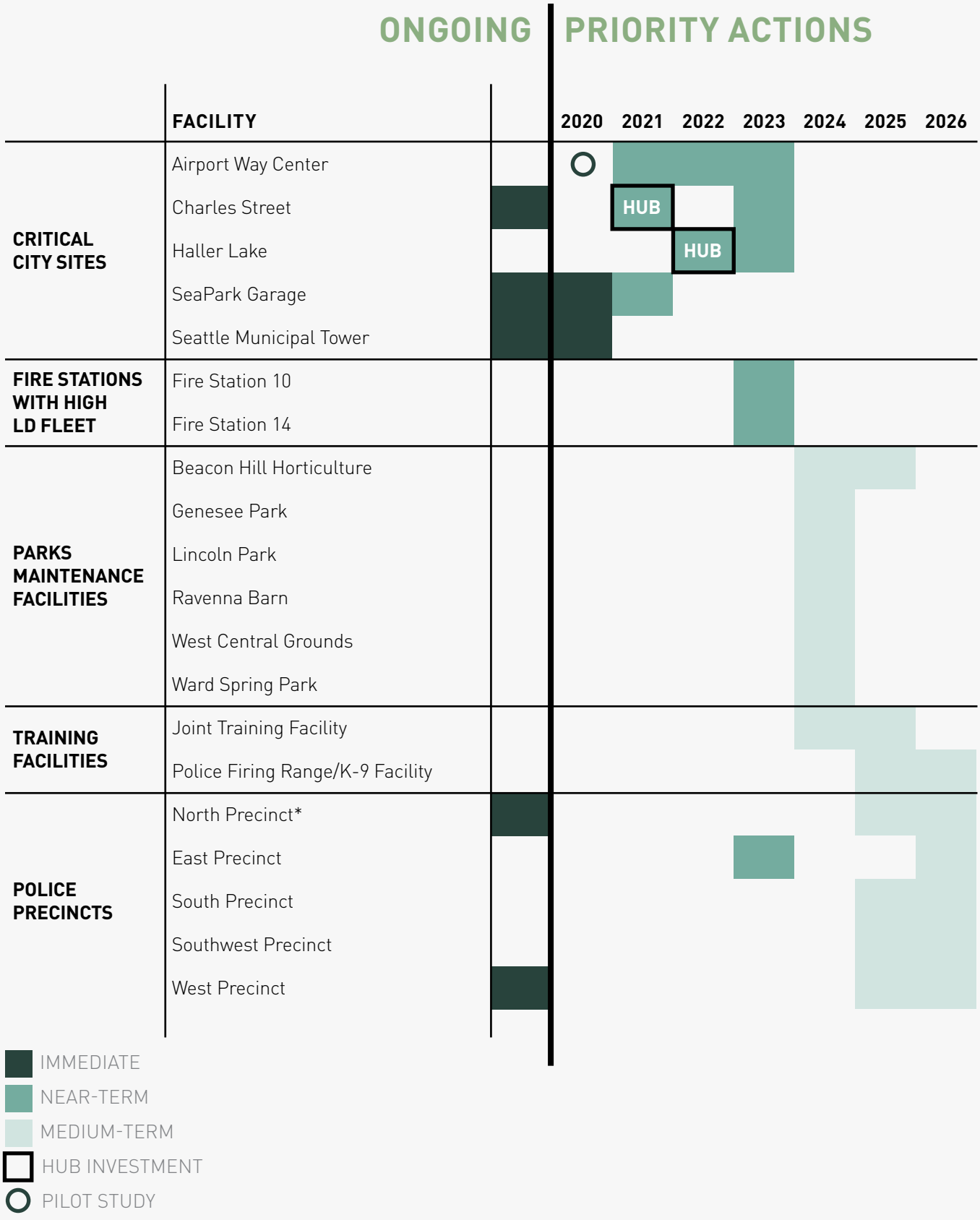


FIGURE 6. FY 20-26 PRIORITY INVESTMENTS
Includes investments greater than $0.5 million

**Placeholder to acknowledge ongoing site needs; update as planning effort evolves*

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INTRODUCTION

BACKGROUND

In 2016, Mayor Ed Murray announced a major initiative to tackle climate change at the local level and take meaningful action to reduce greenhouse gas (GHG) emissions. A sector-wide transportation initiative, Drive Clean Seattle, was a key piece of this action agenda and one of the most comprehensive plans to electrify transportation at significant scale in the country. Seattle's City Council adopted a resolution later that year in support of this goal (City of Seattle Resolution 31696).

DRIVE CLEAN SEATTLE

In 2017, the City of Seattle's (City) Office of Sustainability & Environment (OSE) issued Drive Clean Seattle, which recommends strategies to achieve carbon neutrality by 2050. Drive Clean Seattle proposes investing in electrical infrastructure, identifying opportunities for public/private partnerships, and piloting innovative projects to accelerate the adoption of electric vehicles throughout the city. Following that, in early 2018, Mayor Jenny A. Durkan directed the City to accelerate electrification of City's fleet and eliminate fossil fuel vehicles by 2030 (Executive Order 2018-02: Green Fleet, April 13, 2018).

FIGURE 7. DRIVE CLEAN SEATTLE

GREEN FLEET ACTION PLAN

The Green Fleet Action Plan (GFAP) (2019) was developed to outline implementable strategies to support Mayor Durkan's directive of 50% reduction in GHG emissions by 2025 and 100% use of fossil-fuel-free (F3) fuels by 2030. The GFAP is based around three guiding principles:

RAPID FLEET ELECTRIFICATION

Build the electric vehicle (EV) charging infrastructure, deploy market-ready EVs, and pilot emerging EV technology in medium and heavy duty vehicles.

REDUCED FUEL USE

Implement opportunities to increase service delivery efficiency, turn off engines when not in use, and eliminate unnecessary vehicle miles traveled.

USE FOSSIL FREE FUELS (F3)

Substitute sustainable bio-based fuels as a direct replacement for fossil-based fuels.

The GFAP also includes five specific strategies to achieve the City's goals:

- Procurement process coordination
- Fuel reduction policy implementation
- Electric vehicle charging infrastructure planning
- Emergency management upgrades
- Public-private partnership development

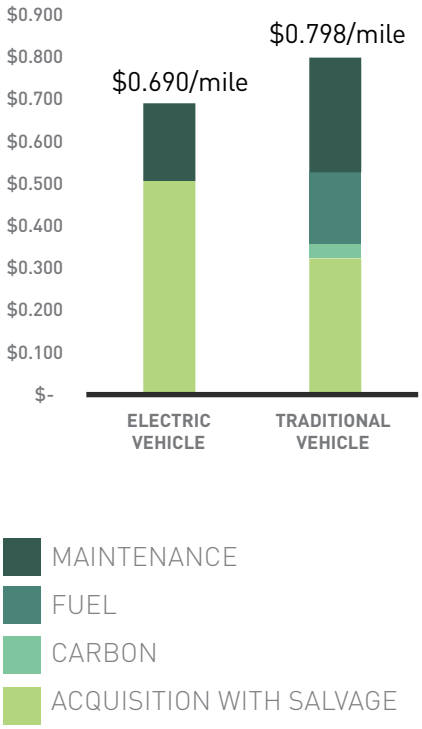

FIGURE 8. PER-MILE COST OF OWNERSHIP COMPARISON
Source: Green Fleet Action Plan (2019)

EVSE SYSTEMWIDE ASSESSMENT

The Electric Vehicle Supply Equipment (EVSE) systemwide assessment is an outcome of these initiatives. It is intended to be used as a resource for capital project planning.

PURPOSE

- Document where City fleet is located today.
- Identify gaps in City's EVSE infrastructure.
- Estimate costs to build-out EVSE to support 100% fleet electrification.
- Analyze cost reduction strategies and industry trends that best suit the City's fleet.
- Recommend a citywide EVSE investment strategy.

SCOPE

The study's scope identifies infrastructure gaps, cost estimates, and recommends a citywide EVSE investment strategy, limited to sites that are owned and leased by general fund departments. Additionally, it documents the sites where all fleet vehicles are located.

DOCUMENT ORGANIZATION

The EVSE systemwide assessment is organized into three sections. A brief overview provides background information on the transportation industry and how electric vehicles and charging infrastructure affect it. The second section documents City's existing conditions and gap analysis for fleet and charger infrastructure. Finally, recommendations include cost estimates and an implementation strategy.

DEFINITIONS

The following definitions are intended to provide helpful context for the EVSE Systemwide Assessment.

GENERAL FUND DEPARTMENTS

For the purposes of this study, "general fund departments" reference. Departments primarily supported by a central fund composed of general tax revenues and discretionary resources. It also includes departments supported by revenues from permits, inspection fees, grants, and levies. For the purposes of this study, general fund departments include:

- Arts & Culture (ARTS)
- Seattle Center (CEN)
- Department of Neighborhoods (DON)
- Department of Parks & Recreation (DPR)
- Finance and Administrative Services (FAS)
- Human Services Department (HSD)
- Information Technology Department (ITD)
- Mayor's Office (MO)
- Office of Housing (OH)
- Department of Construction & Inspections (SDCI)
- Seattle Department of Transportation (SDOT)
- Seattle Fire Department (SFD)
- Seattle Municipal Court (SMC)
- Seattle Police Department (SPD)
- Seattle Public Library (SPL)

ENTERPRISE FUND DEPARTMENTS

"Enterprise fund departments" indicate departments supported through a self-supporting fund composed of utility fees paid by service area customers. Enterprise fund departments include Seattle City Light (SCL) and Seattle Public Utilities (SPU).

ROLLING STOCK VEHICLES

For purposes of this study, "rolling stock" indicates self-propelling vehicles that have a powertrain unit.

NON-ROLLING STOCK VEHICLES

In this study, non-rolling stock are vehicles incapable of self-propulsion (lack a powertrain). Non-rolling stock vehicles include a variety of trailers such as bomb containment and surveillance units, boats, generators, motors, mobile ventilation units, sand blasters, water tanks, and construction and landscape equipment.

OFF-ROAD VEHICLES

This study defines off-road vehicles as rolling stock vehicles intended to operate primarily on non-paved roads such as golf carts, bicycles, Zambonis, and personal mobility devices.

FLEET

For the purpose of this study, the term 'fleet' indicates light, medium, and heavy duty rolling stock and does not include off-road vehicles.

FLEET TYPE

Defined by the Federal Highway Administration (FHWA) and Department of Energy (DoE):

LIGHT DUTY (LD)

Class 1-3 vehicles including motorcycles, passenger cars (such as minivans, sedans, sport utility vehicles (SUVs), and smaller pickup trucks).

MEDIUM DUTY (MD)

Class 4-6 vehicles including mid-sized trucks and vans that have 2-3 axles and/or six tires.

HEAVY DUTY (HD)

Class 7-9 vehicles including those with four or more axles such as larger dump trucks, vactor trucks, and larger service vehicles.

ELECTRIC VEHICLES

For the purpose of this study, the term 'Electric Vehicle' or 'EV' indicates BEVs and PHEVs and does not include hybrid vehicles.

ELECTRIC VEHICLE (EV)

Vehicles that derive all or part of their power from electricity and use batteries to power an electric motor. These include battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs).

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

Electric vehicle charger connected to the electric grid. There are three main categories of chargers, based on the maximum amount of power the charger provides to the battery from the grid:

L1 CHARGERS (L1)

Provide charging through a 120 Volt (V) alternating current (AC) plug. L1s provide a 12 ampere (A) charge and can deliver 2-5 miles of driving range per hour of charging. Most often used in homes but sometimes used at workplaces.

CHARGERS

For the purpose of this study, 'chargers' include existing and near-term planned L2 and DC fast chargers (DCFC).

The term 'chargers' has been used in this study interchangeably with 'Electric Vehicle Supply Equipment' or 'EVSE'.

L2 CHARGERS (L2)

Provide charging through a 240V or 208V AC plug. L2s can provide 20A or 40A charge and require installing special charging equipment. Can deliver 10-20 miles of driving range per hour of charging. Used in homes, workplaces, and for public charging.

DC FAST CHARGERS (DCFC)

Provide charging through 480V direct current (DC) plug and requires specialized high-powered equipment in the station and the vehicle itself. DCFCs can deliver 60-80 miles of range in 20 minutes of charging. Used most often in public charging stations, especially along heavy traffic corridors.

FEDERALLY-FUNDED CHARGERS

Eaton chargers identified in the existing conditions are federally-funded chargers that Seattle plans to replace over time. Eaton, a former manufacturer of commercial EVSE made a strategic business decision in 2015 to discontinue manufacturing and providing technical support for Eaton commercial chargers after their warranty period.

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3 INDUSTRY CONTEXT

ELECTRO-MOBILITY MEGA TRENDS

The transportation industry is at an early stage of a radical re-invention that will impact all aspects of mobility—how people and goods will move, how vehicles will be controlled and fueled, and how transportation will be paid for. It is important to understand the technological context of this transition before converting the fleet to electric.

By 2030, City of Seattle intends to have a fully zero-emissions fleet. By then, today's norm of human-operated liquid-fueled vehicles may be replaced by automated, digitally-connected electrically-powered vehicles operated as part of a Mobility-as-a-Service industry.

While exploring the potential impacts of this transportation ecosystem disruption is beyond the scope of this study, it is relevant to examine the major changes that will impact the City's investments in vehicles and charging infrastructure. For simplicity, the overarching trends likely to affect the City's fleet include:

- Expansion of electric vehicle choice
- Longer range batteries and faster charging
- Integration of energy and transportation
- Proliferation of smart technologies
- Mobility-as-a-Service

FIGURE 9. ELECTRIC TRUCKS
With support from General Motors, Lordstown Motors plans to produce an electric pickup truck by 2021 with a $52,500 starting price range before federal incentives.

EXPANSION OF ELECTRIC VEHICLE CHOICE

One of the existing challenges to fleet electrification is lack of market-ready electric vehicles that are comparable in costs to traditional vehicles. With rapid technological advancement, however, indications are that by 2021 multiple vehicle models suitable for fleet use will be in production.

LIGHT DUTY VEHICLES

As of 2019, there are limited options of all-electric vehicles or BEVs (battery electric vehicles) suitable for municipal fleets in terms of vehicle cost and driving range as compared to traditional vehicles (Watt EV2Buy). The most common options consist of the Nissan Leaf or Chevrolet Bolt, both of which are part of Seattle's fleet today. Despite increased availability of light duty BEVs, they remain a fraction of total light duty vehicle models currently available to fleet buyers (Edison Electric Institute).

The gradual shift towards electric vehicle adoption has seen legacy automotive Original Equipment Manufacturers (OEMs) developing multiple all-electric models, with plug-in hybrids considered compliance placeholders and market penetrators. With increased production volume, parity with traditional vehicles is expected between 2022-24 (BloombergNEF).

MEDIUM AND HEAVY DUTY VEHICLES

Medium and heavy duty all-electric vehicle options are currently limited to expensive semi-custom electrified or hybrid versions of commercially-available vehicle platforms such as Workhorse and Lion Electric. As FIGURE 10 demonstrates, today's limited offerings will be augmented by multiple commercially-available medium and heavy duty electrified vehicle platforms with longer drive ranges. This will facilitate replacement of a significant percentage of diesel and gas-powered fleet with zero-emission options prior to 2030. It should be noted that the timeline of availability of these fleet is reliant on individual automakers' development and production schedules.

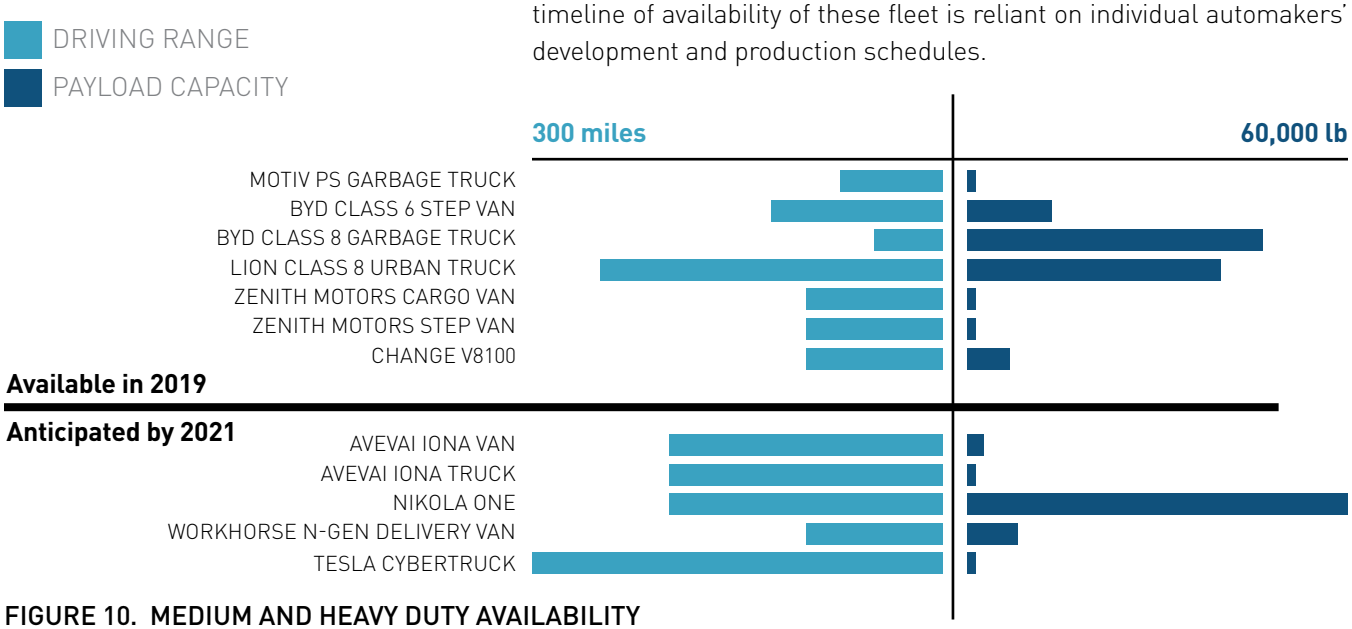


FIGURE 10. MEDIUM AND HEAVY DUTY AVAILABILITY

LONGER RANGE BATTERIES AND FASTER CHARGING

Limited driving range and lack of access to charging infrastructure have been constraints on public electric vehicle adoption. This has indirectly affected availability of market-ready vehicles suitable for municipal fleets. As of 2019, however, multiple vehicles with at least 200 miles of driving range are either market-ready or in production. Simultaneously, charging infrastructure development has expanded availability of direct current (DC) chargers that shorten light duty fleet charge time and begin to make medium duty fleet charging more practical.

INCREASED RANGE AND REDUCED BATTERY COSTS

Along with lack of vehicle choice, 'range anxiety' and vehicle cost have challenged electric vehicle adoption. Battery technology improvements have contributed to increased energy density and longer driving range. At the same time, decreasing battery costs (per unit kWh) have reduced upfront and total ownership costs. According to the Rocky Mountain Institute, the average battery cost has fallen to a tipping point that will soon see electric and traditional vehicle cost parity (Seattle City Light: Transportation Electrification Strategy, 2019). See FIGURE 11.

For Seattle's fleet, increased battery efficiency and cost-effectiveness could mean lower cost and/or longer-range vehicles. This will reduce charging frequency, allow charger sharing, and reduce charger installation and electric service upgrade.

FIGURE 12 shows a typical weekly charging schedule for a City vehicle that drives average 25 miles per day. This schedule assumes a 5 day work week with 16 hours night dwell time and is modeled using a Nissan Leaf (62kWh) with a 225 miles drive range.

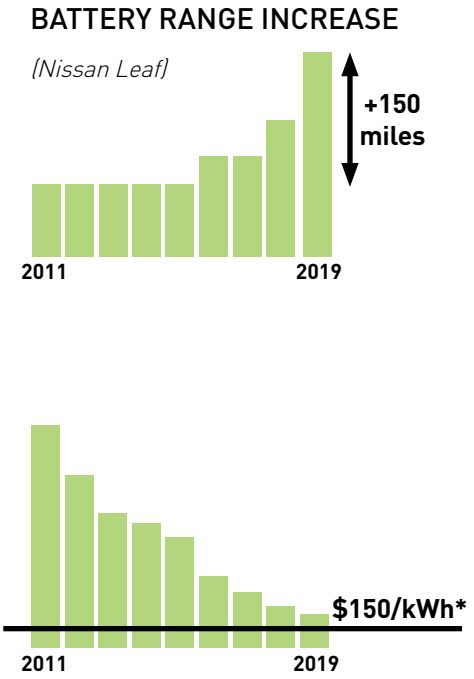


FIGURE 11. BATTERY RANGE INCREASE AND REDUCED COSTS

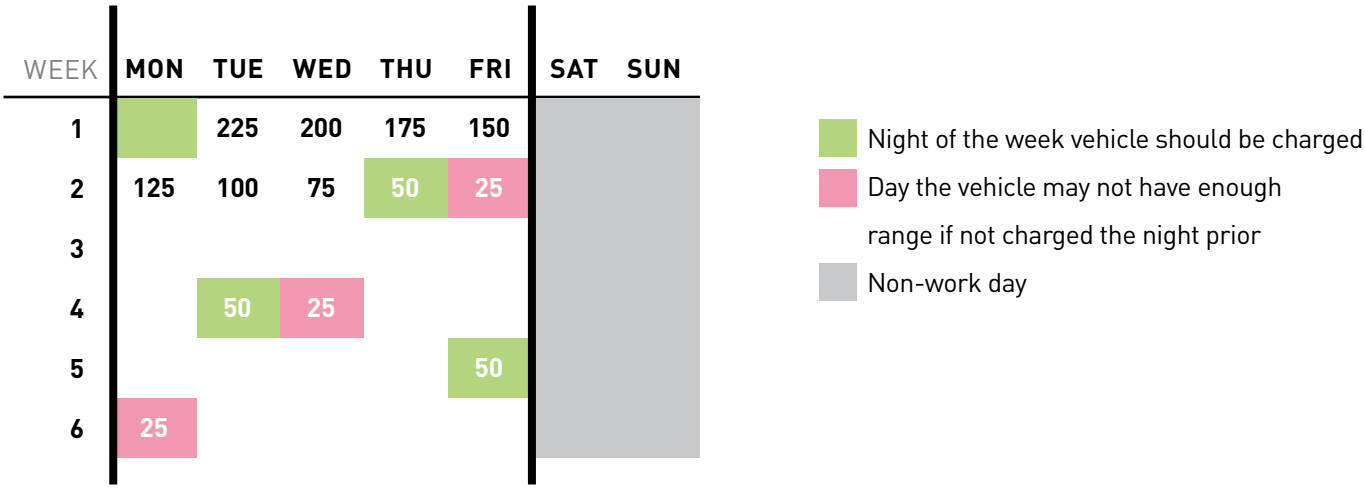


FIGURE 12. TYPICAL CHARGER SHARING SCHEDULE
Numbers denotes drive range at the start of work days
Assumes Nissan Leaf (62 kWh) with a maximum 225 miles drive range

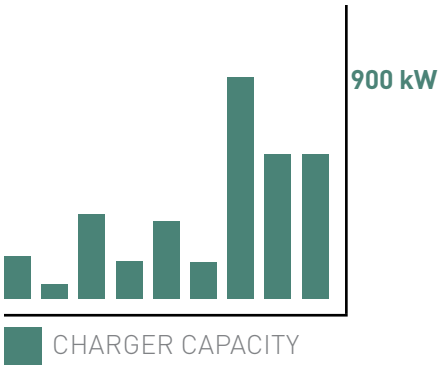


FIGURE 13. HIGH-POWER CHARGING NETWORKS
Models by ABB, Blink, BTC Power, Charge Point, Efacec, Heliox, Power Electronics, Tritium, and Siemens

FASTER CHARGING

Charge durations are limited by the charger's capacity to transmit electricity and the ability of vehicles to accept higher charging rates. Most electric vehicles are limited to rapid charging speeds of 50kW, which is provided by the most commonly available DC fast charger. Advancement in this sector has allowed liquid cooled cords in higher powered chargers (200 kW or higher) that reduce charge time.

As of 2019, multiple high-power charging networks exist or are being installed nationally in anticipation of wider fleet availability and to support municipal fleet emergency response (FIGURE 13).

INTEGRATION OF ENERGY AND TRANSPORTATION

Electro-mobility represents a convergence between energy utilities and the transportation industry. As electricity replaces petroleum-based vehicle fuel, utilities like Seattle City Light can expect significant new electrical demand and revenues, but could also experience localized constraints depending on the distribution network.

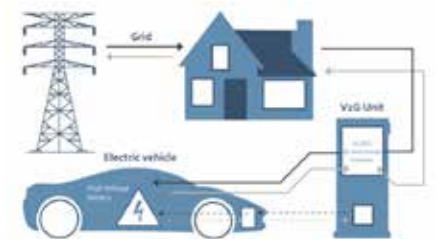


FIGURE 14. V2G TECHNOLOGY
Source: Energy Storage Journal

V2G & V2B

Vehicle-to-grid (V2G) and vehicle-to-building (V2B) technology is bi-directional electrical flow technology that has the ability to benefit utilities and fleet operators. V2G facilitates the use of surplus vehicle battery capacity to sell power back to the grid reducing utilities' investment in new energy sources and creating a revenue source for fleets. Similarly, V2B facilitates sharing of power between buildings co-located with a fleet parking facility. This allows buildings to manage peak demand by borrowing stored electricity from the vehicle batteries and reduces the building's electric costs.

FIGURE 15. ENERGY STORAGE WITH SOLAR COLLECTION
Source: Envision Solar

ON-SITE ENERGY STORAGE

Mission-critical fleets, such as police, fire, and rescue vehicles, need power-outage resilient fueling infrastructure. Traditionally, this has included on-site generators that run on fossil fuel. Alternate sustainable options include on-site energy storage, coupled with solar collection canopies (or other distributed energy microgrids) and vehicle charging (such as Envision Solar and Paired Power). These portable units are quick to install, require no site preparation or permits, and can be islanded or connected to the grid. Other options include standalone battery banks (such as Samsung, LG, and Chem) integrated into energy storage banks (Watt Power) to provide short-term backup power.

PROLIFERATION OF SMART TECHNOLOGIES

The mobility revolution is in part being driven by smart data collection and analytics technologies, also known as telematics. Smart technologies improve electric fleet operations and reduce costs by lowering peak electric loads.

DATA/ANALYTICS

Numerous smart technologies are improving electro-mobility planning and operations. These include data collection and analytics to distribute and manage electrical loads to specialized charging technologies that address the unique needs of specific fleet components. Vehicle data such as miles and routes driven, energy consumption, and driver behavior can be collected using telematics (Geotab) and analyzed for both light duty (Sawatch Labs) and heavy duty fleets (EVOpt) to inform vehicle choice and charging equipment decisions.

LOAD MANAGEMENT

Upgrading electrical service to charge electric vehicles typically requires costly electrical service capacity and infrastructure upgrades. One way to reduce this investment is through technology that balances or manages the electrical load to avoid peak demand charges by charging vehicles sequentially.

In addition to load management, some charging networks include software with customizable algorithms to intelligently share power chargers so each vehicle charges as fast as possible without exceeding the site's electrical capacity

Seattle has successfully deployed two such technologies, PowerFlex and CyberSwitching. Both smart solutions leverage low daily miles and long dwell times for fleet that are parked overnight to charge multiple vehicles on a single circuit.

LINE VOLTAGE

Another cost reduction strategy is to install charging infrastructure that needs no step-down transformer. This can be accomplished by using line (medium) voltage to charge both Level 2 and DC fast chargers. These chargers are able to accept 480V direct chargers that can then self-convert to 240V alternating current (AC) for vehicle charging. This eliminates the cost of additional transformer and switchboard installation. This strategy is applicable for facilities with buildings that have 480V capacity (such as Airport Way Center) that would otherwise require upgrading to 240V to supply typical Level 2 chargers.

Similarly, for fast charging, integrating transformer and medium-voltage cells into the same set of equipment simplifies charger installation and results in considerable capital and operating cost savings.

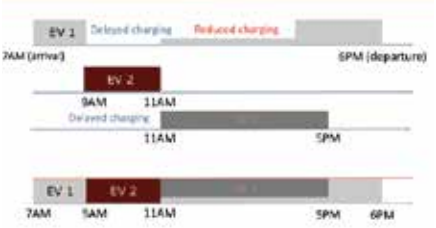


FIGURE 16. ADAPTIVE LOAD MANAGEMENT
Source: PowerFlex

FIGURE 17. MEDIUM VOLTAGE HIGH POWER CHARGER
Source: Power Electronics NB Station

FIGURE 18. MOBILE POWER SOURCE
Source: Dannar

FIGURE 19. MODULAR FAST CHARGERS
Source: SparkCharge

MOBILE CHARGING

Many municipal fleets, like Seattle's, are seeking to electrify vehicles with minimal behavior modification through dedicated charging, ensuring that vehicles start the work day with a full charge.

However, an alternate way of charging vehicles while parked would be through a mobile charger that can be moved between vehicles, or charge multiple vehicles simultaneously at low speeds (FreeWire Technologies). This assumes some investment in personnel for unplugging and plugging chargers. Another option is a mobile power source that can charge multiple battery types. This would replicate the function of a trailer-mounted mobile generator and be easily transported between sites if required (Dannar). Multiple variants of mobile chargers are available, such as SparkCharge that produces a highly portable, modular arrangement of DC fast chargers.

Mobile charging technology can be used by fleets to augment the range of low cost or older electric vehicles, reduce range anxiety, and support long off-site emergency response deployments .

MOBILITY-AS-A-SERVICE

The transportation sector is at the onset of a disruptive trend as it transitions from owner-operated vehicles to a Mobility-as-a-Service business model that is expected to dominate increasingly shared, autonomous connected modes of mobility.

SHARED MOBILITY

The initial stage of this revolution coincides with the advent of shared mobility exemplified by app-based car-sharing, ride-hailing, and micro-mobility. Like other transportation services, municipal fleet operations will be impacted by these changes which offer new opportunities to reduce capital and operating costs while reducing lifecycle carbon footprints. Cities and states that have used car-sharing and services to supplement their municipal fleets have found many benefits and cost savings (Portland, OR and San Francisco, CA).

One opportunity is partnerships with third-party vehicle owner/operators (Envoy). Under such a scenario, third-party vehicles could supplement the City's own motor pool by providing vehicles during peak fleet use. To facilitate this, vehicles would be located at City-owned garages to address potential peak vehicle demand that exceeds the capacity of a right-sized municipal fleet. These vehicles could also be used during the evenings by other car share members including other City agencies (such as Seattle Housing Authority). This would reduce vehicle ownership costs, distribute operational costs, and reduce financial risk.

Shared mobility is creating an ecosystem of additional service providers —a virtual service aggregator that connects auto mechanics, vehicle inspectors, cleaners, and other service providers that could potentially include municipal fleet technicians (Halocar). Another solution is use of a smart phone app that allows charger owners to rent their chargers to other EV users when not in use through an online reservation system (EVMatch). Fleets could use this technology to generate revenue from their infrastructure during the day when the charging infrastructure is available, allowing other agencies and City employees to compensate the City for charger use while advancing City's emissions reduction objectives.

CHARGING AND FLEET-AS-A-SERVICE

Another example approach is to contract EV charging-as-a-Service (Amply, ChargePoint and EVgo). By outsourcing, fleets can focus their capital investments on vehicles and avoid the upfront charging infrastructure costs while avoiding the risk of investments in charging technology that become obsolete. This Fleet-as-a-Service business model can allow a municipal fleet to stabilize its finances by shifting capital investments to operating expenditures.

4

EXISTING CONDITIONS

FLEET OWNERSHIP

The City currently has approximately 4,000 pieces of equipment in its fleet, of which 3,194 are rolling stock. 2,005 of these are used by general fund departments and owned by the City's department of Finance and Administrative Services (FAS). These fleet are located at 117 sites that are owned or leased by FAS. See FIGURE 21.

To provide a comprehensive picture, the study also incorporates 1,199 enterprise fund fleet owned by Seattle City Light (SCL) and Seattle Public Utilities (SPU) that are located on 19 sites.

The study's scope includes all 2,195 fleet at general fund owned/leased sites, and excludes 999 fleet at sites owned/leased by SCL and SPU. See FIGURE 20.

General Fund fleet	2,005
Enterprise Fund fleet at FAS sites	190
Other Enterprise Fund fleet	999
TOTAL FLEET	**3,194**

FAST FACTS

- SPD has the highest number of fleet and accounts for 24% of the fleet citywide; 77% of the SPD fleet is located among six sites (five precincts and Airport Way Center).
- 40% of all City fleet is located on shared sites, or sites that support multiple City departments.
- Seattle Municipal Tower and the adjoining SeaPark Garage have the highest concentration of multiple departments on one site, with seven and 11 departments, respectively.
- Almost a third of SPU's fleet is located on FAS sites.
- DPR has the highest number of sites where fleet are parked (50 sites); SFD is a close second with 41 sites. Of those sites, most have fewer than five fleet, such as DPR's 27 community centers and SFD's 34 fire stations.

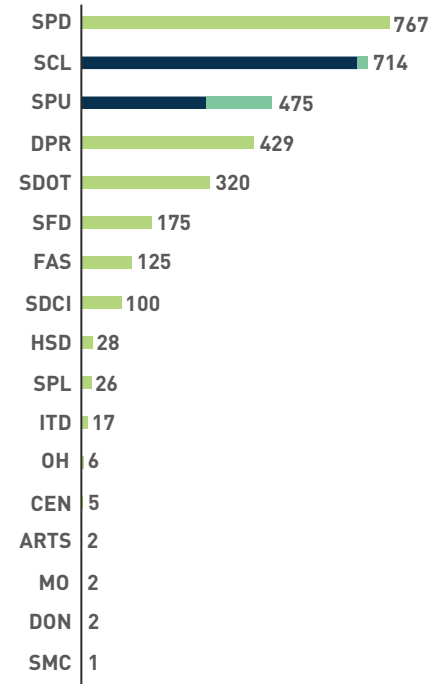


FIGURE 20. FLEET OWNERSHIP AND COUNTS

ROLLING STOCK

For the purposes of this study, 'rolling stock' refers to self-propelling vehicles with a powertrain unit.

SHARED SITE

For the purposes of this study, 'shared sites' refers to locations with fleet assigned to multiple general fund and/or enterprise fund departments.

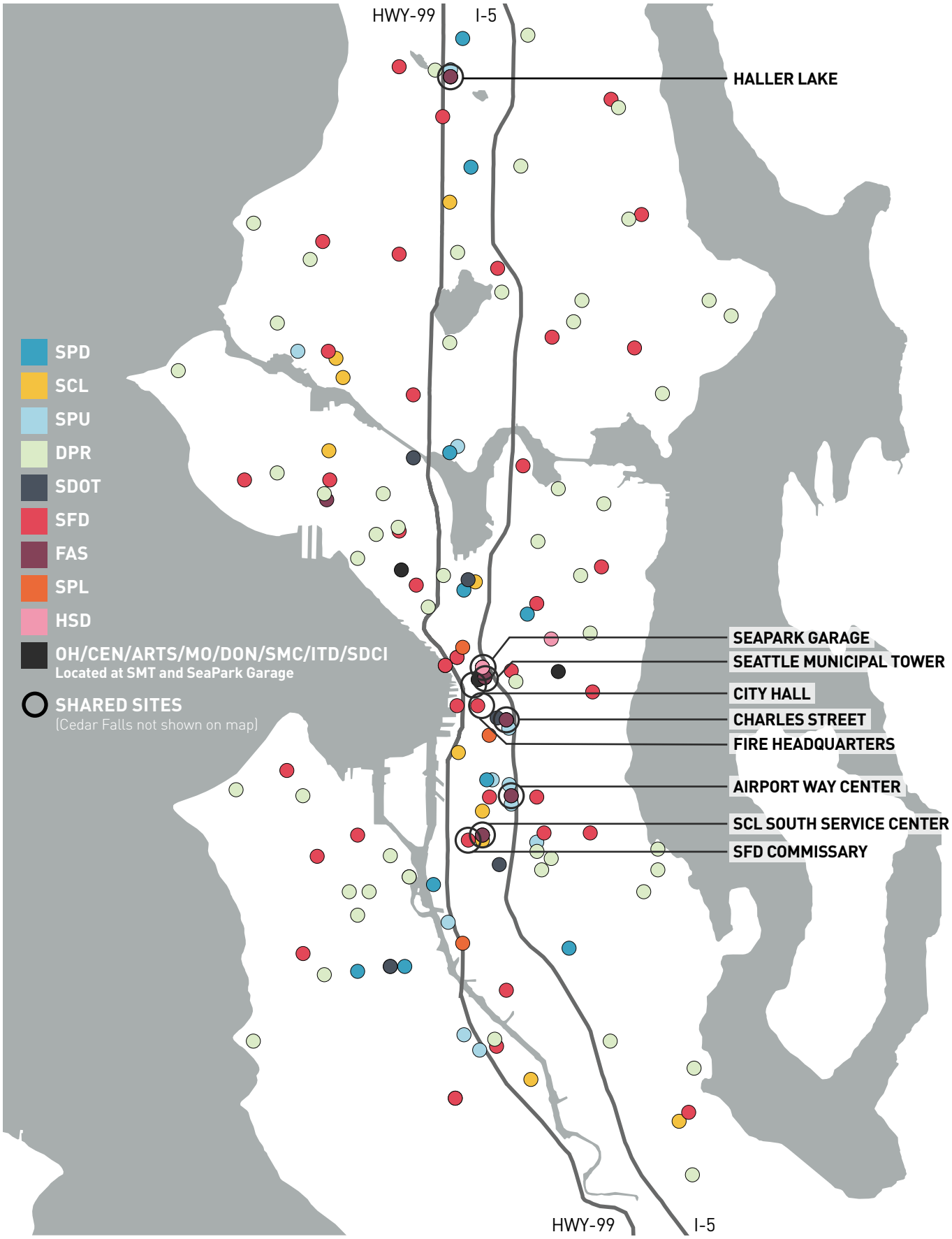


FIGURE 21. FLEET OWNERSHIP AT EXISTING SITES

FLEET DISTRIBUTION

City fleet is located on 136 owned or leased sites, some of which are located outside the City's service area (FIGURE 22). Much of Seattle's fleet (70%) is concentrated on 15 sites, each with 50 or more fleet vehicles (FIGURE 24) .

Most of the fleet is classified as light duty vehicles. The majority of medium and heavy duty fleet is located in the city's NORTH and SOUTH sectors (FIGURE 23).

FAST FACTS

- Airport Way Center has the highest concentration of fleet, with 9% of the total City fleet.
- Fifty-four percent of all fleet is located in the CENTRAL and SOUTH sectors (FIGURE 22).
- Nearly half of the City's fleet is located on just seven critical sites:
  - Airport Way Center
  - Charles Street
  - Haller Lake
  - SeaPark Garage
  - Seattle Municipal Tower
  - SCL - North Service Center
  - SCL - South Service Center
- 25% of the in-scope project fleet are located at Charles Street, Haller Lake, and Airport Way Center.
- Almost 8% of the City's fleet is located outside of city limits, most of which is enterprise fund fleet.
- Sites leased by the City house 13% of the total fleet.

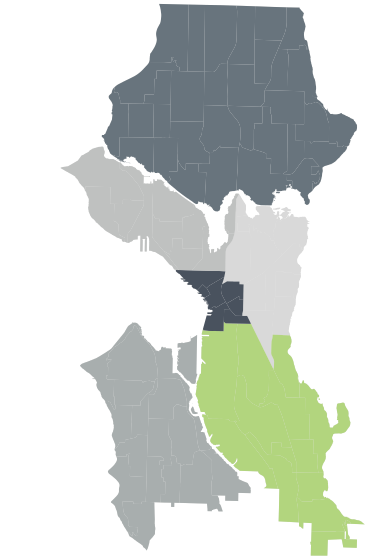


FIGURE 22. CONCENTRATION OF FLEET BY SECTORS

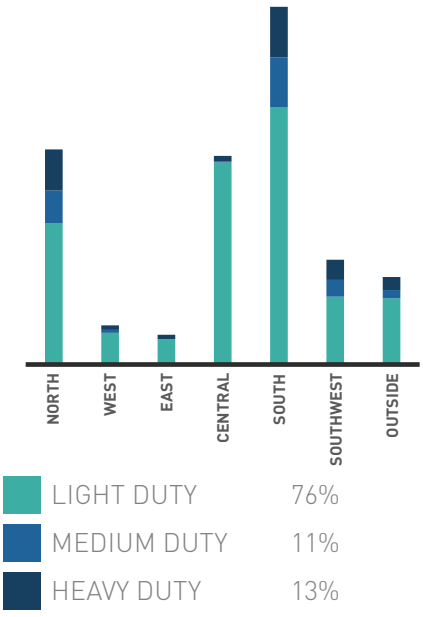


FIGURE 23. DISTRIBUTION OF FLEET TYPES

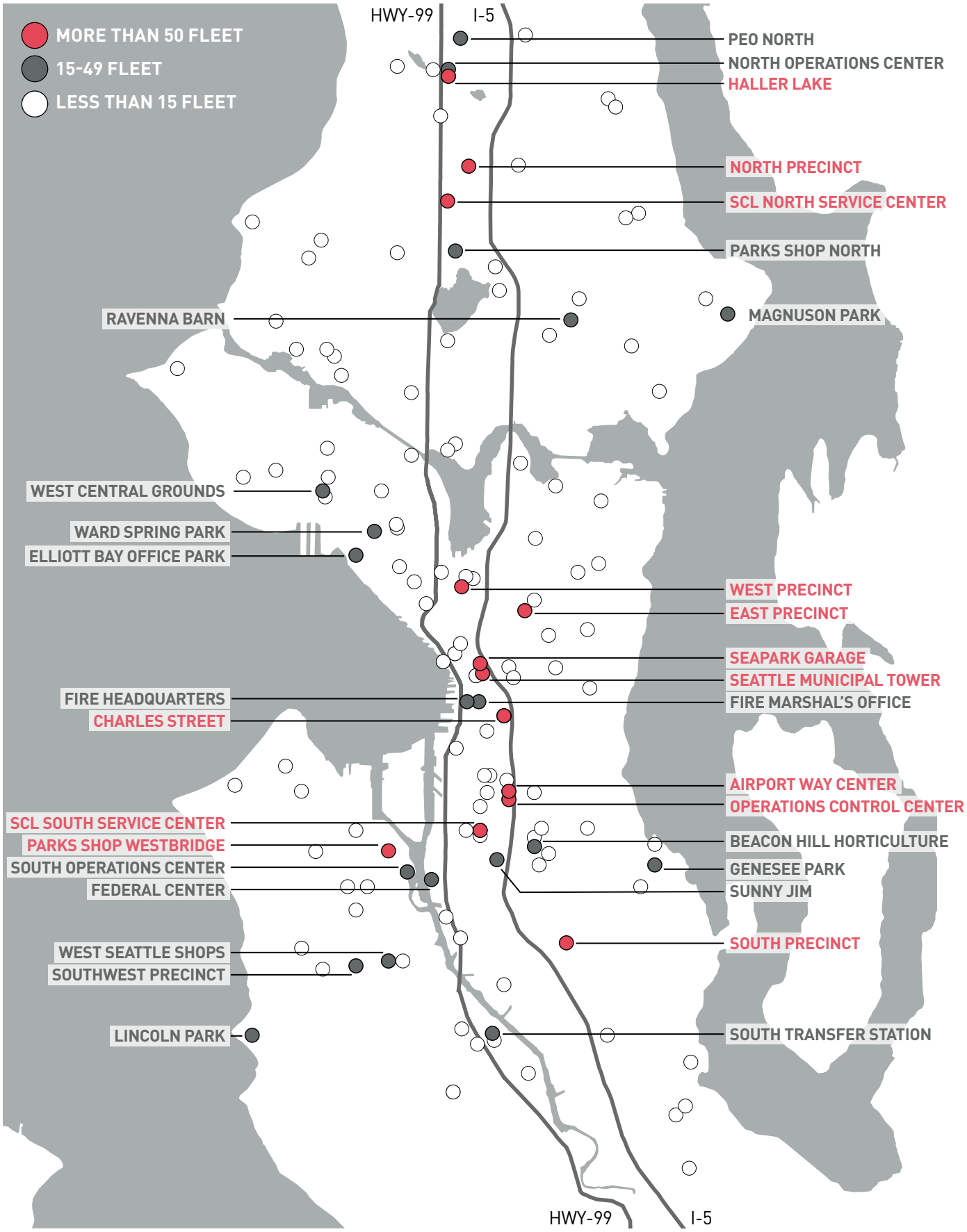


FIGURE 24. FLEET DISTRIBUTION AT EXISTING SITES

ELECTRIC VEHICLE AND CHARGERS

Seattle is currently investing in electric vehicles while installing charging infrastructure, mostly in the CENTRAL and SOUTH sectors.

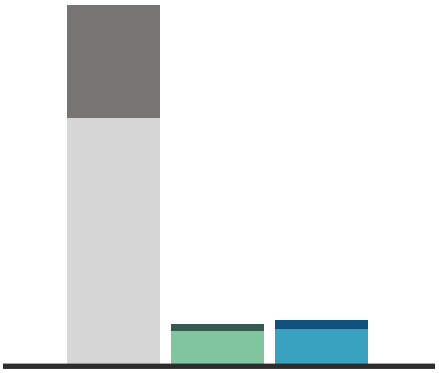
FAST FACTS

- Seattle Municipal Tower (SMT) and SeaPark Garage house 47% of all electric vehicles the City currently owns.
- SMT has 63% of the City's existing and near-term planned chargers.

GAP ANALYSIS

Analysis of the 2,195 in-scope project fleet shows that about 14% of the City fleet is currently electric and the City has capacity to charge a little over 15% of the fleet. There are some minor gaps in the system; some sites have vehicles or chargers, but not both. (FIGURE 25; FIGURE 26; FIGURE 27)

Sites with EV and chargers	17
Sites with EV but no chargers	12
Sites with chargers but no EV	7



Project scope sites

FLEET	2,195
ELECTRIC VEHICLE	310
CHARGER	329

Out of scope sites

FLEET	999
ELECTRIC VEHICLE	63
CHARGER	82

FIGURE 26. ELECTRIC VEHICLES AND CHARGERS (2019)

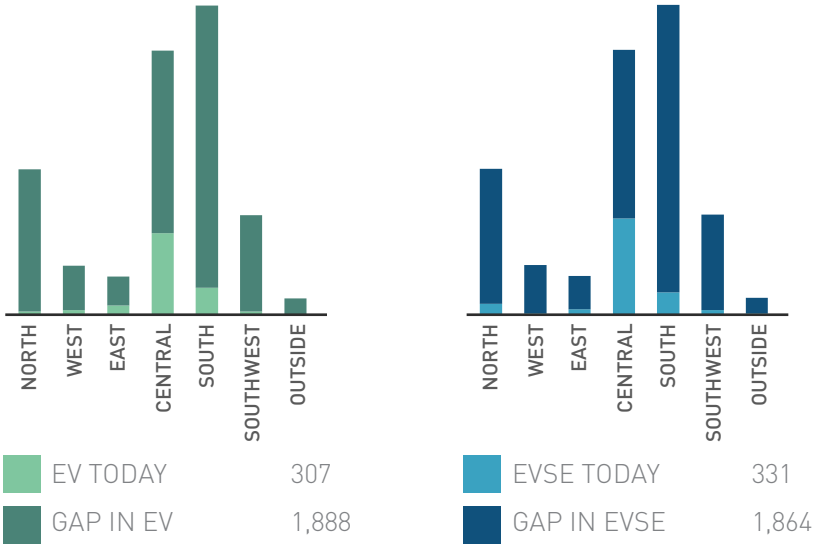


FIGURE 25. EV AND EVSE GAP
Includes 2,195 project scope fleet

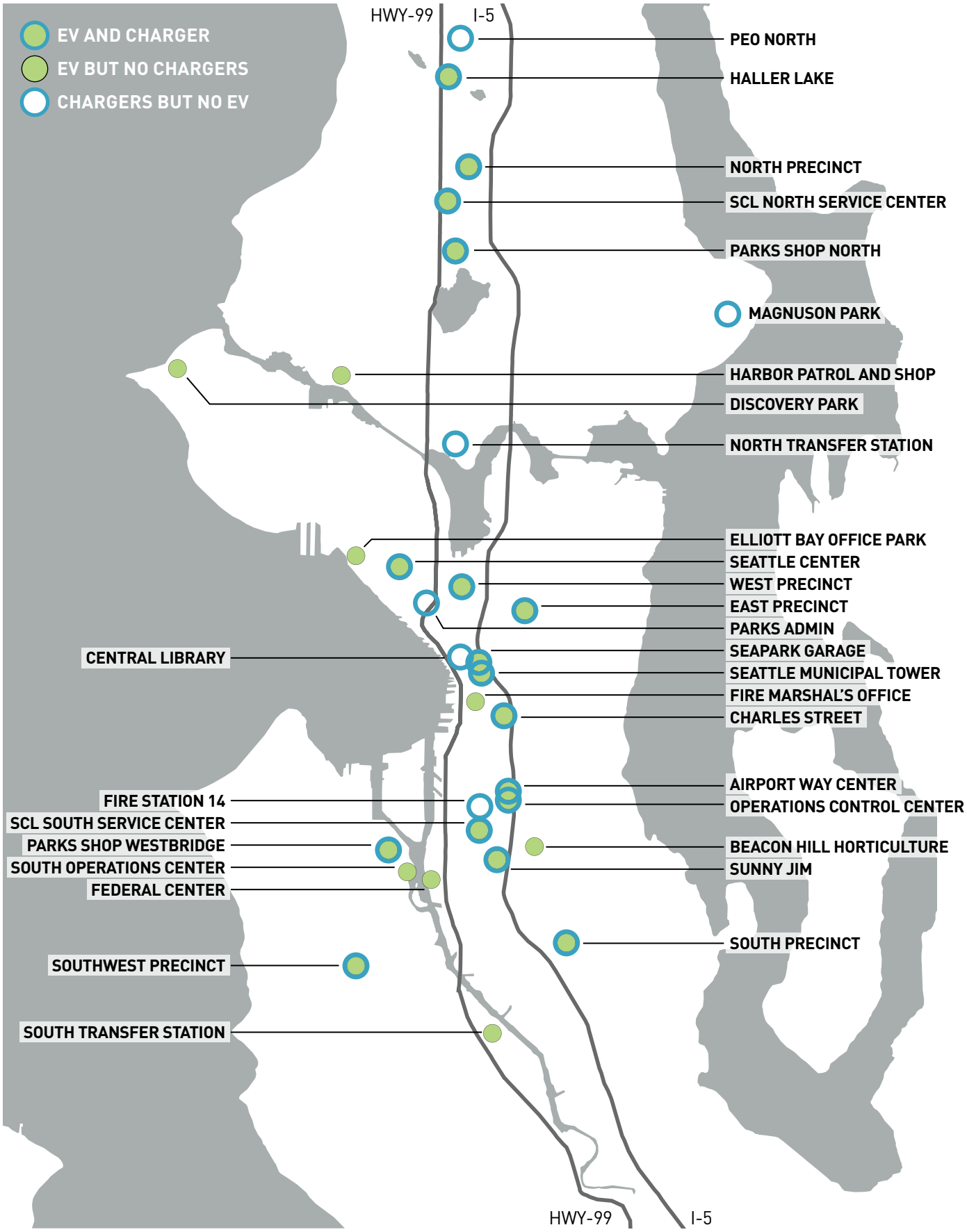


FIGURE 27. ELECTRIC VEHICLE AND CHARGER LOCATIONS

HUB SITES & FAST CHARGING

The City currently operates fuel tanks at 32 fleet sites (FIGURE 29), including locations outside of Seattle. Although fuel consumption is spread throughout these sites, 53% of the annual consumption occurs at the two hub sites, Charles Street and Haller Lake (FIGURE 28). Most general fund fleet and some enterprise fund fleet rely on the hubs for fueling, the exception being 13 fire stations and the five police precincts which have on-site fueling.

To support emergency preparedness for the growing EV fleet, the City has installed DC fast chargers at three sites - Airport Way Center, Charles Street, and Cedar Falls.

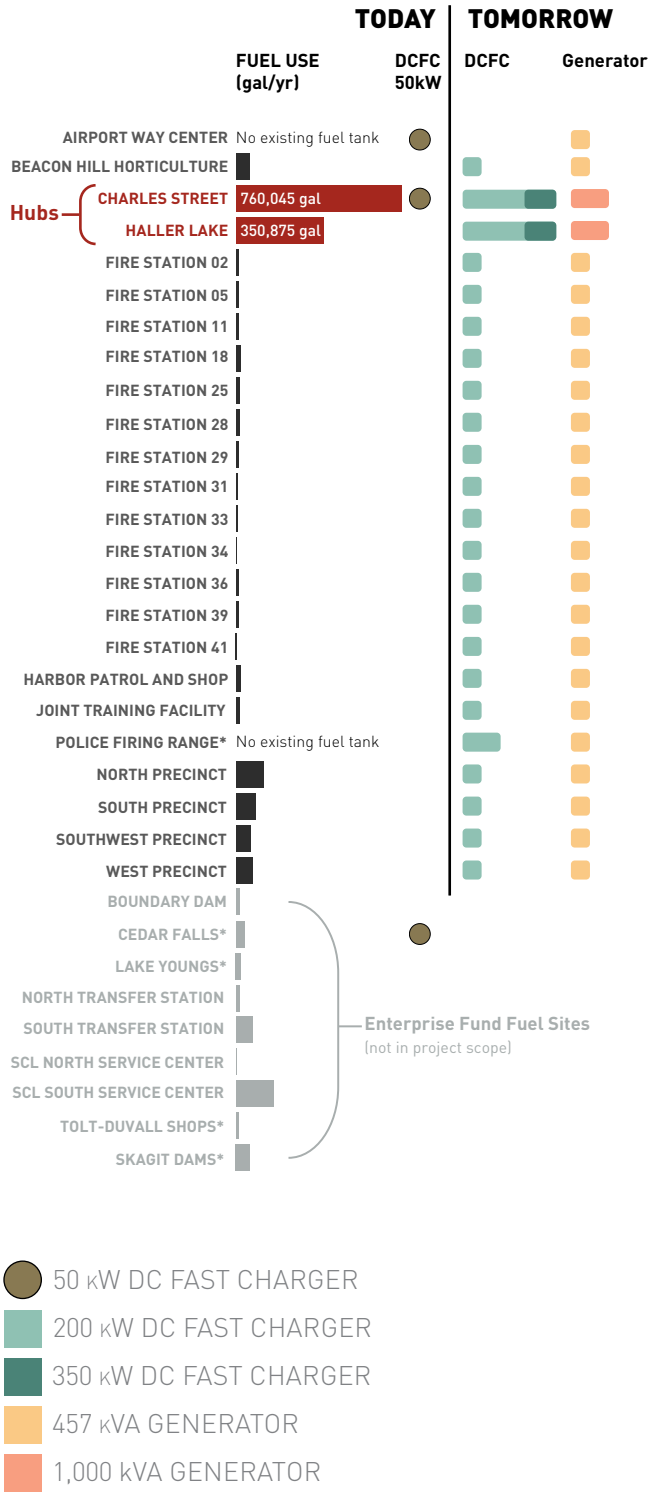
FAST FACTS

- Of the 13 Fire Stations with fuel tanks, almost 70% of SFD's annual fuel consumption occurs at six stations.
- SPD fleet accounts for 18% of annual fuel consumed by City vehicles.
- Annual fuel consumption by City departments is 2.1 million gallons, 80% of which is used by general fund departments.

GAP ANALYSIS

Conversion to electric assumes on-site dedicated charging that reduces reliance on hub sites for fueling. The baseline scenario assumes fast chargers are installed at all existing fueling stations. Back-up generators will be installed at these sites to ensure continuity of service during emergencies.

To retain the hub functionality at Charles Street and Haller Lake, the baseline scenario assumes multiple fast chargers and generators are added.



200kW chargers - baseline scenario assumes 6 at the hubs, 3 at Police Firing Range, and 1 at other fuel sites

350kW chargers - baseline assumes 2 at the hubs

**Sites not shown on map in FIGURE 29*

FIGURE 28. FUELING AND FAST CHARGING SITES

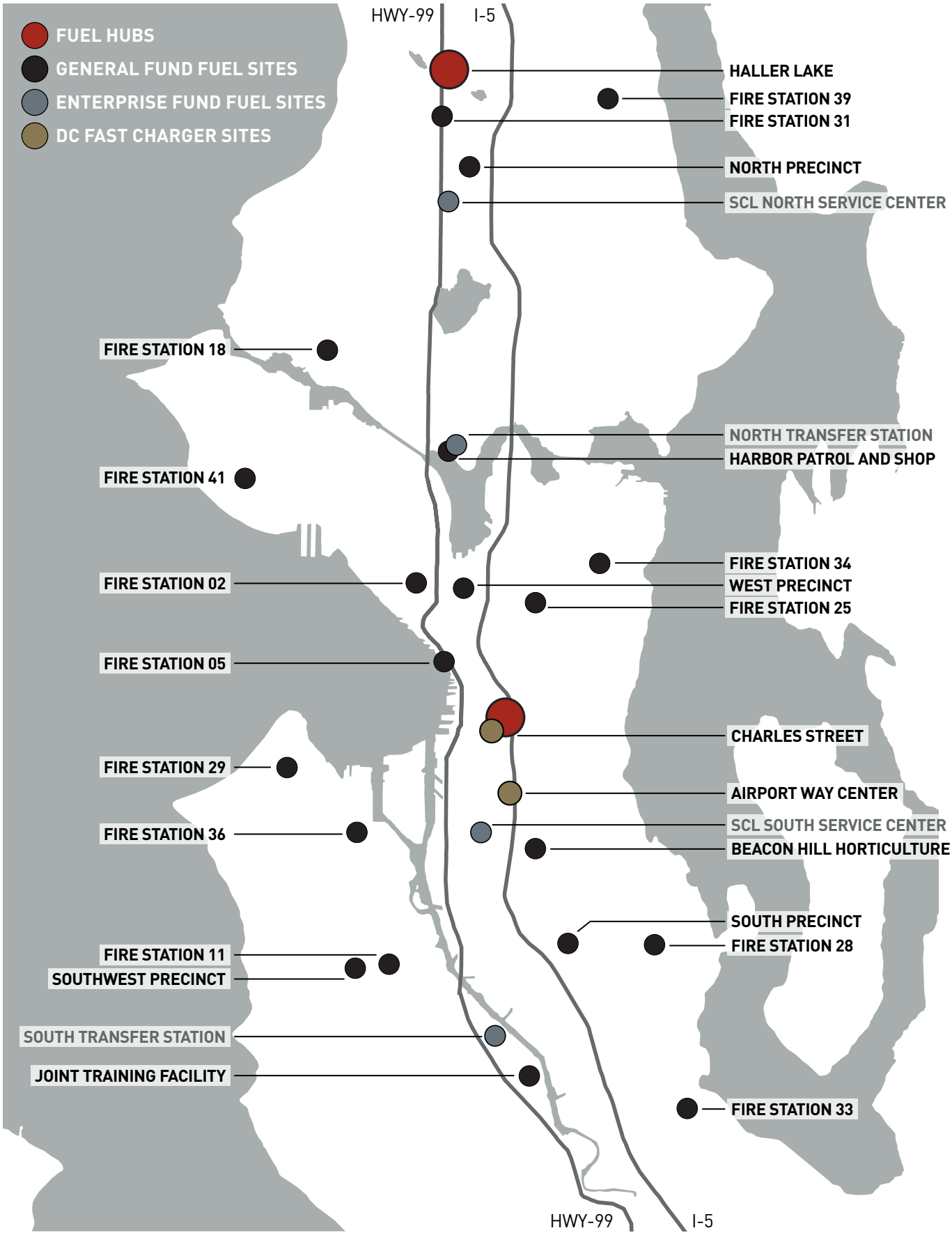


FIGURE 29. HUB SITES AND EXISTING SITES WITH FUEL TANKS

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5 RECOMMENDATIONS

ANALYSIS APPROACH

To meet the City's emission policy objectives, the team first explored a baseline scenario that installs the following by 2030:

- One L2 charger for every vehicle.
- One DC fast charger and generator at sites with existing fuel tanks.
- A hub of fast chargers at Charles Street and Haller Lake.

The baseline is estimated to cost $227 million in 2019 dollars. See page 35.

To reduce costs, the team explored three main strategies:

- Managing charger load demand.
- Sharing chargers for applicable fleet.
- Aligning fire station infrastructure with fire fleet behavior.

The recommendation reduces overall costs by $76 million in 2019 dollars. See page 36.

The team then developed an implementation strategy that prioritizes sites with the highest light duty fleet count and builds two fast charging hubs for emergency resilience and efficient system-wide service. See page 38 for details.

COST ASSUMPTIONS

EVSE systemwide assessment cost estimates are rough order of magnitude costs at a strategic planning level and should be refined as projects are designed. Estimates have six key components:

- CHARGER
- ELECTRICAL INFRASTRUCTURE
- MANAGED TECHNOLOGY
- DC FAST CHARGER/GENERATOR
- PROJECT CONTINGENCY
- SOFT COSTS

BASELINE	RECOMMENDATION
One L2 charger for every vehicle	Charger sharing for applicable fleet to reduce capital costs
One DC fast charger and generator at existing fuel sites	One DC fast charger and generator at existing fuel sites; include key fire stations only
Electrical service upgrade at sites to meet dedicated charging needs	Manage load demand to reduce electrical infrastructure costs at applicable sites
$227M	**$151M**

Both scenarios include investment of fast charging banks at Charles Street and Haller Lake

FIGURE 30. BASELINE AND RECOMMENDATION
Costs in 2019 dollars

BASELINE COST

$227 M

2019 dollars; includes project contingency and soft costs

$314 M

Escalated dollars, assuming 5% annual escalation

BASELINE

The baseline scenario assumes dedicated charging infrastructure is provided for 100% of the in-scope fleet. The baseline scenario cost is estimated to be $227 million in 2019 dollars. Costs include charger installation, electrical infrastructure upgrade, managed technology, DC fast charger and generators, project contingency and soft costs. See FIGURE 31. Of this, $49 million is required at three critical locations - Charles Street, Haller Lake, and Airport Way Center.

IMPLEMENTATION STRATEGY

The GFAP budget includes $5.5 million for electrical investments at general fund sites between FY 19-21. The baseline scenario assumes an additional $4 million will be available between FY 22-25 (pending budget approval). Given the available budget between FY 19-25, implementation of this scenario would require an average of $44 million per year (or $61-$75 million per year in escalated dollars) between FY 26-30. FIGURE 32 highlights the rough order of magnitude (ROM) estimates of probable planning costs by year for budgeting purposes. Costs are estimated in 2019 dollars and have been escalated at 5% per year.

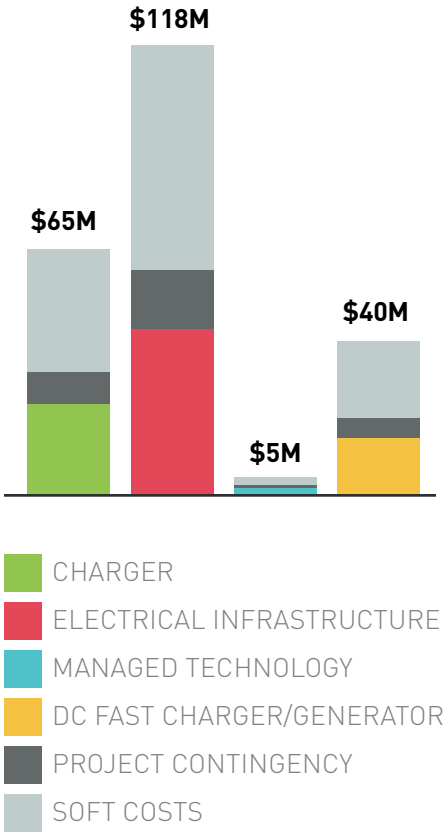


FIGURE 31. BASELINE COST

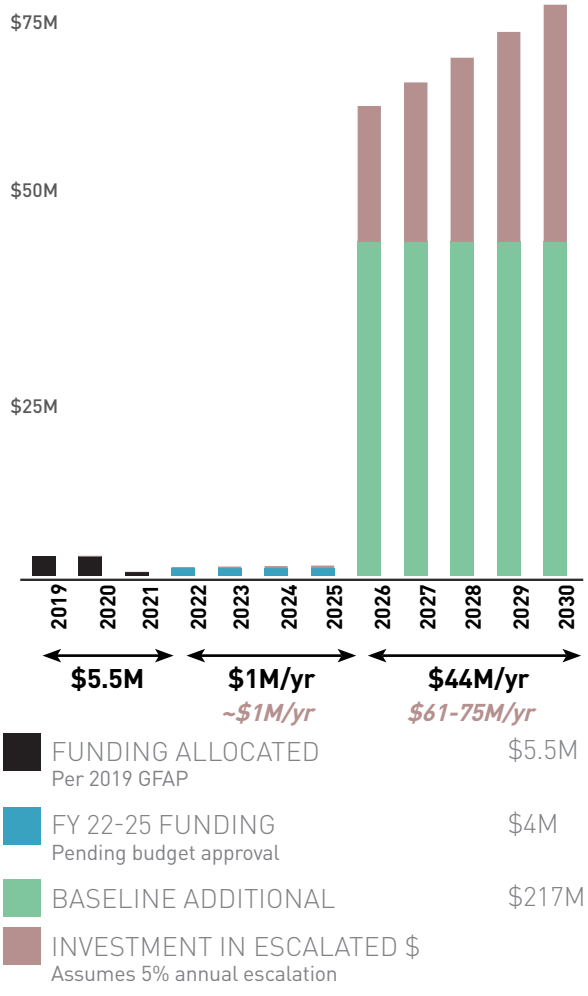


FIGURE 32. BASELINE IMPLEMENTATION

RECOMMENDATIONS

The recommendations optimize the investment at each site to provide the greatest cost benefit. This recommended approach will reduce the cost by approximately $76 million. Key actions are:

OPTIMIZE INVESTMENT AT EACH SITE

Adopt cost reduction strategies aligned with fleet use and behavior at each site. Strategies include:

LOAD MANAGEMENT

Investing in load management reduces the power required and decreases the cost of chargers and electrical service upgrades. This strategy requires load management equipment, extends the charge time required, and is applicable for light and medium duty fleet. See page 20 for details.

CHARGER SHARING

Sharing chargers reduces the costs of electrical upgrades. This strategy is applicable at sites with sufficient low and medium mileage light duty fleet. Adoption of charger sharing requires adhering to a charging schedule, accepting behavior change, and investing in fleet management software and/or personnel. See page 18 for details.

FIRE STATION OPTIMIZATION

Align investments at fire stations with fire fleet behavior and availability of market-ready heavy duty fleet. Invest in fast charging infrastructure at six key fire stations, or one per district (FIGURE 34). Use mobile and fast charging at hubs for medic units.

INVEST IN A SYSTEM OF FAST CHARGERS

Install fast charger banks, upgrade electrical infrastructure, and install backup generators at the hub sites - Charles Street and Haller Lake. Add fast chargers to other key fuel sites to provide fast charging capabilities to support emergency services and efficient operations throughout the city (FIGURE 34).

RECOMMENDED COST

$151 M

2019 dollars; includes project contingency and soft costs

$217 M

Escalated dollars, assuming 5% annual escalation

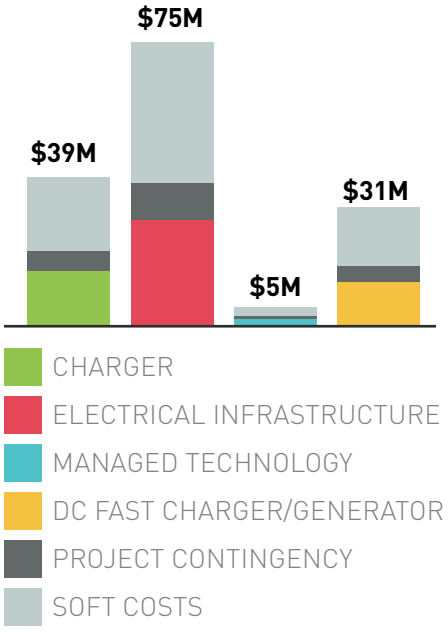


FIGURE 33. RECOMMENDED COST

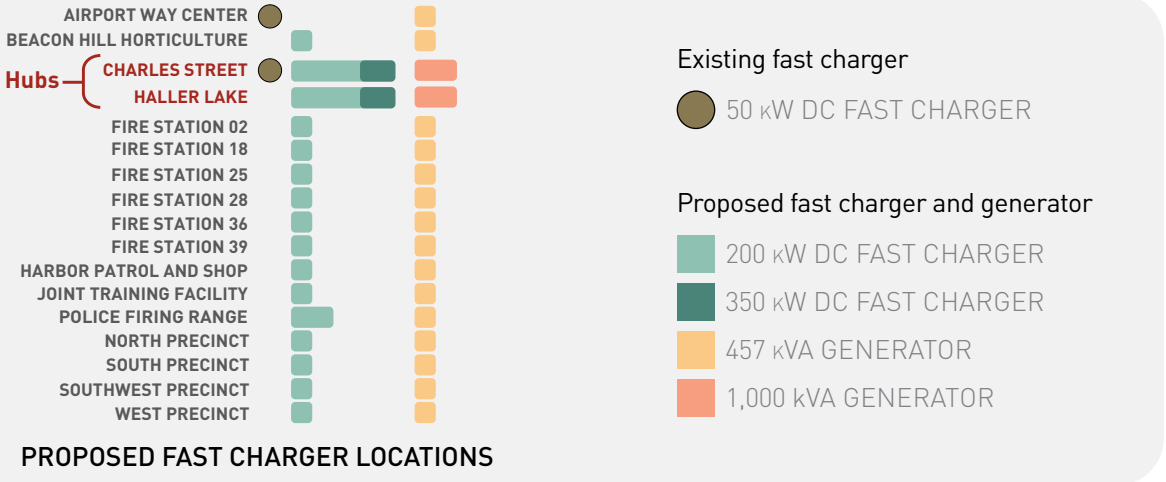


FIGURE 34. PROPOSED FAST CHARGER LOCATIONS

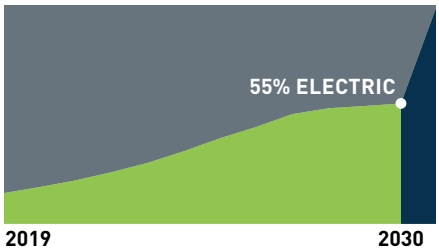


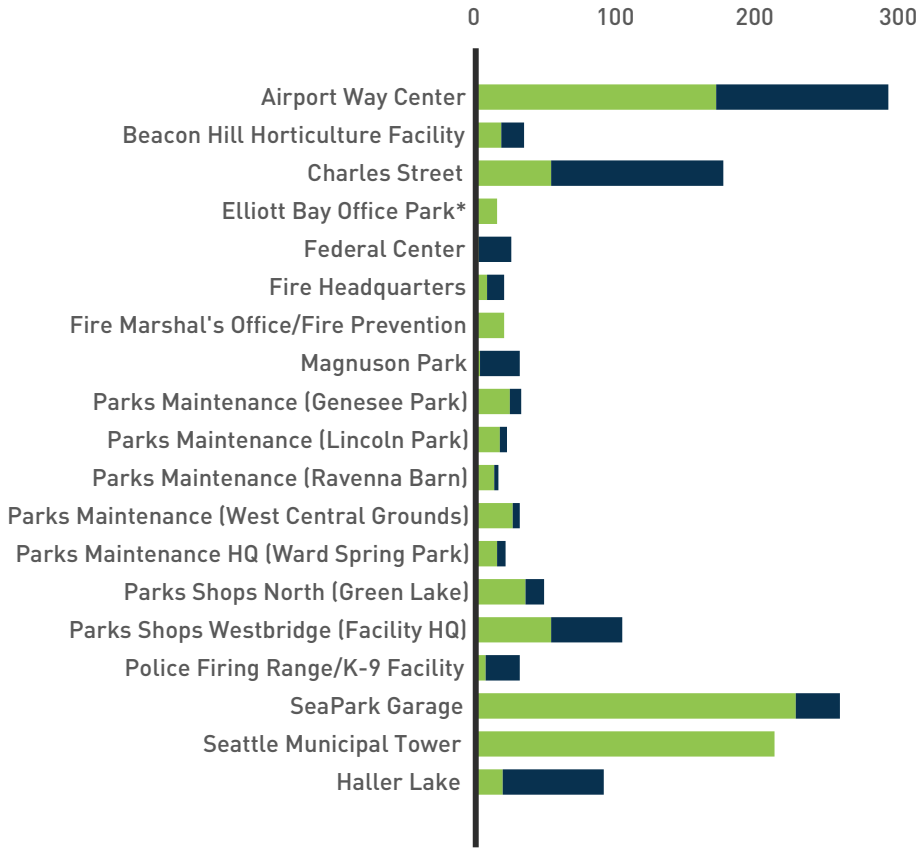
FIGURE 35. ELECTRIC VEHICLE ACQUISITION CYCLE

PRIORITIZE HIGHEST VALUE INVESTMENTS

Prioritize investments at sites with high fleet count and/or high percent of light duty fleet (FIGURE 36).

Other priorities for near term planning and investment are Charles Street and Haller Lake, to install the electrical infrastructure upgrades and fast charging hubs needed to support the system and build in resiliency (FIGURE 34).

Finally, align charger investments to follow electric vehicle acquisition plans (FIGURE 35). This defers charger investment for fleet not planned for replacement by 2030. Lower cost interventions (installing a small number of chargers on a site without upgrading the electrical capacity) should be completed throughout the timeline as budget allows.



**Fleet previously located at Parks RDA Building*

FIGURE 36. SITES WITH HIGH FLEET COUNT OR HIGH LIGHT DUTY

IMPLEMENTATION STRATEGY

The recommended implementation strategy is divided into five actionable phases.

IMMEDIATE (FY 19-20)

Complete ongoing investments at Seattle Municipal Tower, SeaPark Garage, and other planned smaller investments such as at Charles Street and North Precinct.

NEAR-TERM (FY 21-23)

Develop fast charging capabilities and electrical infrastructure upgrade at the hub sites - Charles Street and Haller Lake.

Upgrade electrical infrastructure and charger installation for applicable fleet at Airport Way Center.

Install chargers at fire stations with high light duty fleet - Fire Station 10 and Fire Station 14.

MEDIUM-TERM (FY 24-27)

Invest in fast charging capabilities, infrastructure upgrades, and chargers based on electric vehicle acquisition at Parks maintenance sites, City training facilities, and police precincts.

LONG-TERM (FY 28-30)

Invest in sites with low fleet count and/or high percent of medium/ heavy duty fleet and in backup capabilities in key fire stations.

DEFERRED (FY 31 AND ONWARDS)

Invest in charger installation for fleet that are not planned to be electrified by 2030 and for heavy duty fleet.

For budgeting purposes the rough order of magnitude (ROM) estimates of probable planning costs by phases (FIGURE 37) and by year (FIGURE 38) are included. ROM costs include project contingency and soft costs. Costs are reported in 2019 dollars and escalated at 5% per year.

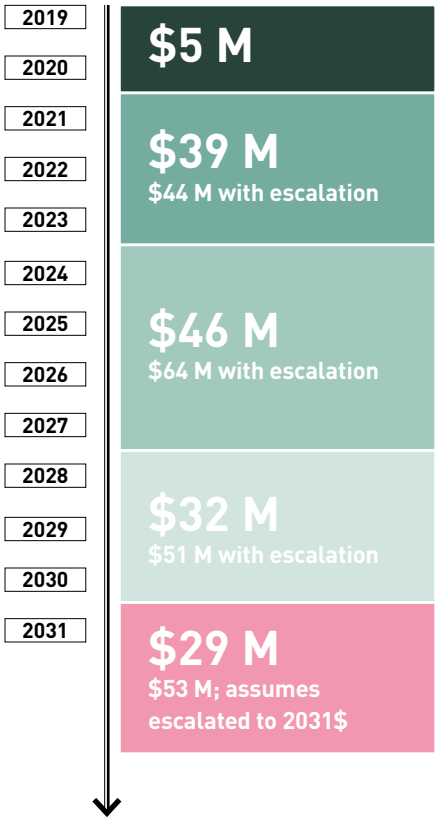
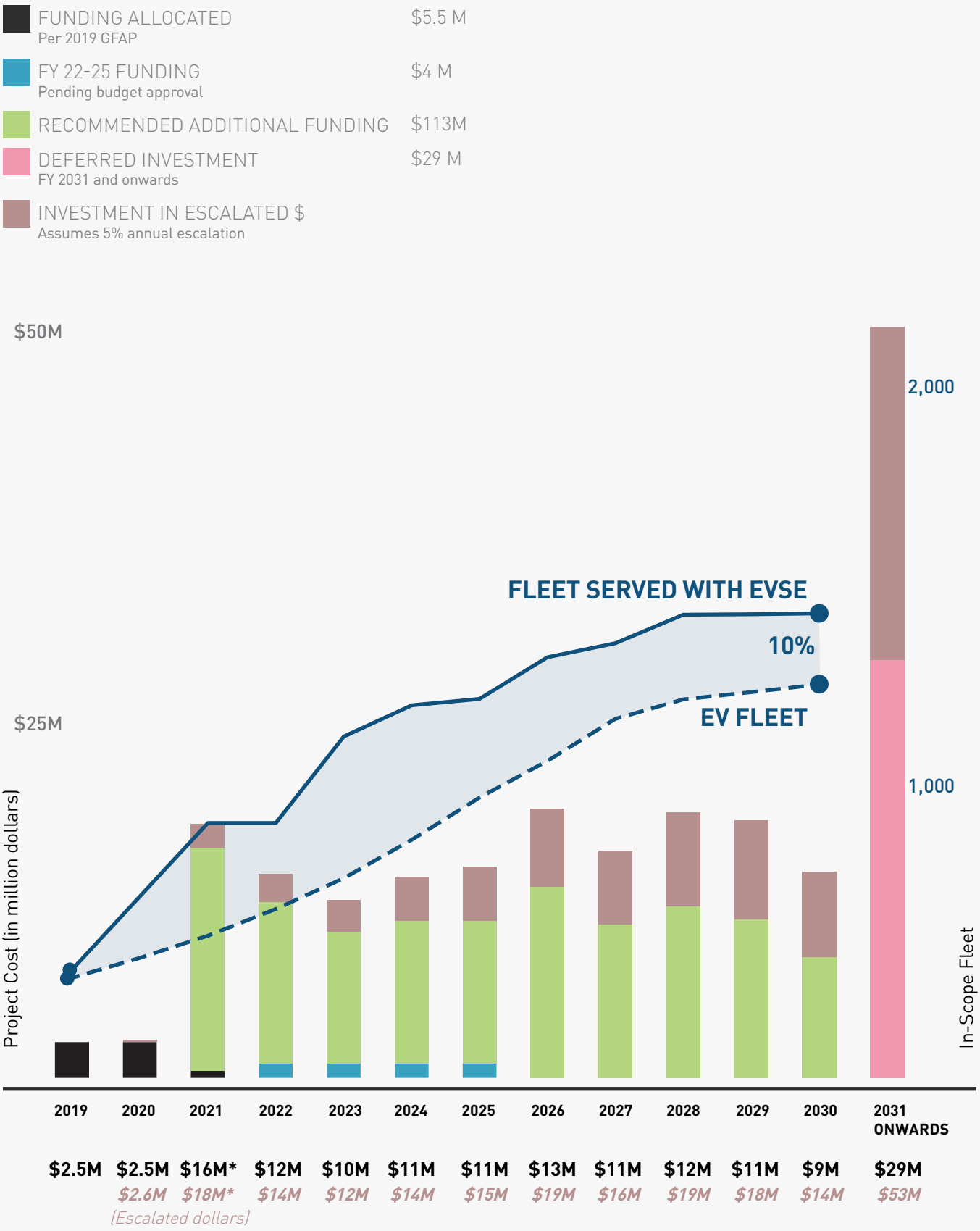


FIGURE 37. INVESTMENT AMOUNTS IN EACH PHASE



*Includes $0.5 million allocated funds in FY 21

FIGURE 38. RECOMMENDED IMPLEMENTATION STRATEGY

PRIORITY ACTIONS

The following summarizes the recommendation's near-term priority actions.

IMMEDIATE (FY 19-20)

Complete planned investments at Seattle Municipal Tower, SeaPark Garage, Charles Street, and North Precinct.

Pilot a study on telematics, fleet user behavior, and optimum load management strategy at Airport Way Center.

NEAR-TERM (FY 21-23)

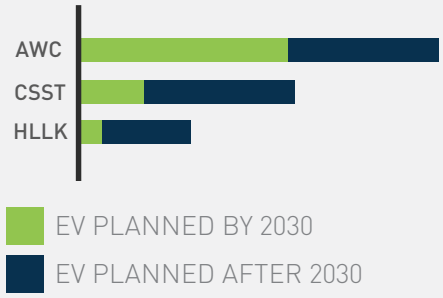
Develop fast charging capabilities and electrical infrastructure upgrades at Charles Street and Haller Lake.

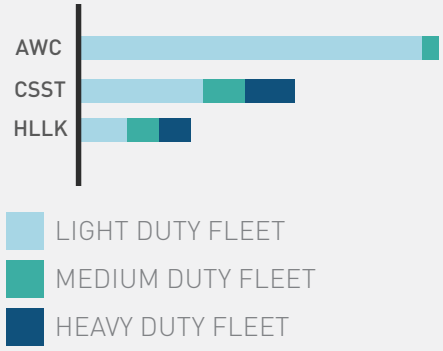
Launch master planning efforts to anticipate City and tenant needs and incorporate EVSE fast charging hubs.

Assess the feasibility and cost-benefit of developing an EV fleet parking maintenance garage that reuses captured heat.

Invest in on-site energy storage to augment resiliency capabilities, e.g., mobile chargers, solar powered microgrids, and battery storage banks.

Upgrade electrical infrastructure and install chargers for applicable fleet at Airport Way Center.





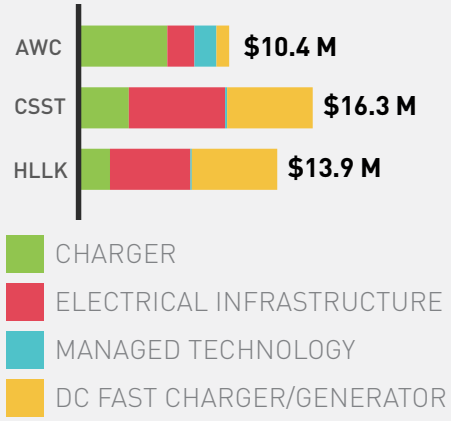


FIGURE 39. RECOMMENDED COST ESTIMATE

CHARLES STREET, HALLER LAKE, AND AIRPORT WAY CENTER

Three critical sites - Charles Street (CSST), Haller Lake (HLLK), and Airport Way Center (AWC) account for 25% of the total in-scope fleet and 53% of the City's annual fuel consumption is at the two hub sites (Charles Street and Haller Lake). Major investments are required at each site to meet the City's electrification goals and provide fast charging capabilities.

The recommendation optimizes the investment at each site through cost reduction strategies - charger sharing and load management. This recommendation reduces the cost by $8 million (in 2019 dollars) over the baseline. The recommended approach to investment in these properties is summarized below and illustrated in FIGURE 40. Defer investment in charger installation to FY 31 and onwards for fleet that are not planned to be electrified by 2030 and for all heavy duty fleet.

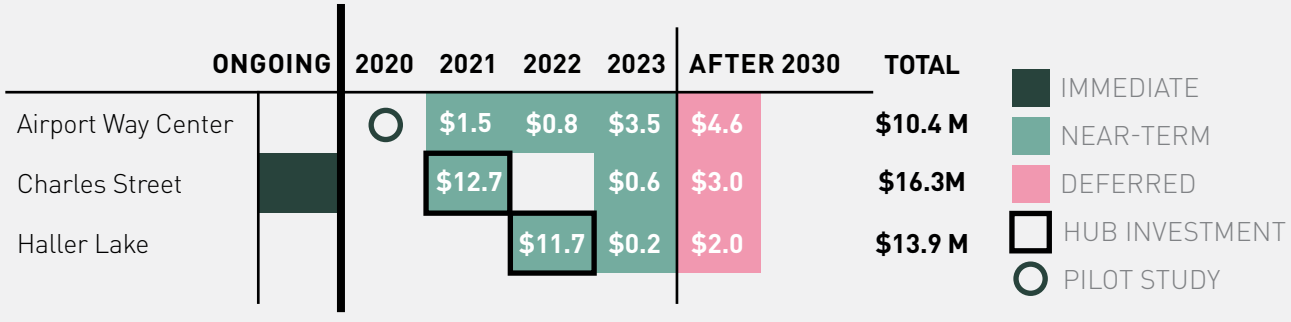


FIGURE 40. IMPLEMENTATION STRATEGY AT THREE CRITICAL SITES
Cost in 2019 million dollars

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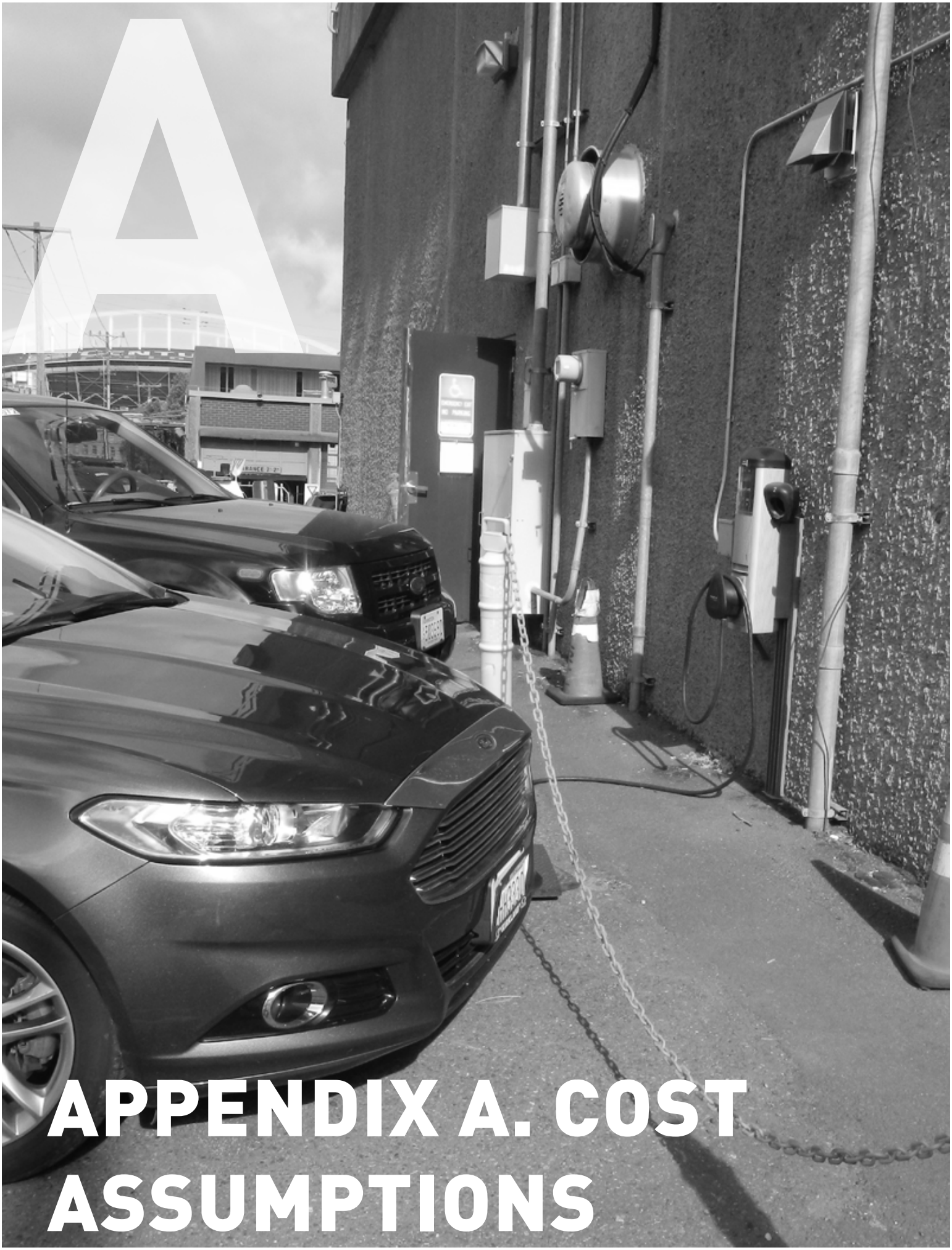

APPENDIX A. COST ASSUMPTIONS

COST ASSUMPTIONS

Appendix A provides DKS Associates' rough order of magnitude (ROM) estimates of probable costs for the baseline and the recommended plan in 2019 dollars. These cost estimates are appropriate for strategic citywide planning. Estimates will be refined in future site-specific studies and designs.

The different cost components are:

CHARGER AND GENERATOR COSTS

Unit costs for chargers and generators includes only cost of device.

Cost source: BTC Power

CHARGER TYPE	UNIT LOAD	UNIT COST	APPLICABILITY
Level 2 (L2) Charger	9.6 kW	$5,778	Light and medium duty fleet
Level 2 (L2) Charger	33.4 kW	$7,733	Heavy duty fleet
DC Fast Charger (DCFC)	200.0 kW	$123,866	Sites with fuel island
DC Fast Charger (DCFC)	350.0 kW	$233,880	Only at hubs
Backup Generator	457 kVA	$323,565	Trailer-mounted deployable
Backup Generator	1,000 kVA	$479,281	Trailer-mounted deployable; only at hubs

Note: DC fast chargers (from BTC Power) are a combination of a power cabinet combined with one or more power dispensers and are modular in nature. It is possible to modify and upgrade the installation in the future to meet the growing needs of the City fleet. If multiple power dispensers are pulling from the same cabinet then the cabinet will distribute the power evenly.

PER CHARGER INTERIM COST

$7,750

Infrastructure costs assume charger will use existing available electrical load on site. Costs exclude managed charging investment.

PER CHARGER BUILD-OUT COST

$6,208

Infrastructure costs assume charger will require additional service from SCL. Costs exclude managed charging investment, if any.

INFRASTRUCTURE COSTS

Costs include site preparation such as:

- Bollards
- Signage
- Foundations
- Curbing
- Drainage - small set amount meant to cover minor drainage issues that arise during construction
- Conduits, including surface restoration (average 65' per charger based on sites evaluated)
- Trenching, including surface sawcut and restoration
- Conductors
- Junction boxes
- Service panels
- Channelization, including parking stalls and pavement legends
- Tree removal and landscaping

Costs exclude environmental clean-up, special soil conditions, unique site topography, right-of-way improvements, etc.

COST METHODOLOGY

Four sample sites were evaluated to estimate a cost for interim improvements (assumes no electrical power upgrade) and build-out improvements (assumes electrical power upgrade) to provide charging for 100% of fleet vehicles. They also provided a diverse sample as they contain a range of fleet types, quantities, and available electrical capacity. These sites (Haller Lake, Charles Street, Airport Way Center and Parks Shop North) were selected due to their complexity to ensure that unit pricing would be conservative. Each total site cost was reduced by the cost of the new chargers to be installed at that site and divided by that number to determine a "per charger" infrastructure cost. Specific numbers were then averaged to determine a citywide "per charger" infrastructure cost.

MANAGED CHARGING COSTS

Two types of managed charging investment has been assumed in this study. This includes:

LOAD MANAGEMENT

Assumes installation of EV master controllers (EVMC) between the circuit main and chargers to reduce the cost of wiring and conduit required. This increases the charging time per vehicle and decreases the overall system capacity.

CHARGER SHARING

Assumes installation of fleet management software and sensor outfitting of applicable fleets. Cost, if any, for fleet management personnel has been excluded in this study.

Requires further study to target fleet, accurately model potential cost savings, and ensure users will accept reduced chargers and adopt behavior change.

LOAD MANAGEMENT COST

$11,239 per 4 chargers
Cost source: CyberSwitching

Assumes installation during interim scenario in baseline and where applicable in the recommendation.

FLEET MANAGEMENT COST FOR SHARING CHARGERS

$2,000 per applicable fleet
Cost source: Ubisense

ELECTRICAL SERVICE UPGRADE

Cost of electrical service upgrade is calculated based on total load required for complete charger installation on a site-by-site basis with an addition of 25% to account for existing load.

Costs are calculated on a tiered basis, per discussions with SCL representatives and include:

- SCL service cost to provide electrical service to the site.
- Electrical infrastructure costs to deliver power to the site, such as conduits, junction boxes, conductors, building improvements, etc.

POWER RANGE (kVA)	SCL SERVICE	INFRASTRUCTURE
0-100	$10,000	$10,000
101-1000	$100,000	$600,000
1001-2000	$200,000	$950,000
2001-3000	$300,000	$1,300,000
3001-4000	$400,000	$1,700,000
4001-5000	$500,000	$2,000,000

CONTINGENCY

Project cost includes a mark-up of 35% to hard costs to account for contingency.

SOFT COST

Project costs are assumed to be 50% construction and 50% soft costs.

Soft costs include:

- Design
- Permitting
- Special studies
- Services during construction
- City costs
- Unforeseen construction issues
- Other unknowns

Excludes unknown expenses such as environmental remediation, right-of-way acquisition, unique site topography, etc.

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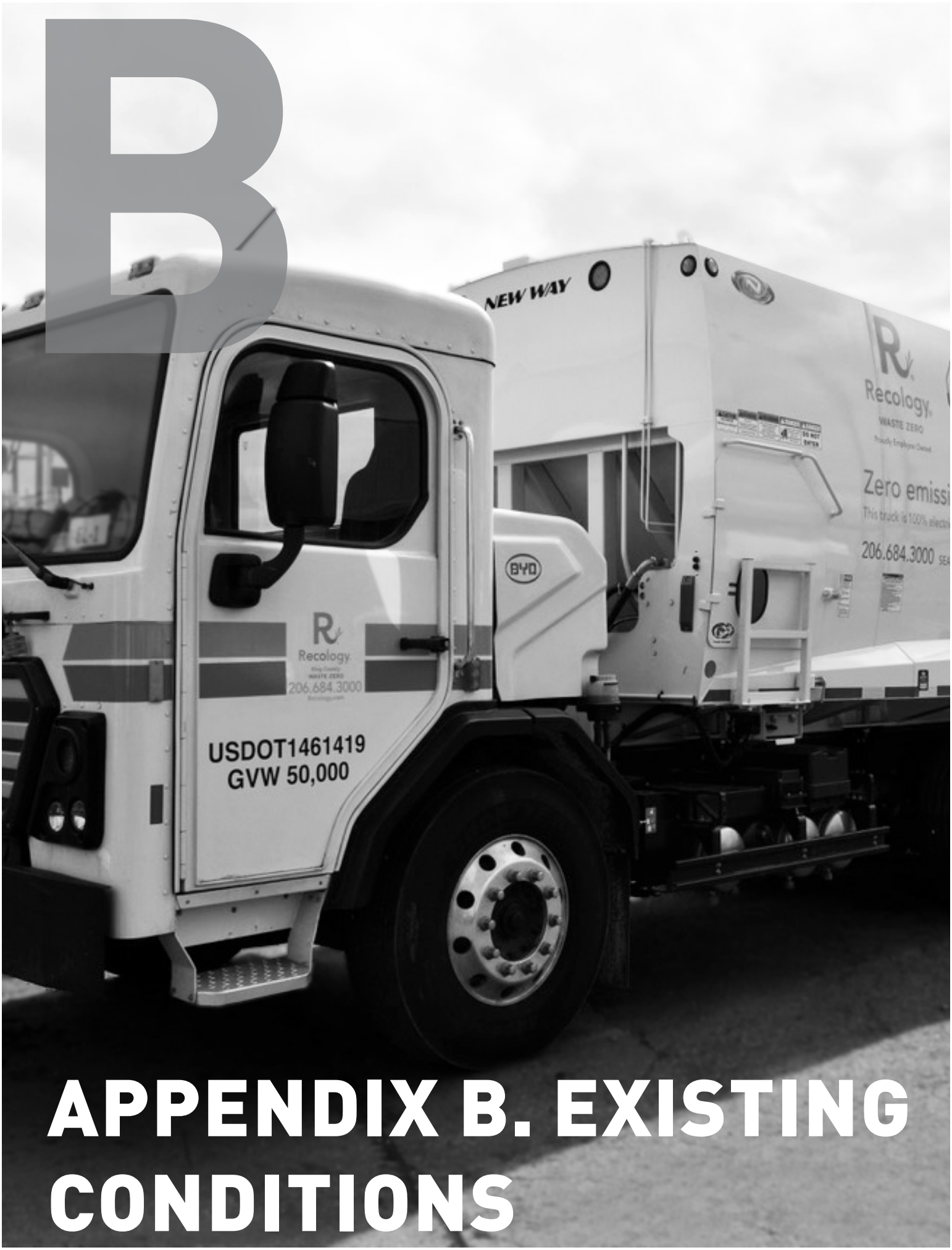


B

APPENDIX B. EXISTING CONDITIONS

EXISTING CONDITIONS

The location for Seattle's fleet and chargers are provided with the information listed below. Sites are organized by ownership - general fund, enterprise fund, and leased sites.

FACILITIES

City owned or leased properties with assigned fleet organized into geographic sectors. Sectors include: NORTH, WEST, EAST, CENTRAL, SOUTH, SOUTHWEST, and OUTSIDE. OUTSIDE sites are located beyond city limits.

Shared sites are highlighted in gray and include a breakdown of fleet by department.

EXISTING FLEET

Rolling stock by type, categorized as "LD", "MD", or "HD" and totaled. Existing electric vehicles (only BEV and PHEV).

Information from the FAS fleet database. Sites without a Campus Name/ Campus Address were assigned to a sector based on their Preventive Maintenance (PM) location.

EXISTING EVSE

Existing EVSE count, categorized as "L1", "L2", or "DCFC" charger type.

NEAR-TERM PRIORITY

High priority L2 chargers currently being planned or designed. Information provided by the FAS project team.

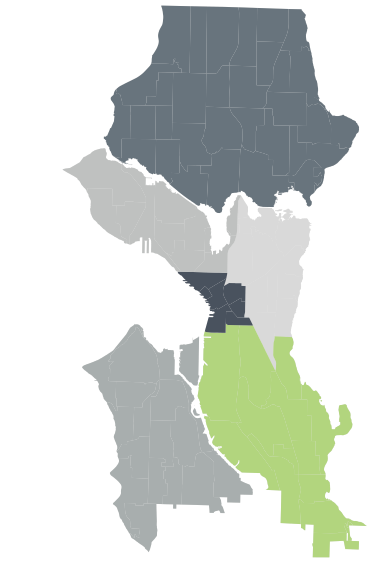
PANEL SPACE

Conveys known information about electrical capacity, indicated with "Yes" and "No".

- YES. There is room on at least one existing main panel (as determined by field review and/or review of record drawings) to install at least one sub-panel for the purpose of supplying EV Charging stations with power.
- NO. There is no room on an existing main panel (as determined by field review and/or review of record drawings) to install at least one sub-panel for the purpose of supplying EV Charging stations with power.
- Unknown. Record drawings and/or field review were insufficient to determine whether there is room on an existing main panel to install at least one sub-panel for the purpose of supplying EV Charging stations with power.

Capacity determined from information provided by FAS and site visits to select properties.

Geographic Sectors



NORTH
WEST
EAST
CENTRAL
SOUTH
SOUTHWEST
OUTSIDE
Not shown on map

NORTH

GENERAL FUND OWNED

FACILITIES	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
	LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Community Center (Ballard)	1			**1**						
Community Center (Bitter Lake)	2			**2**						
Community Center (Green Lake)	1			**1**						
Community Center (Lake City)	1			**1**						
Community Center (Laurelhurst)	1			**1**						
Community Center (Loyal Heights)	1			**1**						
Community Center (Magnuson)	1			**1**						
Community Center (Meadowbrook)	2			**2**						
Community Center (Northgate)	1			**1**						
Community Center (Ravenna-Eckstein)	1			**1**						
Fire Station 09			2	**2**						
Fire Station 16			1	**1**						
Fire Station 17	2		4	**6**						YES
Fire Station 18	2		5	**7**						YES
Fire Station 21			2	**2**						
Fire Station 24			2	**2**						
Fire Station 31			4	**4**						YES
Fire Station 35			2	**2**						
Fire Station 38			2	**2**						
Fire Station 39			2	**2**						
Fire Station 40			3	**3**						
Golden Gardens Park		1		**1**						
Golf Course (Jackson Park)	2	1		**3**						
Green Lake Small Craft Center	7			**7**						
Haller Lake	**39**	**26**	**25**	**90**	**1**		**1**			**NO**
FAS	2			**2**			1			
SDOT	16	10	13	**39**						
SFD	1			**1**	1					
SPU	20	16	12	**48**						

NORTH (CONT.)

GENERAL FUND OWNED (CONT.)

FACILITIES	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
	LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Harbor Patrol and Shop	2	2		**4**						
Magnuson Park	25	5	1	**31**			2			NO
North Precinct	82	1	1	**84**	6		2		8	
Parks Maintenance (Ravenna Barn)	15		1	**16**						NO
Parks Shops North (Green Lake)	43	1	4	**48**	1		2			NO

ENTERPRISE FUND OWNED

FACILITIES	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
	LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Ballard Operations Building/ Yankee Diner	13			**13**						
North Operations Center	8	3	12	**23**						
North Transfer Station	1	1	1	**3**			1			
SCL - North Service Center	152	60	52	**264**	14		8		33	
Systems Operations Center (SOC)	10			**10**						

LEASED

FACILITIES	LEASE EXPIRY	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
		LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
PEO North (Parking Enforcement)	2023	17			**17**			10			

WEST

GENERAL FUND OWNED

FACILITIES	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
	LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Community Center (Magnolia)	1			**1**						
Community Center (Queen Anne)	1			**1**						
Discovery Park	5			**5**	1					
Fire Station 08			2	**2**						
Fire Station 20			4	**4**						
Fire Station 41			1	**1**						
Fremont Bridge Shops	3	5		**8**						
Golf Course (Interbay)	2	1		**3**						
Parks Admin Building	8			**8**			2			
Parks Maintenance (West Central Grounds)	28	1	2	**31**						NO
Parks Maintenance HQ (Ward Spring Park)	18	1	2	**21**						NO
Seattle Center	3			**3**	8					

ENTERPRISE FUND OWNED

FACILITIES	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
	LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Pole Yard (Future Interbay Substation)			3	**3**						

LEASED

FACILITIES	LEASE EXPIRY	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
		LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Elliott Bay Office Park*	Unknown	15			**15**	5					
Seattle Animal Shelter and Clinic	2022	12			**12**						
Seattle Center (5th Ave Garage)	Unknown	1	1		**2**						

**Fleet previously located at Parks RDA Building*

EAST

GENERAL FUND OWNED

FACILITIES	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
	LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Community Center (Garfield)	3			**3**						
Community Center (Miller)	1			**1**						
Community Center (Montlake)	1			**1**						
Community Center (Yesler)	1			**1**						
East Precinct*	32	1		**33**	19		12			YES
Fire Station 22			3	**3**						
Fire Station 25	2		6	**8**						
Fire Station 34			2	**2**						
Langston Hughes Institute	1			**1**						
Volunteer Park	1			**1**						
Washington Park Arboretum	1			**1**						

LEASED

FACILITIES	LEASE EXPIRY	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
		LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
East Precinct (12th Ave Arts Garage)	2077	16			**16**	3					
East Precinct (Diamond Parking Lot)	Month-to-month	16			**16**						
Harborview Medical Center	Unknown	2		2	**4**						

**Leased parking lots listed separately*

CENTRAL

GENERAL FUND OWNED

FACILITIES		EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
		LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Central Library		8	1		**9**			2		3	
City Hall		**5**			**5**						
	MO	2			**2**						
	SPD	3			**3**						
Community Center (Belltown)		1			**1**						
Community Center (International District/Chinatown)		1			**1**						
Fire Headquarters		**18**	**0**	**2**	**20**	**4**		**5**			
	ITD	1			**1**	1					
	SFD	17		2	**19**	3		5			
Fire Station 02				4	**4**						
Fire Station 05		7		1	**8**						
Fire Station 10		10		7	**17**	1					YES
SeaPark Garage		**256**			**256**	**73**	**7**	**9**			**YES**
	ARTS	1			**1**						
	DON	2			**2**						
	FAS	16			**16**	4					
	HSD	11			**11**						
	ITD	16			**16**						
	OH	6			**6**						
	SDCI	32			**32**	22					
	SDOT	38			**38**	9					
	SMC	1			**1**						
	SPD	89			**89**	32	7	9			
	SPU	44			**44**	6					
West Precinct		72	3	2	**77**	2		2		2	

CENTRAL (CONT.)

LEASED

FACILITIES		LEASE EXPIRY	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
			LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
901 Building			10			**10**						
CenturyLink Field			1			**1**	1					
Fire Marshal's Office/Fire Prevention			20			**20**	13					
Seattle Municipal Tower		**2064 (Ground lease)**	**210**			**210**	**100**	**3**	**205**			
	FAS		52			**52**	38	3	205			
	HSD		3			**3**						
	SCL		26			**26**						
	SDCI		68			**68**	35					
	SDOT		44			**44**	22					
	SPU		17			**17**	5					

SOUTH

GENERAL FUND OWNED

FACILITIES		EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
		LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Airport Way Center		**277**	**13**		**290**	**47**		**11**	**1**		**YES**
	FAS	23			**23**						
	SPD	240	13		**253**	39		11	1		
	SPU	14			**14**	8					
Beacon Hill Horticulture Facility		21	4	9	**34**	2					NO
Charles Street		**101**	**33**	**40**	**174**	**8**	**1**	**12**	**1**	**8**	**YES**
	FAS	11	4	1	**16**	3			1		
	SDOT	48	29	39	**116**	3	1			6	
	SFD	1			**1**					2	
	SPU	41			**41**	2					
Community Center (Jefferson)		1			**1**						
Community Center (Rainier Beach)		1			**1**						
Community Center (Rainier)		2			**2**						
Community Center (Van Asselt)		1			**1**						
Fire Station 06				2	**2**						
Fire Station 13		2		1	**3**						
Fire Station 14		4		4	**8**			7			
Fire Station 28				6	**6**						
Fire Station 30				2	**2**						
Fire Station 33				2	**2**						
Golf Course (Jefferson Park)		2	1		**3**						
Kubota Garden		1			**1**						
Mt. Baker Rowing & Sailing Center		4	1		**5**						
Parks Maintenance (Genesee Park)		29	1	2	**32**						NO
South Precinct		61		1	**62**	4		3			
Sunny Jim		15	23	5	**43**	3		5			

SOUTH (CONT.)

ENTERPRISE FUND OWNED

FACILITIES		EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
		LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Beacon Hill Reservoir/ Graffiti Rangers Program		4			**4**						
Operations Control Center		64	20	19	**103**	6		4			
SCL - South Service Center		**160**	**44**	**59**	**263**	**26**		**0**		**33**	
	SCL	154	40	58	**252**	26					
	FAS	2			**2**						
	SDOT	4	4	1	**9**						

LEASED

FACILITIES		LEASE EXPIRY	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
			LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Federal Center		2021	18	5	2	**25**						
Georgetown Warehouse/ Parking		2021	10			**10**						
Lighting Design Lab		2020	1			**1**						
SoDo Warehouse/ Parking		Unknown		7		**7**						
SFD Commissary/ FAS Surplus Warehouse		**2024**	**10**		**1**	**11**						
	HSD	8	8			**8**						
	SFD		2		1	**3**						

SOUTHWEST

GENERAL FUND OWNED

FACILITIES	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
	LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Camp Long	3			**3**						
Community Center (Alki)	1			**1**						
Community Center (Delridge)	1			**1**						
Community Center (Hiawatha)	1			**1**						
Community Center (High Point)	1			**1**						
Community Center (South Park)	1			**1**						
Fire Station 11			2	**2**						
Fire Station 26			3	**3**						
Fire Station 27			3	**3**						
Fire Station 29			2	**2**						
Fire Station 32	1		3	**4**						
Fire Station 36	0		3	**3**						
Fire Station 37	1		3	**4**						
Golf Course (West Seattle)	2	1		**3**						
Joint Training Facility	2		3	**5**						
Parks Maintenance (Lincoln Park)	20		2	**22**						NO
Parks Shops Westbridge (Facility HQ)	86	14	3	**103**	5		6			YES
Police Horse Stables	6			**6**						NO
Southwest Precinct	45	1		**46**	3		4			YES
West Seattle Shops	11	8	4	**23**		1				NO

ENTERPRISE FUND OWNED

FACILITIES	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
	LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
South Hazardous Waste Facility	1	1		**2**						
South Operations Center	17	24	6	**47**	1					
South Transfer Station	8	2	25	**35**	2					

☐ OUTSIDE

ENTERPRISE FUND OWNED

FACILITIES		EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
		LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Boundary Dam		23	1	4	**28**	6					
Cedar Falls		**44**	**7**	**5**	**58**			**3**	**1**		
	SCL	3			**3**						
	SPU	42	6	5	**53**			3			
	FAS	1	1		**2**				1		
Kent Highlands Landfill		6			**6**						
Lake Youngs		8	1	6	**15**						
SCL - Substations		22	9	10	**41**	1					
Skagit Dams (Diablo, Newhalem, Ross)		59	6	11	**76**	7					
Tolt-Duvall Shops		4		3	**7**						

LEASED

FACILITIES	LEASE EXPIRY	EXISTING FLEET					EXISTING EVSE			NEAR-TERM L2	PANEL SPACE
		LD	MD	HD	TOTAL	EV	L1	L2	DCFC		
Police Firing Range/K-9 Facility	2021	29	1	1	**31**						NO
Time Square 600 / HSD Aging & Disability	2023	6			**6**						