



The Department of the Environment City and County of San Francisco

# San Francisco's Electric Vehicle Ready Community Blueprint

July 2019



**SF Environment**

**Our home. Our city. Our planet.**

A Department of the City and County of San Francisco

SF Environment

1455 Market Street, Suite 1200, San Francisco, CA 94103

SFEnvironment.org • (415) 355-3700



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SFCTA: Amber Crabbe

SFMTA: Tim Doherty, Emily Stefiuk

SFPUC: Manuel Ramirez

SF Environment: Lowell Chu, Suzanne Loosen, Shawn Rosenmoss, Tessa Sanchez, Zac Thompson

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## ACRONYMS AND ABBREVIATIONS

ADS	Automated Driving System
BAAQMD	Bay Area Air Quality Management District
BEB	Battery Electric Bus
CARB	California Air Resources Board
CAV	Clean Air Vehicle
CBO	Community-based organization
CEC	California Energy Commission
CPC	San Francisco Planning Department
CPUC	California Public Utilities Commission
CSE	Center for Sustainable Energy
DPW	Department of Public Works
EV	Electric Vehicle
EVWG	Electric Vehicle Working Group
FCEV	Fuel Cell Electric Vehicle
GHG	Greenhouse Gas
ICA	Integration Capacity Analysis
ICE	Internal Combustion Engine
kW	Kilowatt
MUD	Multi-unit Dwelling
MTC	Metropolitan Transportation Commission
OEWD	Office of Economic and Workforce Development
PG&E	Pacific Gas & Electric Company
RED	Real Estate Division
RFP	Request for Proposals
RFQ	Request for Qualifications
RPD	Recreation and Parks Department
SCE	Southern California Edison



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SFCTA	San Francisco County Transportation Authority
SFMTA	San Francisco Municipal Transportation Agency
SFO	San Francisco International Airport
SFPD	San Francisco Police Department
SFPUC	San Francisco Public Utility Commission
SFUSD	San Francisco Unified School District
SOV	Single-occupancy Vehicle
TDM	Transportation Demand Management
TIMMA	Treasure Island Mobility Management Agency
TNC	Transportation Network Company
VMT	Vehicle Miles Traveled
ZEV	Zero-emission Vehicle

## EXECUTIVE SUMMARY

In 2018, the City and County of San Francisco (the City) secured funding from the California Energy Commission to create an Electric Vehicle (EV) Ready Community Blueprint. The City's Department of the Environment (SF Environment) led the effort to develop a document that lays out a strategic implementation plan to turn the City's ambitious vision of 100% greenhouse gas-free transportation in San Francisco by 2040 into reality. The Blueprint details actions and timelines, identifies potential barriers and challenges, and assigns roles and responsibilities to City departments and supporting partners to achieve specific outcomes and deliverables.

The Blueprint designates the identified actions to electrify transportation as near-term (0-12 months) or long-term (12+ months). Near-term actions are high priority and high urgency, crucial to the implementation of other actions, or are already in-process with feasible near-term completion. Other actions were categorized as long-term, depending on their expected completion times.

Some of the highlights for achieving the vision of all trips in San Francisco being electric include:

- facilitating information flow by creating an EV Help Desk and an on-line hub for residents, businesses, and fleet managers to access information about EVs, charging, incentives, and any other EV- and emerging mobility-related issues;
- exploring City incentive program options such as cash rebates, particularly for low-income residents, to make EVs more affordable and convenient than gasoline and diesel vehicles;
- increasing awareness by working with dealerships and community groups to arrange ride-and-drives, and provide extended test drive opportunities for both new and used EVs;
- protecting the health of vulnerable populations by implementing Green Zones in disadvantaged communities where Muni buses only operate on electric motors;
- increasing EV adoption rates among commuters by working with regional government institutions to create discounted lane access for EVs;
- expanding the existing workforce development opportunities in the clean mobility sector and creating new ones by partnering with City College of San Francisco's Automotive Program and other stakeholders;
- supporting grid stability and reducing the costs of charging an EV—whether it's a car, a medium-duty truck or even a school bus—by providing smart charging solutions, battery storage and implementing off-peak charging structures;
- electrifying the shared mobility sector by partnering with the city's taxi fleet and other private sector partners;
- ensuring that the vehicles of today and the vehicles of the future can leverage the same charging assets, regardless of how the vehicles or electrical grid evolve by creating common technical standards; and
- identifying priority areas for near- and long-term EV charging infrastructure and associated investments using a state-of-the-art mapping and modeling tool.

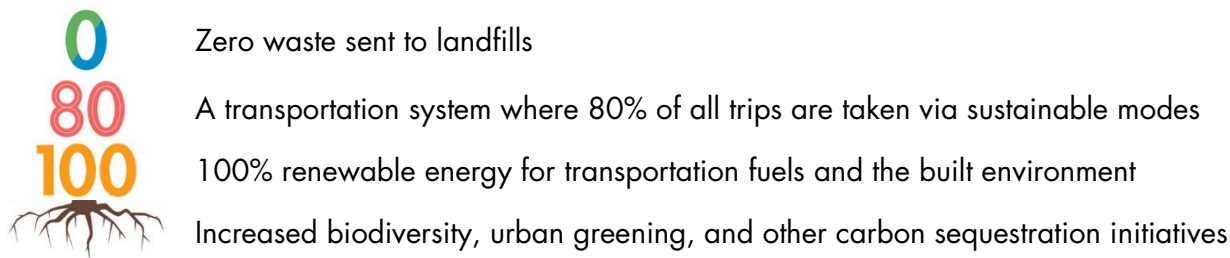
## Background

San Francisco is internationally-recognized for its pioneering policies and programs on sustainability and climate change. The City has continuously reduced its annual greenhouse gas (GHG) emissions in recent years by enforcing new green building standards, investing in renewable energy systems, pursuing rigorous energy efficiency improvements, increasing the share of sustainable trips, and moving closer to zero waste being sent to the landfill.

Since 1990, the City has reduced its annual GHG emissions 36% below 1990 levels, while its population has increased by 22% and its economy has grown by more than 166%.

The City has already pledged to accelerate its GHG emissions reductions to achieve net-zero emissions by 2050 and aligned its goals with the 2016 Paris Climate Agreement. Even with this impressive reduction in GHG emissions and its stated goals, earlier this year, San Francisco declared that the planet is in a true climate crisis.

San Francisco's climate action framework is simply described as "0-80-100-Roots" and outlines actions that will help the City meet the challenge of climate change through innovative policies, programs and partnerships.



The transportation sector continues to present ongoing challenges to achieving these net-zero emissions goals and is responsible for almost half of the City's GHG emissions, with the bulk coming from privately owned vehicles, including medium- and heavy-duty freight trucks.

The pathway to reducing emissions and congestion is to increase sustainable trips—those made by transit, bicycling and walking—while simultaneously electrifying the remaining vehicles operating on the city's roads.

Over the last fifteen years, San Francisco has made tremendous gains in vehicle electrification. San Francisco's public transportation system, Muni, is on path to being GHG-free. The City has secured millions of dollars in federal, state, and regional government funding to accelerate the process of vehicle electrification. San Francisco is among the leading cities nationally in providing publicly accessible charging stations and has one of the largest electric vehicle (EV) markets in the country.

From 2016 to 2017, the San Francisco metro area saw a 39% increase in EV registrations and has invested heavily in charging infrastructure to support this growth. The area has roughly four times the U.S. average of public charging ports per capita. That said, much more needs to be done to expand

the city's public charging network, not only to support the current EV market, but also the expanded market that the Blueprint will facilitate.

## The Foundation for San Francisco's EV Blueprint

In 2017, the City formed an Electric Mobility Subcommittee, which included representatives from thirteen City departments and agencies, local community-based organizations, workforce development and EV industry partners, and state and regional government agencies. The Subcommittee recommended six critical strategies and associated actions to electrify private transportation in San Francisco, while ensuring a more livable and equitable city. The strategies and actions that served as the foundation to the EV Blueprint include:

1. Increasing **public awareness** by creating a staff position to provide EV support to the public, businesses, and other City departments while integrating EVs with the City's Transportation Demand Management work
2. Exploring an **incentive structure** that might include lease and purchase incentives, low-emission zones, transportation pricing strategies, and EV lane access
3. Ensuring a robust **charging infrastructure** network by working with City- and privately-owned parking structures, creating a master plan for off-street charging, and creating workforce development programs to support this infrastructure
4. Integrating EV charging with a 100% renewable **electrical grid** by creating programs for charging during off-peak hours and incorporating battery storage into charging infrastructure
5. Electrifying **medium- and heavy-duty vehicles** and creating transition plans for municipal, San Francisco Unified School District, and private fleets
6. Advocating for and encouraging **emerging mobility** options, such as carsharing and ridesharing, to be GHG-free

The EV Blueprint presents a comprehensive implementation plan for these strategies and actions.

### 100% Renewable Electricity

A major part of planning for this EV transition, has been accounting for the impact of EVs on the electrical grid and ensuring that the electricity powering EVs is produced via renewable sources.

EVs in San Francisco can easily be powered by 100% renewable electricity through the investor-owned utility, Pacific Gas & Electric Company's (PG&E) Solar Choice program; the San Francisco Public Utilities Commission's (SFPUC) GHG-free hydroelectric system; and the City's community choice aggregation program, CleanPowerSF, which is operated by the SFPUC and works in partnership with PG&E to deliver cleaner energy to residents and businesses. Both PG&E and CleanPowerSF offer alternative rate structures specifically for EV owners.

## Equity and Access

The EV Blueprint, consistent with the City's existing policy frameworks, promotes equity, public health and economic vitality. All action items and tasks in the Blueprint are designed to create a more livable and equitable San Francisco. The Blueprint:

- addresses disparities in mobility options and services for low-income and underserved communities and strives to build a more equitable multimodal transportation system,
- reduces air pollution from vehicle emissions along major traffic corridors, particularly from medium- and heavy-duty vehicles, and
- features a robust community outreach and engagement process

With its focus on equitable access to electric mobility options, the Blueprint ensures that reductions in transportation emissions directly benefit local communities, especially those that are disproportionately impacted by poor air quality.

## Challenges

Even with the growth in the City's EV market, numerous barriers prevent accelerated EV adoption.

### Private Transportation

The transportation sector is San Francisco's primary GHG emitter, responsible for 46% of the city's emissions, with the majority (71%) coming from private cars and trucks. Approximately 460,000 vehicles are registered in the city, thousands more commute in every day, and on a typical weekday, more than 5,700 ride-hail vehicles operate on the city's streets. The sheer number of these vehicles presents congestion challenges on roadways, and if electrified, on the electrical grid as well.

### Access to Charging Infrastructure

Another challenge for San Francisco is the diversity of its housing stock. Private residential charging stations are the most convenient and affordable options, yet many San Francisco residents do not live in single-family homes with private off-street parking. Approximately one-third of cars registered in the city are parked in shared multi-unit dwelling garages, where the installation of charging stations is much more complex than in single-family homes. It is estimated that another one-third of cars are parked on the street, presenting additional challenges for those EV drivers.

Between the San Francisco registered vehicles without access to off-street parking and those commuting into and operating in the city, significant investments in publicly available charging stations, particularly fast charging, are needed to keep up with increasing EV adoption rates. While the rate of EV adoption is outpacing other cities, San Francisco's approximately 700 public charging ports equate to just 0.07 ports per EV currently registered in the city. If sales continue to outpace accessible chargers, this ratio will only get worse.

## Cost Parity

While average prices continue to be reduced, EVs are not expected to reach cost parity with their gasoline- and diesel-powered counterparts until the early- to mid-2020s at the earliest. Many potential EV drivers and fleet owners struggle to understand and take advantage of available incentives that would reduce the upfront cost of EVs, while others need additional incentives to make an EV purchase or lease economically feasible.

## Funding

To implement this Blueprint, the greatest challenge will be a lack of available funding. Despite our creativity and successes thus far, this lack of funding has limited the strides the City has been able to make in spurring EV adoption and accelerating emissions reductions from the transportation sector. Securing funding to implement the Blueprint will allow the City to take a more sweeping and strategic approach to electrifying San Francisco's transportation sector. Therefore, SF Environment will be seeking Phase II funding from the California Energy Commission in addition to opportunities from other funding agencies such as the California Air Resources Board, the Bay Area Air Quality Management District, and others.

## Deliverables of San Francisco's EV Blueprint

In addition to the detailed Blueprint actions, SF Environment staff is partnering with Google on the creation of an EV charging mapping and modeling tool. Staff has also developed a two-part public engagement plan and a playbook of the City's best practices and recommendations for accelerating EV adoption.

## Blueprint Actions

The strategies and actions below were developed from those recommended by the Electric Mobility Subcommittee and will serve as the implementation plan for achieving the City's goal of having a 100% GHG-free transportation sector in San Francisco by 2040.

Strategy	Action
A. Public Awareness	<ol style="list-style-type: none"> <li>1. EV Staff Position</li> <li>2. Transportation Demand Management</li> <li>3. Wayfinding</li> </ol>
B. Incentives	<ol style="list-style-type: none"> <li>1. EV Purchase/Lease Incentive</li> <li>2. EV Lane Access</li> <li>3. Airport Incentives</li> <li>4. Low-Emission Zones and Car-Free Corridors</li> <li>5. Transportation Pricing Strategies</li> <li>6. EV Charging Rates</li> </ol>
C. Charging Infrastructure	<ol style="list-style-type: none"> <li>1. City-Owned Parking Facilities</li> <li>2. Privately-Owned Facilities</li> <li>3. Off-Street EV Charging Masterplan</li> <li>4. Curbside Charging</li> <li>5. Workforce Training</li> <li>6. EV Charging Experience</li> </ol>
D. Electrical Grid	<ol style="list-style-type: none"> <li>1. Smart Charging Program</li> <li>2. 100% Renewable Electricity</li> <li>3. Stationary Battery Storage</li> </ol>
E. Fleet and Emerging Mobility Electrification	<ol style="list-style-type: none"> <li>1. Medium- and Heavy-Duty Pilots</li> <li>2. Regulatory Efforts and Initiatives</li> <li>3. Shared Mobility Services</li> <li>4. Electric Car Rentals</li> <li>5. Taxi Electrification</li> <li>6. Zero-Emission Facility and Fleet Transition Plan</li> </ol>

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## Blueprint Mapping Tool

In addition to the Blueprint Actions, SF Environment staff partnered with Google's Environmental Insights Explorer Team for the development of the Blueprint Mapping Tool. This dynamic interactive EV charging mapping and modeling tool will be used to identify sites in priority areas for EV charging infrastructure investments. The tool will identify gaps in San Francisco's existing public charging network to prioritize near-term infrastructure investments. It will also use a variety of modeling scenarios to predict future needs for EV charging and identify target areas for long-term investments.

Initially, the tool will be for the use of City staff, but as development continues, the tool will be made available to EV charging station providers, utilities, property owners, and residents. The tool will be developed in four phases:

- Phase I: Data collection and mock tool development
- Phase II: Initial application and mapping
- Phase III: Add data layers and deepen metrics
- Phase IV: Modeling and predictions

The Blueprint Mapping Tool will not only help San Francisco develop its own EV Charging Masterplan but will also serve as a replicable model for other cities in California and beyond to develop their own charging plans. Both SF Environment and Google have engaged other municipalities in the Bay Area to share the results of this work and solicit feedback on the tool's applicability in their communities. The team has also begun to engage with other government agencies, utilities, and charging station providers regarding further development of the tool.

## Blueprint Engagement Plan

SF Environment also developed a Blueprint Public Engagement Plan to carry out an electric mobility outreach and awareness campaign for the strategies and actions outlined in the EV Ready Community Blueprint. The Plan is separated into two parts. The first section documents how SF Environment engaged the community in the development of the Blueprint to ensure that the strategies and actions are aligned with community needs, concerns, and interests and to ensure inclusivity and equitability. The second section of the plan outlines the outreach and engagement to community-based organizations, state and local agencies, residents, businesses, and industry that is expected to occur during Blueprint implementation.

## Blueprint Playbook

As part of this process SF Environment crafted a Blueprint Playbook to share the City's experience and best practices for accelerating EV adoption. This step-by-step guide outlines how San Francisco established and coordinated the EV Working Group, engaged with the community, and developed an EV Ready Community Blueprint and mapping tool.



# INTRODUCTION

San Francisco has long been a pioneer of innovative and responsible environmental policies and programs. The City’s overall climate goals are elegantly articulated as 0-80-100-Roots. 0% waste to landfill without incineration by 2020; 80% of all travel via sustainable modes by 2030; achieve 100% renewable electricity<sup>11</sup> (for the built environment and transportation) by 2030; and Roots, maximize carbon sequestration by using the city’s urban forest and compost on rangelands [Figure 1].



Figure 1. San Francisco’s Climate Action Framework

As of 2017, San Francisco has reduced greenhouse gas (GHG) emissions 36% below 1990 levels, while growing its economy 166% and experiencing a population increase of 22%, proving that cities can have a robust economy while simultaneously reducing their climate impacts [Figure 2].

This Electric Vehicle (EV) Ready Community Blueprint supports the City’s climate action framework and carbon reduction goals, serving as an implementation plan to achieving a GHG-free transportation system in San Francisco.



Figure 2. San Francisco’s Decrease in Emissions and Growth in Population and Economy, 1990 – 2017

<sup>1</sup> The City of San Francisco considers solar PV, wind, small- and existing large-hydro, geothermal and biomass to be renewable

## San Francisco's Sustainable Transportation Vision

Based on the latest data (2017), transportation is responsible for 46% of the city's GHG emissions; with most of these emissions (71%) coming from privately owned cars and trucks [Figures 3 and 4]. While San Francisco's public transportation system, Muni, has targets in place to be GHG-free, private transportation poses an ongoing challenge. Aggressively tackling these emissions will help the City achieve both its 80% Sustainable Trips and 100% Renewable Energy climate goals. 0-80-100-Roots is San Francisco's climate action framework, which will help us meet the challenge of climate change through innovative policies, programs, and partnerships.

### 80% Sustainable Trips by 2030

San Francisco's primary strategy to reduce congestion, improve public health and safety, and reduce GHG emissions is to focus on mode shift — encouraging residents and visitors to use sustainable modes of transport, including transit, biking and walking, instead of relying on single occupancy vehicles.

San Francisco's 1973 Transit First policy aims to reduce congestion and improve public health and safety by prioritizing the use of limited public street and sidewalk space for pedestrians, bicyclists, and public transit. Transit First is a long-term policy, requiring considerable investments in multimodal transportation infrastructure that is equitable, safe, sustainable, and affordable. The policy is advanced through key strategies and policies including the San Francisco Municipal Transportation Agency's (SFMTA) *Strategic Plan* and long-range regional planning efforts like *ConnectSF*, which establishes a 50-year vision for a transportation system that represents San Francisco's long-term priorities, goals, aspirations and commitment to equity.

Despite the City's gains through its model Transit First policy, San Francisco has seen an explosion of emerging mobility services and technologies over the last 10 years, including ride-hailing services such as Uber and Lyft. In response to this rapid growth, the San Francisco County Transportation Authority (SFCTA) and the SFMTA adopted ten *Guiding Principles for Emerging Mobility Services and*

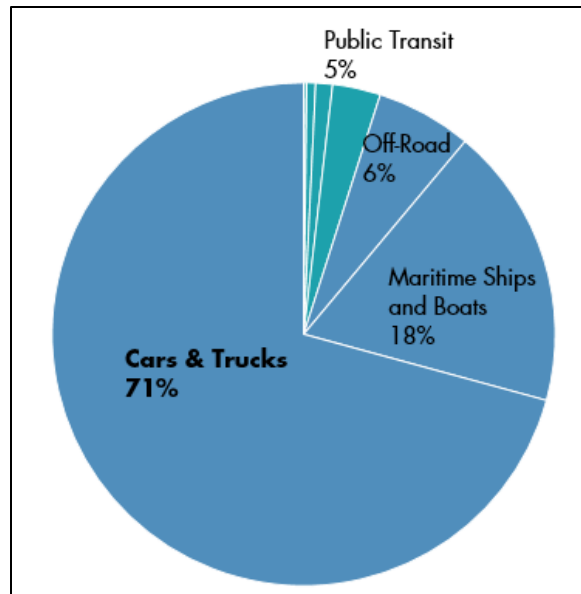


Figure 3. 2017 Transportation Emissions

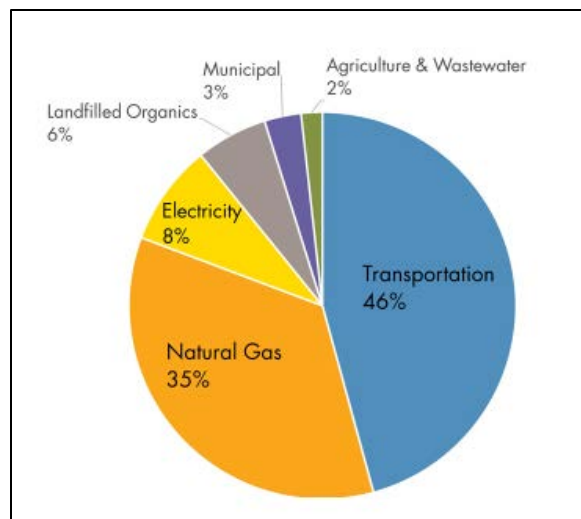


Figure 4. 2017 Emissions by Source

*Technologies (2017)*, which reflect adopted City policies, plans, and strategies and serve as a framework for evaluating emerging mobility services and technologies.



Furthermore, the City's 2017 *Transportation Sector Climate Action Strategy* provides a framework for accelerating the reduction of transportation sector emissions and building a more resilient transportation sector to adapt to climate impacts such as sea level rise. In addition, the SFMTA has committed to electrify its remaining diesel-fueled transit buses by 2035.

Under the umbrella of its Transit First policy, the City has an established

framework for achieving an GHG-free public transit system and growing the share of sustainable trips from 57% of all trips made today to 80% by 2030 (SFMTA, 2017). Even with these ambitious timelines for increasing the use of sustainable modes of transportation, there will be residents and businesses that continue to rely on private vehicles and fleets. The City must create a plan for transitioning these remaining vehicles from using fossil fuels to 100% renewable electricity, which includes having an integrated EV charging network.

## 100% Renewable Electricity by 2030

As part of planning for this transition, the City must consider how the electricity used to charge EVs is produced and the impact of this new load on the overall electrical grid. Even as it commits to supporting EV adoption and providing a robust charging system, the City is working with its electricity providers to ensure that this new system is, in fact, completely carbon free.

San Francisco is served by two utilities — the local investor-owned utility, Pacific Gas & Electric Company (PG&E), which has historically served businesses and residents, and the San Francisco Public Utilities Commission (SFPUC), which has provided GHG-free electricity to municipal buildings, San Francisco International Airport (SFO), and the Port of San Francisco, as well as the City's electric transit fleet for more than 100 years. As a municipal utility with considerable power generation resources, the SFPUC has been a leader in the transition to a sustainable power grid.

The SFPUC was crucial to the City's 2002 creation of an *Electricity Resource Plan*, which outlined actions to improve air quality, and establish a long-term goal of 100% renewable electricity for all of San Francisco. In 2012, the City adopted the *Updated Electricity Resource Plan*, which articulated even more ambitious plans to meet its electricity needs through 100% renewable resources. The updated Plan identified three broad strategies and made fourteen recommendations to achieve a 100% renewable electric sector by 2030, by meeting all of its energy needs from the SFPUC's Hetch Hetchy Reservoir hydro-electric facility and other renewable energy sources.



In 2016, the City launched CleanPowerSF, its Community Choice Aggregation program that will increase the proportion of electrical energy supplied to the San Francisco electrical grid from local



renewable sources, decrease San Francisco's GHG emissions, and combat climate change.

CleanPowerSF is a not-for-profit entity operated by the SFPUC that works in partnership with PG&E. All San Francisco residents and businesses are automatically enrolled in CleanPowerSF.

Customers began receiving cleaner energy in phases beginning in May 2016 with all eligible customers slated to receive their electricity from CleanPowerSF by the end of 2019.

Between the SFPUC's GHG-free hydro-electric power system and CleanPowerSF renewable electricity system, San Francisco will ensure that all EVs operating in the city will be powered by GHG-free electricity by 2030, making them true zero-emission vehicles (ZEVs).

## 100% GHG-Free Transportation by 2040

San Francisco is committed to reducing emissions and congestion by increasing trips made by transit, biking and walking, while simultaneously electrifying the remaining vehicles operating in the city and powering those vehicles with 100% renewable energy. The City has adopted a bold new vision to make all transportation in San Francisco GHG-free by 2040. The goal is for all cars, vans, medium- and heavy-duty trucks, buses and shuttles making trips originating in, ending in, or passing through San Francisco to be battery electric or hydrogen fuel cell electric. In addition to the private sector electrification goals laid out in this Blueprint, the SFMTA has committed to electrify its remaining diesel-fueled transit buses by 2035.

This Blueprint lays out a strategic development process and implementation plan to turn this ambitious vision into reality. It will guide the City and is intended to serve as an inspiration and model for communities far beyond San Francisco. This achievement will be a monumental step toward meeting the City's pledge of net-zero GHG emissions by 2050.

## CHALLENGES

The key to reaching net-zero emissions by 2050 is a GHG-free transportation system, as the transportation sector is the city's primary GHG emitter. San Francisco, however, embraces the opportunity to create a roadmap for other communities to follow on how to accelerate this transition.

Private transportation poses unique challenges as the city becomes more densely populated. Approximately 460,000 vehicles are registered in the City, and thousands more commute in every day, contributing to congestion, air quality and GHG emissions concerns (California Department of Motor Vehicles, 2018). The proliferation of smartphones and connected vehicle technologies is enabling the explosive growth of privately-owned ride hailing vehicles. On a typical weekday, more than 5,700 ride-hail vehicles operate on San Francisco's streets, making more than 170,000 vehicle trips within the city, and representing 15% of all intra-city vehicle trips (San Francisco County Transportation Authority, 2017). As they become more viable, automated driving system (ADS)



equipped vehicles will alter the private transportation system even further.

In 2017, private vehicles produced 1.7 million tons of carbon dioxide equivalent in San Francisco (SF Environment, 2017). While the overall transportation emissions have decreased 10% since 1990, this decrease has been slow, and the transportation sector has proven to be a stubborn sector in terms of reductions (SF Environment, 2017). For comparison,

during the same period, the City decreased electricity emissions by 81% (SF Environment, 2017).

While San Francisco is among the leading cities nationally in EV adoption, they make up just a fraction of the total number of vehicles registered in the city. Of the ~460,000 registrations in 2018, a mere 2.3% (10,648) were EVs — including battery electric, plug-in hybrid electric, and fuel cell electric vehicles (FCEV; California Department of Motor Vehicles, 2018).

## Barriers to EV Adoption

A number of barriers prevent accelerated EV adoption in San Francisco and beyond. While the influx of new models on the market and falling battery production costs have reduced the average price, EVs are still not expected to reach cost parity with their internal combustion engine (ICE) counterparts until the early- to mid-2020s (BNEF 2019). Many potential EV drivers and fleet owners struggle to understand incentives available to reduce the upfront cost of EVs and are not aware of other benefits of ownership, such as lower fuel and maintenance costs. For example, a University of California, Davis study reported that many respondents who “can imagine owning an EV” either did not know about incentives available or thought it would be too cumbersome to apply for them, while most respondents who “cannot imagine owning an EV” knew nothing of available incentives (Cahill, Davies-Shawhyde, & Turrentine, 2014).

Creating a robust charging infrastructure is another major challenge. While private residential charging stations are the most convenient and affordable options, many San Francisco residents do not live in single-family homes with garages and/or driveways to park their vehicles. Multi-unit dwellings (MUD) represent a large and diverse part of San Francisco's housing stock. Smaller scale (<100 units) buildings built before 1940 are the largest sub-segment of MUDs, totaling ~75,000 units. It is extremely difficult and costly to install charging stations in these buildings, as they often have few off-street parking spaces, if any. At the other end of the scale are newer MUDs with more than 100 units per building. While they typically have larger parking garages, and it is generally easier to install charging stations, there are only ~23,000 units across the city (CSE 2017).



The sheer diversity of MUD housing stock in San Francisco represents additional barriers as charging infrastructure installation processes are unique to each individual building. While specifics vary from building to building, residents and landlords face similar obstacles:

- MUDs garages have shared and often fully utilized electrical panels.
- Many MUDs feature distributed ownership and control over common spaces and investments. Parking space is often deeded to individual units.
- In rent-controlled buildings there are limitations on the owner's ability to recoup capital improvements directly.
- Cost effectiveness requires a coordinated approach across many residents in a single building. It's often cost prohibitive to pay for charging station installation individually, versus electrifying multiple spaces at once to achieve economies of scale.

EVs parked on the street must rely on workplace and/or public charging, where station availability and time required to charge are limiting factors. San Francisco is a national leader in providing publicly accessible charging stations with over 700 charging ports citywide, yet this equates to just 0.07 ports<sup>2</sup> per EV registered in the city (California Department of Motor Vehicles, 2018). The vast majority of these ports are Level 2 charging stations, which take many hours to fully charge an EV.

Significant investments in publicly available charging stations, particularly fast charging, are needed to keep up with increasing EV adoption rates. Challenges to providing such a network include:

- High initial investments in electrical infrastructure upgrades and accessibility compliance
- Limited availability of parking spaces, often with high monthly lease prices

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<sup>2</sup> This statistic does not factor in whether registered EVs have access to home charging.

- Higher unit cost of electricity as compared to attractive residential EV rate plans; compounded by peak demand charges for high-power charging
- Leasing and contracting terms for EV charging spaces are often 10+ years
- High real estate costs

These hurdles make EV adoption in commercial use cases difficult. The amount of power needed to charge a fleet of vehicles, especially medium- and heavy-duty models, can trigger demand charges that make the business model for EVs less desirable in these cases. This would also be the case for transportation network company (TNC) drivers that rely on publicly available fast chargers while providing ride hail services.

## SCAFFOLDING FOR THE EV READY COMMUNITY BLUEPRINT: SAN FRANCISCO'S EV ROADMAP

In the context of San Francisco's pledge to be carbon neutral by 2050, the City developed a roadmap for an accelerated path toward electrification of all forms of private transportation, and a reduction in total vehicle miles travelled (VMT) in the city by increasing the share of sustainable trips.

In 2015, Mayor Ed Lee established the Electric Vehicle Working Group (EVWG) and tasked this group with developing recommendations and solutions to address the challenges to EV adoption, electrifying the municipal fleet and transforming the marketplace for EVs in private transportation. Led by the Office of the City Administrator and the Director of the Department of the Environment (SF Environment), this group of City department and agency directors oversaw the development of two ordinances: (1) the San Francisco Municipal Fleet Zero-Emission Vehicle Ordinance mandates the municipal light-duty passenger fleet be zero-emission by 2022 and (2) the San Francisco EV Readiness Ordinance requires all new buildings and major renovations to install EV-ready infrastructure.

In addition, the Mayor's Office funded a study on worldwide best practices and recommendations to inform other actions to increase EV adoption. A subcommittee of the EVWG integrated this study into its development of San Francisco's EV Roadmap, which outlines strategies to rapidly electrify private sector transportation. Led by SF Environment and co-chaired by

Table 1. EVWG Subcommittee Member Organizations

### EVWG Member Organizations

Bay Area Air Quality Management District  
 Bloomberg New Energy Finance  
 Brightline Defense Project  
 ChargePoint  
 Charge Across Town  
 County Transportation Authority  
 Department of Building Inspection  
 Department of Public Health  
 Department of Public Works  
 Department of the Environment  
 General Motors  
 Governor's Office of Business and Economic Development  
 Mayor's Office  
 Mayor's Office on Disability  
 Metropolitan Transportation Commission  
 Office of Economic and Workforce Development  
 Pacific Gas and Electric  
 Planning Department  
 Port of San Francisco  
 Real Estate Division  
 Recreation and Park Department  
 San Francisco International Airport  
 San Francisco Municipal Transportation Agency  
 San Francisco Public Utilities Commission  
 Tesla  
 The Greenlining Institute  
 Veloz



SFMTA and SFPUC, the Subcommittee includes staff from relevant city, regional, and state agencies, as well as key stakeholders from the private and non-profit sectors and regional and state government agencies [Table 1]. The EV Roadmap is the outcome of the Subcommittee’s collaborative effort to identify the most critical strategies and actions to electrify private transportation in San Francisco.

The overarching vision of the EV Roadmap is to create a more livable and equitable San Francisco. It complements the City’s existing policy frameworks, programs and initiatives and promotes equity, public health and economic vitality. In addition to its specific goals and objectives, the EV Roadmap serves to:

- Address inequities in the broader transportation system and specifically regarding access to electric mobility options
- Reduce air pollution coming from congested traffic corridors, particularly from medium- and heavy-duty vehicles
- Include a robust community outreach and engagement process

Creating equitable access to electric mobility options ensures that reductions in transportation emissions directly benefit local communities, especially those that are

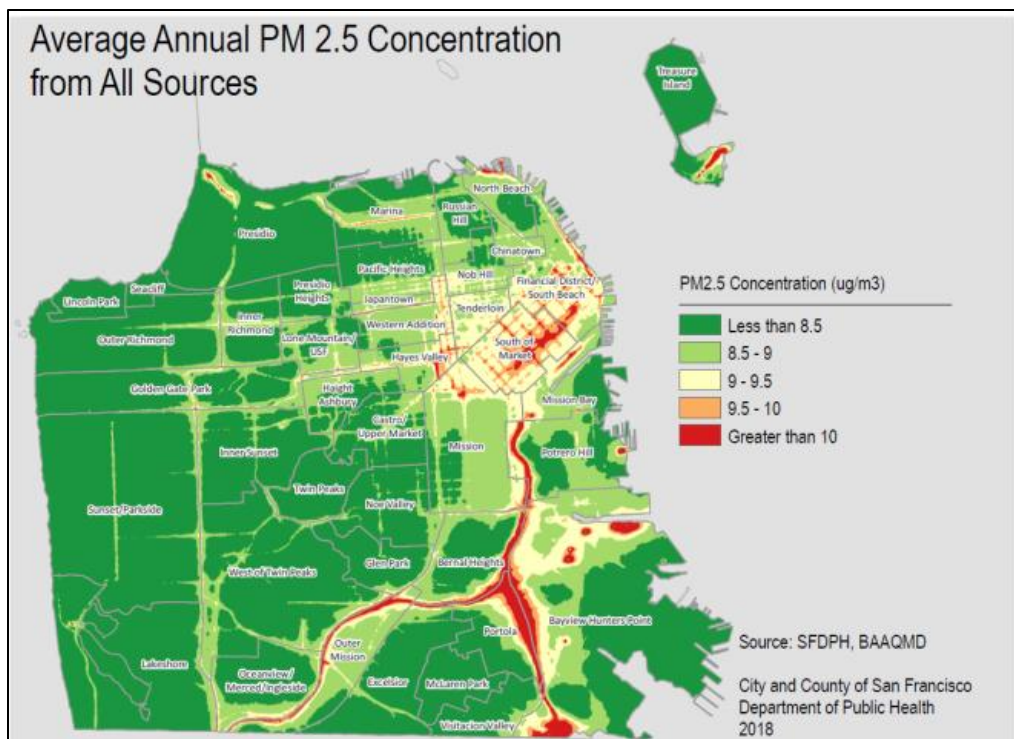


Figure 5. 2018 Particulate Matter Concentrations

disproportionately impacted by vehicle emissions. Notably, neighborhoods with the worst air quality – due to increased emissions from commuter traffic and medium- and heavy-duty vehicles operating on nearby traffic arteries – are often lower-income and underserved communities, placing a disproportionate public health burden on these residents [Figure 5]. Children in these areas are particularly vulnerable to these pollutants with documented health effects such as asthma (SFPDPH et al., 2018). Thus, providing access to electric mobility options for residents and businesses is not enough. It is critical to reduce the emissions from incoming and outgoing commuter traffic as well as the diesel emissions from medium- and heavy-duty vehicles traversing those neighborhoods.



Beyond addressing these public health inequities, the EV Roadmap also promotes a more equitable economy. Electrification opens new employment opportunities for vehicle mechanics, electricians, contractors, and others needed to service EVs and build out the necessary charging network. The EV Roadmap identifies partnership opportunities with the City College of San Francisco’s Automotive Program to promote workforce development opportunities in the clean mobility sector.

## Goals

To inspire near-term action and reduce emissions quickly, the EV Roadmap sets interim targets for 2025 and 2030 specifically focused on new passenger vehicles, emerging mobility, medium- and heavy-duty fleets, and incoming commuter vehicles. The targets aim to reduce the sale of new gasoline and diesel vehicles, with 50% of new passenger vehicle registrations being EVs by 2025, and 100% of new registrations being EVs by 2030. These interim targets will put the City on track to reach the ultimate goal of the EV Roadmap: 100% electrification of all private transportation by 2040 [Table 2]. To achieve this goal, the City will need to collaborate with neighboring jurisdictions and private sector partners, like car rental companies and hotels to ensure incoming commuter vehicles are also electric.

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## Make all transportation in San Francisco GHG-free by 2040

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## Strategies

The EV Roadmap proposes six strategies to achieve its targets, each addressing a key barrier to EV adoption. It also identifies action items to achieve the desired outcomes for each strategy (SF Environment, 2019). The City will continue to work with EVWG stakeholders, additional organizations and the community to implement the strategies and make the vision of GHG-free transportation by 2040 a reality.

1. **Public Awareness:** Achieve broad public awareness, understanding and consideration of the options and benefits of electric mobility.
2. **Incentives:** Create a preference for electric mobility over gasoline and diesel vehicles.
3. **Charging Infrastructure:** Ensure that charging infrastructure for EVs is available and convenient for all residents, businesses, and visitors.

Table 2. Proposed Targets

### By 2025 EVs will be:

50% of new passenger vehicle registrations with no increase in total vehicle registrations per household

50% of emerging mobility VMT

2,000 medium/heavy-duty commercial vehicles registered in the City

1/3 of incoming commuter vehicles

### By 2030 EVs will be:

100% of new passenger vehicle registrations with no increase in total vehicle registrations per household

100% of emerging mobility VMT

10,000 medium/heavy-duty commercial vehicles registered in the City

### By 2040 EVs will be:

All trips originating in, ending in, or passing through San Francisco will be GHG-free

4. **Electrical Grid:** Integrate EV charging with the electrical grid to maximize the benefits of charging infrastructure and support the transition to a renewable electricity future.
5. **Medium- and Heavy-Duty Vehicles:** Lead the way in medium- and heavy-duty vehicle electrification.
6. **Emerging Mobility:** Advocate for and encourage emerging mobility options to be GHG-free.

## DEVELOPMENT OF THE EV READY COMMUNITY BLUEPRINT

The EV Roadmap created the scaffolding for the team to continue to refine the actions vital to its vision of transitioning to a 100% GHG-free transportation system in San Francisco. SF Environment staff worked with EVWG Subcommittee members and took the next steps to create the EV Ready Community Blueprint, which is the implementation plan for the strategies and associated actions laid out in the EV Roadmap.

The Blueprint breaks down specific tasks that detail how, when and by whom each EV Roadmap action will be implemented to secure San Francisco's 2040 vision. The tasks identified in the Blueprint fully incorporate the EV Roadmap's vision to improve the quality of life for all San Franciscans by focusing on equity, public health and economic vitality.

The team, led by SF Environment and supported by SFMTA and SFPUC, thoroughly evaluated each action identified in the EV Roadmap and divided them into two implementation periods: near-term (0-12 months) and long-term (12+ months). Actions were deemed near-term if:

- They are high priority and high urgency
- Implementation of other actions depend on their completion
- Implementation tasks for the action had already begun and its completion within the near-term was feasible

Other actions were categorized as long-term depending on their expected completion times. Completion time was determined based on a variety of factors, including an action's dependency on the completion of another action, technology availability, the scope of the action, the organization(s) vital to completing the action, etc.

After determining the implementation period for each action, the team developed a detailed list of sub-tasks for implementation and assigned EVWG Subcommittee members as action leads and supporters. Organizations and staff responsible for implementation gave feedback on their assigned tasks, which were modified as necessary before formally approving their commitment.

The team then identified areas of overlap and duplication. For example, some actions shared several similar tasks. In such cases, the group was able to streamline the list of actions by combining those that had significant correlation. This led to the development of an evolved list of Blueprint Actions that still serve to achieve the desired outcomes of the strategies laid out in the EV Roadmap [Table 3]. These actions, their lead and supporting roles, and detailed tasks are described in the section below so as to be made available for replication in other communities beyond San Francisco.

## San Francisco's EV Journey

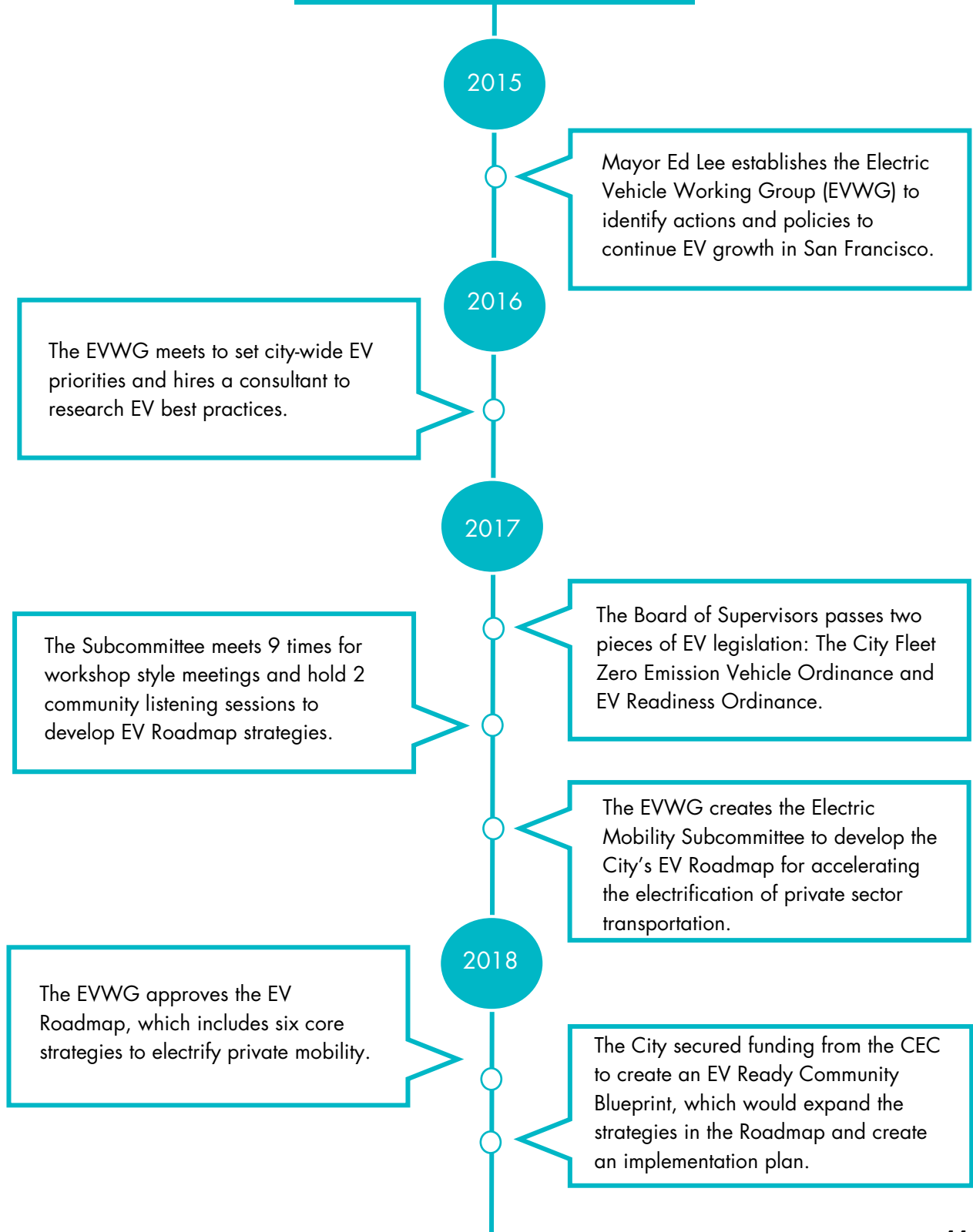


Table 3. Blueprint Actions

<b>Strategy</b>	<b>Action</b>
A. Public Awareness	<ol style="list-style-type: none"> <li>1. EV Staff Position</li> <li>2. Transportation Demand Management</li> <li>3. Wayfinding</li> </ol>
B. Incentives	<ol style="list-style-type: none"> <li>1. EV Purchase/Lease Incentive</li> <li>2. EV Lane Access</li> <li>3. Airport Incentives</li> <li>4. Low-Emission Zones and Car-Free Corridors</li> <li>5. Transportation Pricing Strategies</li> <li>6. EV Charging Rates</li> </ol>
C. Charging Infrastructure	<ol style="list-style-type: none"> <li>1. City-Owned Parking Facilities</li> <li>2. Privately-Owned Facilities</li> <li>3. Off-Street EV Charging Masterplan</li> <li>4. Curbside Charging</li> <li>5. Workforce Training</li> <li>6. EV Charging Experience</li> </ol>
D. Electrical Grid	<ol style="list-style-type: none"> <li>1. Smart Charging Program</li> <li>2. 100% Renewable Electricity</li> <li>3. Stationary Battery Storage</li> </ol>
E. Fleet and Emerging Mobility Electrification	<ol style="list-style-type: none"> <li>1. Medium- and Heavy-Duty Pilots</li> <li>2. Regulatory Efforts and Initiatives</li> <li>3. Shared Mobility Services</li> <li>4. Electric Car Rentals</li> <li>5. Taxi Electrification</li> <li>6. Zero-Emission Facility and Fleet Transition Plan</li> </ol>

STRATEGY A:

## Public Awareness



**Achieve broad public awareness, understanding and consideration of the options and benefits of electric mobility.**

### ACTIONS

1. EV Staff Position
2. Transportation Demand Management
3. Wayfinding

# 1. EV Staff Position

Create a City staff position to coordinate a citywide EV public awareness campaign, operate an EV Help Desk, and develop an extended EV test drive program.

Action Lead(s)	Supporting Department(s)
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SF Environment

SFMTA, SFPUC, BAAQMD

Sub-actions	Timeline
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EV Help Desk

Near-Term

Public Awareness Campaign

Near-Term

Extended Test Drive Program

Long-Term

## Tasks

### EV Help Desk

1. Create and staff EV Help Desk
  - a. Recruit a full-time staff member to lead the administration and implementation of the Blueprint Actions, including aspects of planning, and coordinating the Public Awareness Campaign
2. Create operational protocols for fielding all EV- and emerging mobility-related inquiries from the public, private businesses, property owners, and EV charging station providers
  - a. Develop a system to route electric mobility questions received by City agencies to the EV Help Desk

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### Public Awareness Campaign

1. Develop a communication, outreach and engagement strategy
    - a. Develop content and consistent language for educational and promotional materials
    - b. Seek out industry partners and develop a multimedia marketing campaign to increase EV market share by helping consumers understand the benefits of EVs. This will include digital advertising, search engine optimization, social media, consumer experience events, community focused programs, and fleet-focused press
    - c. Build on knowledge from SF Environment’s successful Zero-Waste program and create online and in-person resources for businesses, property owners, and workplaces interested in installing EV chargers
    - d. Launch an Auto Dealership Awareness campaign - develop relationships with dealership associations, coordinate workshops and training sessions, provide
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promotional materials for dealerships to share with prospective EV consumers about the financial and environmental benefits of driving electric, and finally, offer awards and recognition to well performing dealerships/salespeople

2. Develop a public-facing, easy-to-navigate online information hub that provides San Franciscans with a central resource for EV incentives, cost comparison tools, charger locations, and information for companies and fleets

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### Extended EV Test Drives

1. Create a plan to provide EV experiences for various target segments/vehicle types (e.g., carshare/rental fleets, test drives, medium-/heavy-duty, etc.)
2. Contact dealerships and other potential partners to provide experiences/vehicles
  - a. Negotiate terms of extended test drive, including car models, timeframes, etc.
3. Contact community groups and other potential partners to reach targeted audiences
4. Implement a pilot program
5. Evaluate, adjust and extend programs

---

## Potential Barriers

- Consumer awareness, knowledge, and experience with EVs remains low, as is knowledge of available incentives (Jin & Slowik, 2017)
- Auto dealerships are largely misinformed and unmotivated to learn about how EVs work, how and where to charge them, and available incentives, resulting in poor consumer experiences and therefore, low sales volume (Cahill, Davies-Shawhyde, & Turrentine, 2014)
- Auto dealerships may be reluctant to dedicate time and resources without a guarantee that extended test drives will result in more sales volume

## Where We Are Now

It is well documented that consumer awareness is critical for growing the EV market. Consumers with greater knowledge or first-hand experience with EVs are more likely to consider buying an EV in the future. If prospective buyers lack a general understanding of what EVs are and the benefits they offer, the market will remain in the nascent stages (Kurani, Caperello, & TyreeHageman, 2016).

Thus, SF Environment staff are committed to educating the next wave of buyers on their benefits. They have been engaged in a wide variety of activities to promote an EV transition and have cross-promoted local ride-and-drive events with advocacy groups such as Charge Across Town, Plug-In America, Golden Gate Electric Vehicle Association, Center for Sustainable Energy (CSE), and 350 SF. These events are an effective way of drawing media attention and providing first-hand experience to potential EV consumers.

SF Environment staff have also partnered with 350 SF and the SF Public Library to lead EV 101 public workshops, which present prospective buyers with an overview of the EV market and in-depth



information about going electric; including, available local, state and federal financial incentives, and charging consideration. Staff are also coordinating with Electrify America's outreach team on its Cycle 2 investment for education, awareness, and marketing efforts.

Lastly, SF Environment has developed two key companion documents to the EV Ready Blueprint that outline a replicable communications and outreach strategy that can be scaled within

San Francisco and beyond:

1. The Public Engagement Plan identifies a clean mobility outreach and awareness campaign that strengthens and sustains the City's relationship with the community and ensures that the strategies and actions of the Blueprint are inclusive.
2. The EV Blueprint Playbook shares the City's experiences, best practices, and lessons learned on how to create an environment where EVs can thrive, no matter the size of the community. The Playbook was designed to be and adaptable, best practice starting point for any type of jurisdiction. It is a step-by-step guide for replicating the process of coordinating an EV working group, engaging the community, and developing an EV Ready Blueprint map.

## Where We're Going

### *Desired outcomes*

1. PUBLIC AWARENESS CAMPAIGN – Consistent, reliable and easily accessible messaging regarding EV information, which will deliver a steep increase in the uptake of EVs citywide
2. EV HELP DESK – Hire well-informed City-housed staff to seamlessly communicate with residents and organizations about electric mobility in San Francisco
3. EXTENDED EV TEST DRIVES – Confirmed partnerships with several community organizations and participating dealerships

Effective marketing is crucial to raising the profile of EVs not only in San Francisco, but nationally and internationally. Local governments are particularly well-positioned to facilitate this type of outreach and education, increase the visibility of EVs, and fast track their integration into the regional vehicle



market. SF Environment and its fellow City departments have extensive experience implementing engaging, innovative, and data-driven campaigns, including myriad SF Environment Zero-Waste campaigns and SFMTA's various educational campaigns.

The EV Blueprint implementation team will deliver a joint communications plan that will leverage existing market research, and segment and target both potential EV consumers and auto dealerships through an in-depth "discovery period" to understand the industry and its obstacles.

Market research will integrate findings from the Bay Area Air Quality Management District's (BAAQMD) Bay Area EV Acceleration Plan. This Plan will include detailed market surveys, focus groups, and interviews conducted in the Bay Area to understand the barriers to EV adoption and challenges to installing charging infrastructure. Surveys and focus groups will target low-income and multi-family dwelling residents, auto dealerships, property owners, fleet managers, and ride-hailing drivers in the Bay Area. This effort will fill in gaps and provide data sets across a diverse audience of potential EV users. It will inform San Francisco's policies, programs, marketing and incentive structures.



The work will also create a foundation for a San Francisco-specific campaign grounded in research. A range of platforms – online, print and social media – will be used and SF Environment may contract with a web design and marketing firm to design, build, and maintain the website.

Campaign messaging will be consumer-friendly and help San Franciscans see themselves in the "electric future" of motorized transportation. Resources will be regularly updated to provide answers for those looking for to make an informed decision; whether about buying an EV, installing charging infrastructure, or how to properly charge an EV.

Another key component will be to engage auto dealerships through an Auto Dealership Awareness campaign, as well as an extended test drive program, which offer consumers the opportunity to simulate the experience of owning an EV. A typical test drive gives a prospective buyer limited information about a vehicle. The extended test drive experience allows a buyer more time to evaluate whether an EV is a viable option.

SF Environment will partner with other Bay Area jurisdictions to develop public-private partnerships with auto dealerships and community groups to facilitate a seamless experience. After selecting dealerships to participate, SF Environment and community groups will promote these opportunities. Potential customers will be funneled to auto dealerships, which will provide the vehicles. Ideally, a

customer will simply be able to sign up for an extended test drive, schedule a time that suits their schedule, and pick up the EV from the dealership.

For successful public engagement, the City needs a full-time staff member. In addition to the test drive program and engagement plan, this staff member will also manage and direct the communication and outreach strategy. This staff will be responsible for implementing the communication plan, coordinating the website development project, creating consistent messaging and educational material, developing content for targeted marketing campaigns, fostering public/private partnerships, and staffing the EV Help Desk with the main objective of clarifying and simplifying the complex EV landscape in San Francisco. This staffer will provide technical assistance to public and private sector stakeholders regarding EV incentive programs, selecting and siting charging stations, and facilitating relationships between charging station installers and property owners.

## **Key Deliverables**

1. Staffing for Help Desk
2. Communication plan
3. Website with EV info and resources
4. Educational and promotional materials (posters, handouts, etc.) for dealerships and City agencies

## 2. Transportation Demand Management

*Evaluate how electrification goals are aligned with the TDM programs and policies.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
CPC, SFMTA, SFCTA	SF Environment	Long-Term

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Tasks
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1. Evaluate current TDM policy, program and goals; electrification goals and vision; and identify conflict areas
2. Develop approaches to align conflicts
3. Draft recommendations for program integration and alignment

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### Potential Barriers

- Possible conflict between TDM programs and policies and transportation electrification goals and vision
- Impact of EV electrification on other objectives of TDM programming (i.e., parking maximums, mode shift, etc.)

### Where We Are Now

Transportation Demand Management (TDM) is a web of policies, programs, information, services, and tools that, along with transportation infrastructure and operations, supports the use of sustainable modes for all trips. The goal of TDM is to help households, employees, and visitors make more of their trips on transit, by bike or on foot, or in shared vehicles like taxis and carshares; and thus, reduce the need for car ownership and trips in single-occupancy vehicles (SOV). Not only do TDM strategies reduce congestion, they increase the use of existing services and generally result in cost savings to companies and individuals.

TDM strategies provide easy to understand information about all travel choices, use marketing and incentives to shift trips to more sustainable modes, influence land use to improve viability of sustainable modes and use market pricing to balance transportation demand.

San Francisco's Planning Department (CPC), SFMTA, County Transportation Agency and SF Environment partner to advance TDM areas of: land use and policy coordination, citywide parking demand management, and customer-oriented travel choice marketing, education and outreach. SFMTA and SF Environment meet monthly to discuss the nexus of climate and transportation goals and how programs like TDM and electrification strategies can best be aligned to meet these goals.



## Where We're Going

### *Desired Outcomes*

1. A list of potential alternatives to integrate electrification goals and vision into TDM strategies, communications and incentives.
2. Strategies to electrify that do not conflict with TDM program goals

As TDM policies and services are fundamentally intended to reduce the need to rely on SOV trips and reduce households' need for car ownership, there are significant challenges associated with aligning electrification goals to them. While recognized as a potential opportunity area, other actions in the EV Blueprint have greater potential in advancing electrification. Therefore, this action is considered a long-term action. To advance in the future, this project will need to evaluate the extent to which the EV Blueprint's strategy and actions for electrification are aligned or conflict with TDM programs and policies.

## **Key Deliverable**

1. Recommendations that address conflicts between the TDM program and electrification program

### 3. Wayfinding

Develop wayfinding/branding and signage standards/guidelines for EV charging infrastructure

Action Lead(s)	Supporting Department(s)	Action Timeframe
SFMTA	SF Environment	Long-term

#### Tasks

1. Review EV charging standards and best practices for signage
2. Assess current wayfinding programs and efforts in San Francisco and determine integration opportunities for EV charging infrastructure
3. Analyse the effectiveness of physical signage and how it can complement web and technology-based services and wayfinding tools
4. Develop inventory of current network signage variations
5. Provide recommendations to establish San Francisco’s network guidelines across site locations and ownership models, charging equipment manufacturers and other siting factors

#### Potential Barriers

- Varying property ownership of current/future EV charging sites and infrastructure and wayfinding techniques
- Varying and evolving charging equipment manufacturers, and therefore, associated branding
- Cost of implementing signage may be a financial burden for charging station providers, site owners, or the City
- Diversity of wayfinding and information needs across different user groups
- Lifecycle replacement and maintenance costs
- Need to be consistent with relevant polices, principles across the city



#### Where We Are Now

In mid-2018, SFMTA completed a preliminary literature review regarding standards and best practices for EV charging signage and wayfinding. To date, no additional work has been done and more detailed planning is required relative to a citywide charging network.

#### Where We’re Going

*Desired Outcomes*

1. Increased visibility and improved navigation and access to the citywide EV charging infrastructure network for all users
2. Increased demand and use of EV charging infrastructure

Increasing awareness of and access to publicly accessible EV charging infrastructure will continue to be critical components of charging related strategies. This action is dependent on advances in other areas such as the EV Charging Masterplan and creating a robust Charging Infrastructure (municipal; privately-owned publicly accessible etc.) It has therefore been identified as a long-term action, no work has currently been scoped for this action.

As the publicly accessible charging infrastructure network in San Francisco is further developed, SF Environment will review alternative and draft recommendations suitable for the network. Staff may conduct analyses to determine the most effective approach for wayfinding techniques that provide easy to navigate information regarding public EV charging locations. The recommended approach should include the identification of the parties responsible for sign and technology maintenance. Recommendations should also include the identification of lifecycle replacement funding.

## Key Deliverables

2. Literature review highlighting best management practices
3. Recommendations regarding implementation and next steps (e.g., development of design guidelines)



STRATEGY B:

## Incentives



**Create a preference for electric mobility over gasoline and diesel vehicles**

### ACTIONS

1. EV Purchase/Lease Incentive
2. EV Lane Access
3. Airport Incentives
4. Low-Emission Zones and Car-Free Corridors
5. Transportation Pricing Strategies
6. EV Charging Rates

# 1. EV Purchase/Lease Incentive

*Develop citywide incentive program for qualified individuals to purchase or lease EVs.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
ENV	N/A	Long-term

**Tasks**

1. Review and analyze regional, state and federal incentives
  - a. Assess incentive programs
  - b. Assess potential need for additional incentive programs in coming years based on existing program end dates
2. Evaluate policy options
3. Evaluate potential incentive program’s budgetary needs
4. Conduct legal review and cost/benefit analysis
5. Assess staffing needs to administer an incentive program

## Potential Barriers

- Lack of capacity in City budget for incentive program
- Lack of capacity for staff to administrate incentive program
- Potential unintended consequence of incentive program resulting in more personal vehicles operating on city roads and increasing congestion

## Where We Are Now

SF Environment staff tracks available EV incentive regional, state and federal programs and assist residents, businesses and property owners in understanding and taking advantage of these programs. Staff also meet with program administrators, such as the California Air Resources Board (CARB), the California Public Utilities Commission (CPUC) and California Energy Commission (CEC), and BAAQMD to provide feedback and recommendations on upcoming incentive programs.



## Where We're Going

### *Desired Outcomes*

1. Maintained EV affordability relative to ICE vehicles, especially for lower-income individuals

Developing a citywide incentive program for choosing to purchase and/or lease an electric over an ICE vehicle could prove to be critical for many San Francisco residents, particularly lower-income populations. Currently available incentive programs have expiration dates and other factors, such as incentive reduction timelines. Additional incentive programs will need to close the gap in cost parity between EVs and ICE vehicles, as parity is not expected to be achieved until the early- to mid- 2020s at the earliest (BNEF, 2019).

Staff will need to evaluate all options to bridge this gap, including both policy and incentives analyses with equity issues being of utmost importance. City staff will also need to assess the City's budget to determine the feasibility of funding and staffing the administration of an incentive program. Finally, staff will need to understand the legal aspects of the City administering such a program.

### **Key Deliverables**

1. Policy and program recommendations for a City incentive program
2. Budget proposal

## 2. EV Lane Access

Collaborate regionally to evaluate EV lane policies on managed lanes.

Action Lead(s)	Supporting Department(s)	Action Timeframe
SFCTA	Regional Transportation Agencies	Near-term

### Tasks

1. Analyze existing lane access policies
  - a. Assess existing and proposed Bay Area policies
  - b. Assess existing and proposed policies in other California cities
2. Participate in development of coordinated regional lane access policy
  - a. Collaborate with regional and local transportation agencies
  - b. Evaluate incentives for carpooling, transit, and other high-occupancy trips
  - c. Evaluate incentives for clean air vehicles (CAV), such as EVs
3. Advance San Francisco priorities in regional lane access policy
  - a. Collaborate with regional transportation agencies on regulation

### Potential Barriers

- Political and stakeholder support
- Unintended transportation and congestion impacts on affected and adjacent routes
- Enforcement challenges

### Where We Are Now

SFCTA has worked with regional partners to develop a coordinated plan to charge CAVs, such as EVs, a discounted toll. While there is not yet a set regional policy, coordination between SFCTA and the other operators has coalesced around a 50% discount for CAVs. Charging CAVs a toll, but with a significant discount, is intended to balance the desires of the legislature to encourage adoption of these vehicles while maintaining priority, reliability, and travel time incentives for carpooling, transit, and other high-occupancy trips.



## Where We're Going

### *Desired Outcomes*

1. Strong incentives for incoming commuters to switch to transit, carpooling, or electric modes
2. Increase in EV share of commute vehicles within a decreased overall number of commute trips in personal vehicles



SFCTA will continue to collaborate with regional partners such as the Metropolitan Transportation Agency/Bay Area Infrastructure Financing Authority, Alameda County Transportation Commission, and Valley Transportation Agency to coordinate, implement, and regulate a coordinated tolling policy. The process of implementing a coordinated discount toll policy for CAVs will begin in the South Bay Area this summer, with implementation in the East Bay Area planned by 2020.

Caltrans is required to consider the option of excluding CAVs from standard carpool lanes if the lanes are consistently operating below 45 mph. In addition, state and federal authorization to permit CAVs in carpool lanes (which also mandates a discounted toll for CAVs at bridges with high occupancy vehicle discounts and in express lanes) expires September 30, 2025 if no additional action is taken by both jurisdictions, with a federal extension being a prerequisite for a state extension. SFCTA will continue to monitor this situation closely.

## Key Deliverable

1. Coordinated regional lane access policy for CAV discount

### 3. Airport Incentives

Evaluate incentives (pricing and priority access) for EVs on SFO roadways, in queues and in parking facilities.

Action Lead(s)	Supporting Department(s)	Action Timeframe
SFO	SF Environment	Long-term

#### Tasks

1. Identify opportunities in landside operations to incentivize or prioritize zero emission vehicle access to SFO roadways, queues and parking structures for travelers, employees, and transportation providers (shuttles, taxis, TNCs)
2. Evaluate policy options
3. Evaluate potential incentive program's budgetary needs

#### Potential Barriers

- Potentially limited capacity in SFO budget for incentive program
- Potentially limited capacity to administer an incentive program
- Potential unintended consequences of increased congestion at SFO

#### Where We Are Now

SF Environment staff work closely with SFO staff to evaluate opportunities to increase the use of zero emission vehicles and ground support equipment. Staff assists SFO in developing and reviewing documents that achieve this end, including the draft *SFO Zero Emission Vehicle Readiness Roadmap*. SFO's *Roadmap* will support SFO's Master Utilities Infrastructure Study, which identifies opportunities to increase EV and ground support equipment charging throughout the facility.

#### Where We're Going

##### *Desired Outcomes*

1. Policies and incentives that prioritize zero-emission transportation over traditional internal combustion vehicles.



SF Environment staff will continue to advise SFO staff in developing the airport's *ZEV Readiness Roadmap*. Staff will continue to evaluate potential incentive programs for EVs on SFO roadways and parking facilities. It will be important to consider what leverage and authority the airport can enforce over pickups, drop-offs, short-term parking and long-term parking to create policies and/or incentives that make EVs a more affordable and more convenient option for airport related travel than ICE vehicles, while simultaneously encouraging public transit options above all others.

## Key Deliverable

1. Budget, administrative capacity analysis, legal requirements and limitations, and cost/benefit analysis based on the final SFO Zero Emission Vehicle Readiness Roadmap

## 4. Low-Emission Zones and Car-Free Corridors

*Pilot and evaluate extending the use of low-emission/car-free zones in sensitive areas.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
SFMTA, SFCTA	SF Environment	Long-term

### Tasks

1. Review of best practices in other cities
2. Develop scenarios and alternatives
3. Develop public outreach and engagement strategy
4. Develop criteria for zone identification
5. Model emission savings, health and congestion impacts of various scenarios
6. Draft memo with recommendations
7. Develop, implement pilot(s) projects
8. Evaluate pilot(s)

### Potential Barriers

- Political and stakeholder support
- Unintended transportation/congestion impacts on adjacent routes.
- Enforcement challenges

### Where We Are Now

Muni operates the greenest fleet of any major city in North America. Carrying 26% of all daily trips in San Francisco, Muni generates less than 1% of the city's GHG emissions (and less than 1% of the city's transportation sector GHG emissions). SFMTA is slated to launch its new Green Zone program in 2019. This program will be the first of its kind and represents an on-going effort to reduce GHG emissions, as the agency looks to transition to EVs by 2035.

Green Zones: The purpose of the Green Zone program is to provide geographic areas of San Francisco where the entire SFMTA system operates on electricity. It takes advantage of the latest battery technologies to convert SFMTA's fleet of hybrid electric buses into part-time electric buses as an intermediate stop gap until full fleet electrification. With this new innovative technology, buses will be able to run up to 1/3 or their route on pure battery electric power. These vehicles are equipped with the latest high capacity batteries and a GPS-enabled switch that will automatically deploy as the vehicle enter geo-fenced areas (Green Zones) throughout the city. The criteria by which the agency. The zones were established stakeholder input and will focus on Muni Equity Strategy neighborhoods, areas with poor air quality and will consider other operational factors, such as topography. Muni has



identified four Equity Strategy neighborhoods, two residential neighborhoods and seven bus routes for initial implementation.

The program is expected to result in several operational and summative benefits including the replacement of aging buses, more comfortable rider experience, improved air quality in areas most impacted by transportation emissions, and critical intermediate step towards net zero emissions.

Car-Free Zones: In addition to Muni's Green Zone Program, SFMTA is a city sponsor for the temporary street closure program known as Sunday Streets—once-a-month car-free occasions to promote healthy lifestyles and enjoyment of public spaces and streets, increasing overall health and quality of life for San Franciscans and visitors. The Sunday Streets season runs March through October spanning 10 events throughout the city. In some areas of the city, Sunday Streets programs occur year-round, like weekly Sunday street closures through parts of Golden Gate Park. To further improve air quality in areas particularly burden by transportation related emissions, it is possible to explore opportunities to expand the Sunday Streets program, formalize various closures or introduce road restriction pilots based on vehicle emissions

## Where We're Going

### *Desired Outcomes*

1. Implemented low-emission or GHG-free zones in strategic parts of the City

Muni's Green Zone program to fully electrify transit will be a priority. While planning and tasks related to the development of Clean Air Zones and implementation of a pilot zones have been deemed long-term actions that are not currently resourced, the below highlights ways in which this action could advance. Staff from SFMTA and SF Environment could review of best practices in other cities; understanding various restriction scenarios and overall outcomes. Staff could develop public outreach and engagement strategy to socialize concept, understand public needs, and to develop criteria for zone siting. Staff could also conduct various scenario modeling to determine locations and policies with most emission saving, public health and congestion management potential. Staff would include scenarios that look at options for ZEVs.

## Key Deliverables

1. A memo with recommendations and programmatic framework for "green zones"
2. Implementation of pilot zone(s)
3. Pilot evaluation and zone policy and program recommendations

## 5. Transportation Pricing Strategies

*Evaluate transportation pricing strategies, such as congestion charges, vehicle miles traveled pricing, fuel pricing, and tolling that base fee structure on the emission factors of vehicles.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
SFCTA	SFMTA	Near-term

### Tasks

1. Review best practices in other cities, such as New York
2. Review 2010 Mobility, Access, and Pricing Study recommendations
3. Review 2016 Treasure Island Mobility Management Plan
4. Complete Downtown Congestion Pricing Study
5. Make equitable transportation pricing policy recommendations
  - a. Consider discounts for low-income travelers
  - b. Consider pricing strategies that benefit EV drivers over gas and diesel vehicle drivers
6. Implement and regulate new policies

### Potential Barriers

- Political and stakeholder consensus around geographic boundaries, complementary policies, fee exemptions, and ongoing adjustments may be challenging.
- Transportation pricing strategies typically rely on an electronic cashless technology and households that do not have digital banking capabilities may be unable to set up toll accounts, which may exclude them from use of these facilities.

### Where We Are Now

In 2010, the SFCTA completed its Mobility, Access, and Pricing Study, which considered a discount policy for low-emission vehicles, but the final recommendation of the study did not include such a policy. The SFCTA is now in the startup phase of its Downtown Congestion Pricing Study, which will identify which of the 2010 recommendations should be reconsidered and which should remain in a new set of recommendations. This study will also consider pricing policies, incentives, discounts, subsidies, and multimodal investment for the downtown area.

Also, in 2016, the Treasure Island Mobility Management Agency (TIMMA) adopted toll policies on direction, eligibility, and high occupancy vehicle definition recommended in the Treasure Island Mobility Management Plan. TIMMA's toll policy, however, does not currently discount or exempt EVs. The SFCTA plans to bring revised policy on this topic to its Board in mid-2019.

## Where We're Going

### Desired Outcomes

1. Easy to understand and consistent price signals for road use that make transit, carpooling, or electric modes more affordable and more convenient to use than gas or diesel vehicles

Moving forward, the SFCTA will continue to develop its Downtown Congestion Pricing Study, which is scheduled for an 18-month timeline, with a completion date in mid-late 2020 (SFCTA, 2017). The SFCTA will then make policy recommendations based on this study and a review of the 2010 Mobility, Access, and Pricing Study recommendations. The SFCTA will also work with TIMMA to potentially implement its recommendations to revise policy from the 2016 Treasure Island Mobility Management Plan. Once new policies are put in place, the SFCTA will collaborate with the SFMTA to implement and regulate the new policies.



Figure 6. 2017 PM Peak Roadway Level-of-Service from SFCTA's Congestion Management Program

## Key Deliverables

1. Downtown Congestion Pricing Study
2. Policy recommendations for transportation pricing strategies

## 6. EV Charging Rates

*Develop program that makes residential and public Level 2 and fast charging more affordable and recognizes the time-of-day impact of EV charging on the grid, including alternative rate structures for residential, public and commercial customers.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
SFPUC	SF Environment, PG&E, SFMTA, RPD, Port, SFO	Near-term

### Tasks

1. Develop residential EV electricity rate structures for PG&E customers
2. Implement residential EV electricity rate structures for PG&E customers
3. Develop residential EV electricity rate structures for CleanPowerSF customers based on PG&E's rate structure
4. Implement residential EV electricity rate structures within CleanPowerSF customers
5. Track progress of PG&E's proposed changes to commercial EV electricity rate
6. Develop new commercial EV electricity rates for CleanPowerSF customers based on PG&E's new rate structure
7. Implement new commercial EV electricity rate structures for CleanPowerSF customers
8. Develop new residential and commercial EV rates for Hetch Hetchy customers, including municipal departments, tenants of city-owned property and locations where SFPUC is the public power provider

### Potential Barriers

- PG&E non-bypassable charges continue to be barriers to implement similar rate structures for CleanPowerSF customers
- Hetchy customers being served through the Wholesale Distribution Tariff face interconnection constraints imposed by PG&E

### Where We Are Now

Both utilities serving San Francisco, PG&E and SFPUC (through Hetchy and CleanPowerSF programs), have already established alternative rate structures for residential customers who own EVs. PG&E offers two EV rate plans. One combines the EV's electricity costs with those of the residence. The other involves the installation of another meter, which separates the EV's electricity costs from those of the residence. Both are non-tiered, time-of-use plans. CleanPowerSF's EV rate plan is also non-tiered, time-of-use plan that combines the EV's electricity costs with those of the residence.

PG&E is now proposing a new alternative rate plan for commercial EV owners to the CPUC. CleanPowerSF will likely emulate this rate plan for its commercial customers as well. If PG&E's new commercial rate plan is approved by the CPUC, both PG&E and CleanPowerSF would then begin to implement the new rate plans.

## Where We're Going

### *Desired Outcomes*

1. Consistent, affordable (compared to fueling with gasoline/diesel) EV charging rates for all vehicles, whether in private residences (including MUDs) and commercial buildings or public Level 2 and fast chargers.
2. Rate plans that allow EVs to leverage excess renewable electricity supply on the grid.



## Key Deliverables

1. Documentation of alternative rate structures for PG&E residential and commercial customers
2. Documentation of alternative rate structures for CleanPowerSF residential and commercial customers

## STRATEGY C:

# Charging Infrastructure



**Ensure that charging infrastructure for EVs is available and convenient for all residents, businesses, and visitors.**

## ACTIONS

1. City-Owned Parking Facilities
2. Privately-Owned Facilities
3. Off-Street EV Charging Masterplan
4. Curbside Charging
5. Workforce Training
6. EV Charging Experience



# 1. City-Owned Parking Facilities

*Expand publicly accessible charging infrastructure in City-owned parking garages and lots.*

Action Lead(s)	Supporting Department(s)
SFMTA, SF Environment, RPD, Port	SFPUC, RED, CPC, SFCTA, DPW, PG&E

Key Outcomes	Timeline
Municipal Parking Asset Assessment	Near-Term
Electric Mobility Project Framework	Near-Term
Interdepartmental EV Task Force	Near-Term
Port Request for Qualification	Near-Term
Garage Parking Policy	Long-Term

## Tasks

### Municipal Parking Asset Assessment

1. Conduct baseline assessment of municipal parking assets
  - a. Inventory spatial distribution, facility capital assets and parking capacity
  - b. Assess electrical capacity, electrical demand, parking utilization and existing EV charging stations
2. Analyze utilization trends of existing EV charging stations
3. Conduct condition assessment of municipal parking infrastructure and parking capital assets
  - a. Assess financial, electrical service, spatial and accessibility constraints
  - b. Develop site prioritization criteria and identify locations in which to invest
  - c. Develop capital improvement recommendations to maximize use and value
  - d. Develop investment strategy and conceptual designs for priority sites
4. Model scenarios of future supply and demand for charging in these facilities
  - a. Define modeling factors and assumptions
  - b. Project future need for publicly available EV charging stations
5. Conduct stakeholder engagement with charging station providers, utilities, local policy makers and CBOs
  - a. Identify stakeholders' barriers and bottlenecks to installing charging stations in municipal facilities
6. Develop a standardized process for procurement and contracting with charging network providers.

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### Electric Mobility Project Intake Form

1. Identify municipal parking garages and lots to include as options for potential projects
2. Develop questions project proposals should answer and requests for project details
3. Develop project proposal evaluation criteria
4. Determine process for accepting, evaluating and making recommendations on project proposals

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### Interdepartmental EV Task Force

1. Convene EV charging installation project Task Force of relevant City agency/department staff
  - a. Identify departments/agencies involved in EV charging installation projects
  - b. Identify roles and responsibilities of each department/agency
  - c. Establish procedure for guiding EV charging installation projects through "conception to construction" process
  - d. Obtain participation commitments from specified staff within each department/agency
2. Organize and facilitate Task Force meetings
3. Identify solutions to barriers for EV charging installation, including electrical infrastructure limitations
  - a. Identify barriers to projects, when applicable
  - b. Assign projects to appropriate Task Force staff based on barrier to be solved
  - c. Work with utilities to solve for electrical infrastructure limitations, when applicable

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### Port Request for Qualifications (RFQ)

1. Identify Port properties to include in RFQ
2. Determine types of projects to call for and identify priorities
3. Determine RFQ response evaluation criteria
4. Determine process for accepting, evaluating and making recommendations on RFQ responses

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### Garage Parking Policy

1. Analyze various business models for expanding and maintaining a public charging network in off-street municipal parking facilities
    - a. Identify pros and cons of ownership, business, and operational models
    - b. Identify financing plans for charging network including private and public investment
    - c. Conduct risk assessment of various public private partnership models including assessment of contract requirements and conditions
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2. Develop parking and charging pricing and enforcement strategies
    - a. Inventory and review relevant parking policies and procedures related to: taxes, rates, service requirements, vendors, operations and maintenance
    - b. Conduct case studies of relevant policies in other cities
    - c. Assess financial impacts of various policies and strategies on operations and users
  3. Develop preferred operations plan
    - a. Develop partnership model based on business model analysis
    - b. Develop parking and charging pricing and enforcement strategies
    - c. Develop and implement pilot framework to determine efficacy of operations plan and pricing and policy tools
- 

## Potential Barriers

- Site constraints (electrical infrastructure limitations, physical/structural, financial etc.)
- External grid capacity constraints.
- Community needs and engagement challenges
- Impact on parking revenue/other revenue streams to the City
- Capacity to implement a consistent process across City departments
- Uncertainty of available policy levers (e.g., tax, building code, etc.)
- Impacts of incentive programs on EV market, adoption, equity
- Fiscal impacts of recommendations
- Implications of strategies on broader transportation system
- Community issues and concerns

## Where We Are Now

The SFMTA owns and manages a diverse network of parking facilities. A number of these off-street parking facilities currently have excess capacity. The SFMTA has conducted a baseline analysis of municipal parking assets which inventoried the spatial distribution and parking capacity of the sites as well as use trends of existing EV charging infrastructure. This analysis informed a preliminary set of criteria of priority locations. It is important for the City to invest in EV charging in off-street parking facilities before on-street parking locations so that these assets can be used most effectively as the transportation sector continues to evolve.

SFMTA has scoped a planning process that will assess the current and potential future uses of these facilities. This study will enable the SFMTA, and the City, to better leverage parking facilities and align parking operations with transportation, sustainability and equity policies and goals. As urban mobility rapidly evolves, parking facilities have the potential to play an even more critical role in the city's dynamic multi-modal transportation system. Furthermore, they have the potential to significantly shape electrification of the transportation sector. It is critical to understand how these facilities are operated and which policies, tools and levers can be employed to effectively partner, price and enforce desired utilization outcomes.

The City has determined that SFMTA sites, along with locations managed by other City agencies, are well-suited for the development of a citywide charging network. Thirty-eight municipal parking facilities are going to be made available for project proposals from private developers to install EV charging equipment. The SFMTA, in partnership with SF Environment, Rec and Park and the Mayor's Office, have developed an Off-Street Electric Mobility Project Framework which the City will use to ensure that project proposals align with transportation principles and policies and help strategically electrify the transportation sector.

The Framework provides an operational approach for building partnerships and enabling electric mobility projects in off-street garages and lots. It establishes a vision for electric mobility projects consistent with transportation and climate goals; establishes consistent principles and criteria against which projects are evaluated; defines four electric mobility project typologies; and defines a process to guide electric mobility projects as they progress through processes from intake and review to construction and monitoring.

In addition to the Framework, SF Environment staff have developed an interactive map (see "Off-Street EV Charging Masterplan"), inventorying available off-street municipal parking facilities and are scoping the development of a citywide EV Task Force which would support interagency coordination on projects approved through the Framework. The Task Force will be built out from the EVWG Subcommittee and will serve as a forum for expedited project delivery, troubleshooting projects, sharing lessons learned and providing updates. It will align processes across agency jurisdictions to further streamline project implementation and will be made up of key representatives of agencies managing off-street facilities.

SFMTA staff, with assistance from SF Environment, has already developed the Electric Mobility Intake Form and a dedicated website to collect responses from EV charging station providers regarding potential projects in the identified list of City-owned parking garages and lots. Many of these are operated by SFMTA, but some are operated by Rec and Park Department and the Port. The Port is going through an RFQ process rather than using the Intake Form. It has already developed its RFQ and will release it in the very near future. The Intake Form will also be released very soon. SFMTA and SF Environment collaborated on the evaluation criteria for Intake Form responses, while the Port has developed its evaluation criteria for RFQ responses.

Between the Port RFQ and the Intake Form for garages and lots operated by SFMTA and the Rec and Park Department, the City will vastly increase its publicly available charging network. These facilities are spread across the city and should therefore result in a more geographically equitable charging network.

Finally, the City has long used pricing mechanisms and enforcement strategies to influence travel behavior, which can help to ensure better access and mobility for people of all incomes with diverse transportation needs and result in more desirable economic, social and environmental outcomes. For example, in 2017, San Francisco implemented demand-responsive parking pricing. By periodically adjusting meter and garage pricing to match demand, the City is better able to manage parking availability, which encourages people to park in underutilized blocks and garages, opening spaces

in busy areas and at busy times. Similar strategies could be applied to municipal off-street parking facilities to foster utilization of a variety of electric mobility options. Additionally, as the City prioritizes municipal off-street parking facilities for publicly accessible charging infrastructure, pricing and enforcement strategies will need to be employed to ensure the greatest utilization, influence charging behavior and encourage electric mobility adoption.

## Where We're Going

### *Desired outcomes*

1. MUNICIPAL PARKING ASSET ASSESSMENT – Conduct baseline and condition assessment of municipal parking assets and plan for future scenarios
2. ELECTRIC MOBILITY PROJECT INTAKE FORM – Develop Intake Form for private sector organizations to submit electric mobility project proposals for identified municipal parking assets
3. INTERDEPARTMENTAL TASK FORCE – Develop Task Force consisting of identified staff members of City departments and agencies necessary to streamline EV charging projects through the various City approval and permitting processes
4. PORT REQUEST FOR QUALIFICATIONS – Publish RFQ for EV charging projects at identified Port of San Francisco properties
5. GARAGE PARKING POLICY – Evaluate municipal parking pricing and enforcement strategies and develop recommendations that support transportation electrification and operations of off-street charging infrastructure network

A condition assessment of each off-street parking facility will need to be conducted to properly inform future decision points when one asset may be reaching a critical state of good repair, and to inform revenue generation, and alternative uses. The condition assessment will look across various facility sub-assets such as plumbing, electrical, HVAC etc. Specific to the feasibility of future EV charging infrastructure investment, the assessment will look at current electrical demand, excess capacity and state of equipment to determine the feasibility of various expansion scenarios. This planning process will also include risk assessments based on condition assessment findings, near and long-range visioning regarding alternative uses, near-term operational recommendations and long-term capital investments and will engage the public and stakeholders. Finally, the findings will inform capital improvement recommendations, investment strategies and conceptual designs for priority sites.

Simultaneous to site feasibility determinations, work will need to be done to ensure that the operational approach to advancing installation projects is coordinated, streamlined and effective. Therefore, implementation of the Off-street Mobility Framework will be critical. This will include engaging critical stakeholders to identify barriers and bottlenecks to installing charging stations in municipal facilities, developing procurement and contracting mechanisms for partnering with charging network providers, and implementing the EV Task Force to guide EV charging installation projects through the various City approval and permitting processes. Public outreach and engagement will be critical across all phases of this work.

To advance a Garage Parking Policy for San Francisco, the City will need to conduct research and analyses to determine the appropriate path for operations. This work will include analyzing various business models for expanding and maintaining a public charging network in off-street municipal parking facilities, which would include identifying the pros and cons of ownership, business, and operational models and alternatives and identifying financing plans for a charging network including private and public investment. The City would also need to know the risk associated with alternative public-private partnership models and establish baseline contract requirements and conditions. Simultaneous to establishing ownership and operation models the city would need to develop parking and charging pricing and enforcement strategies, including researching relevant parking policies, procedures, and best practices in other cities. Findings from this research would inform the development of a preferred operations plan, which would include a partnership model, parking and charging pricing and enforcement strategy recommendations and a pilot framework to determine efficacy of an operations plan and pricing and policy tools.

## Key Deliverables

1. A strategy document that includes: condition assessments for each site, capital improvement recommendations, investment strategy and conceptual designs for priority sites.
2. EV Task Force member list and charter
3. Commercial Parking Facility Ordinance
4. Electric Mobility Framework and Project Intake Form
5. Port RFQ
6. EV charging infrastructure projects across several municipal locations
7. Recommendations regarding parking policies and pricing strategies which includes considerations for electric mobility and an operational model for the management of an off-street charging network in municipal facilities



## 2. Privately-Owned Facilities

*Accelerate deployment of charging stations in privately-owned, publicly accessible parking garages and lots, and identify a pathway to electrify existing MUD parking.*

Action Lead(s)	Supporting Department(s)
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SF Environment, Mayor’s Office

SFPD, CPC, SFPUC, PG&E

Key Outcomes	Timeline
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Commercial Parking Facility Ordinance

Near-Term

MUD Charging Pathway

Long-Term

### Tasks

#### Commercial Parking Facility Ordinance

1. Develop inventory of existing parking facilities
  - a. Identify geographic location, parking capacity, and existing EV charging stations
2. Conduct outreach to property owners and managers, EV charging station providers, utilities, and community-based organizations (CBO)
  - a. Identify stakeholders’ barriers to installing charging stations in existing facilities
3. Identify factors that determine a qualified facility or make a facility exempt from the policy (rules and regulations)
  - a. Consider minimum parking capacity, maximum installation requirements, financial burden limitations, etc.
4. Implement and regulate the policy
  - a. Identify exemption approval authority (ENV) and process
  - b. Identify enforcement authority (SFPD) and process

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#### MUD Charging Pathway

1. Identify demand, adoption hurdles and technical solutions
    - a. Leverage existing CSE study conducted on San Francisco MUDs
  2. Conduct a comparative analysis and develop a list of possible actions
  3. Develop target property database of MUDs that exhibit relatively high latent EV demand and low projected installation costs
    - a. Leverage EV Blueprint Mapping Tool
  4. Evaluate the fiscal impact for property owners and residents
  5. Develop policy recommendations and a pathway for implementation of pilot programs
-

## Potential Barriers

- Resistance from property owners and managers
- High infrastructure, operation, and maintenance costs, as well as siting challenges for commercial and MUD garage operators
- Restrictive facility configurations, including metering issues or locational constraints between the electrical service and a desired charging location; could limit the siting possibilities for charging infrastructure
- Spatial and cost limitations of meeting accessibility requirements
- Variance in parking space sizes and orientations across commercial and MUD parking facilities
- Underground parking facilities may not be able to provide reliable communications for networked EV supply equipment because the surrounding structure blocks wireless signals
- General lack of education and understanding of technology, available incentives, or process for getting started

## Where We Are Now

In 2017, the late Mayor Ed Lee signed the EV Readiness ordinance to help San Francisco meet the growing demand for EV charging and continue the City's forward-thinking leadership on climate change (SFBOS, 2017). The goal of this ordinance is to prepare the City's building stock for upcoming EV market growth and reduce the cost and hassle to provide EV chargers to residents, employees, employers, and property owners. The law went into effect January 2018 and requires new residential, commercial, and municipal buildings, as well as major retrofits, to provide electrical capacity and infrastructure such that the project will be capable of providing EV charging services at 100% of parking spaces.

All new residential and commercial buildings must configure 10% of parking spaces to be "turnkey ready" for EV charger installation, and an additional 10% to be "EV flexible" for potential charging and upgrades. The remaining parking spaces must be "EV capable" by ensuring conduit is run throughout the entirety of the parking garage to avoid future cost barriers and maximize the opportunity for future expansion. It's important to note that this ordinance ensures flexibility to add chargers as needed and does not change parking requirements or create new parking.

SF Environment staff worked with CPC staff to develop an inventory of privately-owned, publicly accessible parking garages and lots throughout the city. This inventory includes data on each facility's geographic location, parking capacity, and existing EV charging stations, if applicable.

SF Environment staff have also worked with the Mayor's Office, as well as staff from SFMTA, Rec and Park, and the Port to develop the foundation for an ordinance that would require the installation of charging stations in many of these buildings. The ordinance, once finalized, may require all new and existing publicly accessible parking facilities (privately and publicly owned) with 100+ parking spaces to install charging stations in at least 10% of the spaces, with some exemptions regarding electrical capacity, spatial capacity and cost burdens.

## Where We're Going

### *Desired outcomes*

1. COMMERCIAL PARKING FACILITY ORDINANCE - Develop and implement policy to accelerate deployment of charging stations in commercial parking garages and lots in an equitable and responsible way
2. MUD CHARGING PATHWAY - Identify an effective pathway to electrify existing parking spaces in MUDs

Moving forward, SF Environment staff will be responsible for drafting the final language of the ordinance, as well as implementing and regulating the ordinance. CPC staff will have an important role in identifying the existing and future facilities that will be impacted by this legislation. SF Environment staff also need to work with SFPUC, San Francisco Police Department (SFPD), PG&E and EV charging station providers when regulating the ordinance based on the qualifications and exemptions.

To develop this ordinance in an equitable way, SF Environment will need to conduct extensive outreach to the affected parties to ensure the rules and regulations of the ordinance do not place unreasonable burdens on these parties. They will also need to conduct analyses to ensure that charging stations are deployed where they are needed most, and to ensure that no communities in the city are left out of the benefits of increased charging station deployment.

### **Key Deliverables**

1. Detailed inventory of existing privately-owned, publicly accessible parking facilities
2. Map of existing facilities, charging stations and EV registrations
3. New construction tracking document
4. Local ordinance requiring charging station installations in commercial garages and lots
5. Pilot framework and inventory of MUDs

### 3. Off-Street EV Charging Masterplan

Develop a masterplan to establish a citywide publicly available EV charging network, including fast charging hubs, to meet current and future demand. This masterplan will leverage findings from the EV Blueprint Mapping Tool.

Action Lead(s)	Supporting Department(s)	Action Timeframe
SF Environment	Google, SFMTA, RDP, Port	Near-term

#### Tasks

1. Leverage Phase I & II of the EV Blueprint Mapping Tool for gap analysis
  - a. Use map results and excel model to conduct a gap analysis of the existing publicly available EV charging network and provide location recommendations for the next phase of deployment
  - b. Identify prospective station hosts
  - c. Review technical and economic viability of the proposed locations in the field
2. Review results of comparative analysis of fast charging vs. Level 2 charging
  - a. Study role of fast charging compared to Level 2 charging on economic and business model, capital layout, usability, grid impact, technical development, etc.
3. Analyze current supply and demand for existing charging stations
  - a. Work with charging station providers to understand current utilization rates
4. Complete Phase III & IV of EV Blueprint Mapping Tool and develop a model to forecast future demand for charging infrastructure in all San Francisco neighborhoods
  - a. Project future EV registrations and model scenarios of EV mix, commuting patterns, percentage of population with access to home charging, etc.
5. Convene key stakeholders to share results of gap analysis and discuss optimal strategies for implementation
  - a. Solicit feedback from charging station providers, manufacturers, drivers, advocacy groups, researchers, experts, and funding partners to determine path forward

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#### Potential Barriers

- High Costs
  - Fast charging equipment costs
  - Additional costs for signage, permits, networking, customer service, maintenance, warranties, or high electricity costs
  - Workplaces, MUDs, and businesses may be hesitant to invest
- Grid Capacity

- Distribution lines and transformers could require an upgrade or installation of energy storage to accommodate fast chargers
- If energy demand coincides with general system peak loads, transmission and generation may need to be upgraded
- Network Distribution
  - Private sector deployment of charging stations has resulted in increased charging infrastructure density, yet the infrastructure is not uniformly distributed, leaving many neighborhoods underserved by public charging

## Where We Are Now

To foster EV adoption, drivers must know they will be able to charge their vehicles at conveniently located stations throughout the City. Currently, there are 766 publicly available charging ports operating in San Francisco and additional installation priority areas must be identified to achieve more widespread adoption.

SF Environment has partnered with Google to develop San Francisco’s EV Blueprint Mapping Tool. This partnership highlights Google’s data capabilities and technological expertise and provides San Francisco with the insights necessary to make informed decisions and inspire action at the city-level. This dynamic mapping tool will be used to identify priority areas for near-term EV charging infrastructure and associated near-term investments. A variety of modeling scenarios will also be used to identify target areas for long-term infrastructure investments.

The tool will not only provide City staff with high quality, action-oriented data about priority infrastructure siting opportunities, it will serve as a replicable model for other cities in California and beyond. Both Google and Environment staff have engaged other Bay Area cities to share this work and solicit feedback on the tool’s applicability in their cities and counties.

The tool is being developed in four phases, with initial phases intended for use by City staff for planning purposes. Future phases of tool development will result in a product for use by multiple users, including EV charging station providers and installers, and MUD and commercial property owners and tenants.

Table 4. Phase development of the EV Blueprint Mapping Tool

Phase	Description	Status
Phase I	Data collection and mock-tool development	Complete
Phase II	Initial application and mapping	Complete
Phase III	Additional data layers and deeper metrics	In progress. <i>Projected completion in fall 2019.</i>
Phase IV	Model and predict	Not started. <i>Projected completion in spring 2020.</i>

## Phase I: Data collection and mock-tool development

To determine the key elements of the mapping tool, Google conducted user research interviews around EV charging planning with Environment staff and staff from sister cities in the Bay Area and obtained datasets from SF Environment that each contribute a different perspective to the larger challenge of optimizing EV charger installation and utilization. Sample datasets analyzed include: CPC data on buildings, locations of existing EV chargers and plug types, locations and other information for off-street parking and parking lots, and Department of Motor Vehicle registration data.

Google has done preliminary work to draw connections between City-user needs gathered from research and interviews, with an analysis of the datasets and their corresponding fields by accounting for how likely the field was able to answer a user's question, the type of data (geographic/location, numerical, text, etc.), and whether the data was likely to be reliably available or include privacy-sensitive information and require aggregation.

Mocks of the tool were created as part of the exploratory design process and to anchor the user journey. These were used as visual guides for additional user feedback and research (Appendix III). In addition, technical architecture drawings were created to explore various options for the software engineering components required to develop the application (Appendix III).

## Phase II: Initial Application and Mapping

Google drafted minimal software architecture to reduce unneeded complexity but allow for extensibility and adaption to evolving requirements and user needs. This approach will minimize the technical debt and upfront costs and will more quickly provide insight into whether early versions of the tool will enable the types of analyses needed for optimal charger placement.

The Google team determined that a key aspect was data normalization and centralization and drafted a specific, required set of data fields per dataset type, across the datasets that were most common or likely to provide the most value (normalization is a commonly used technique). Moving forward, the tool will evolve and expand as additional datasets are added and go through similar processing to make them query-able from the mapping tool.

The technology proposed to centralize this data will be Google Cloud BigQuery, chosen for its ability to store large amounts of data, ease of querying/manipulation through its SQL language, and the availability of many interfaces to programmatically interact with BigQuery in an automated fashion. BigQuery has embedded capabilities to interact with geospatial data (GIS) and visualize them, reducing the need for additional geospatial logic and providing a fast way to prototype visual analyses. If needed, more custom geospatial analyses can then be offloaded to an additional part of the technology stack, for which there are many appropriate open source/licensed tools.

An illustration of the technical architecture is given in Appendix III. Relevant datasets are available as visual overlays on the interactive map, and most datasets can be explored and filtered according to properties of interest. For example, MUDs may be limited to show only recent construction, or with a specific number of units. By analyzing the relationships between these inputs, the user can identify potential locations for new EV chargers.



## Where We're Going

### *Desired Outcomes*

1. Interactive Mapping Tool with multiple layers users can toggle on/off depending on use case; including existing EV registrations, EV charging stations, MUDs, commercial garages/lots, travel patterns, and eventually electrical grid capacity (Phase III and IV)
2. Users can adjust factors to model various scenarios regarding vehicle ownership, EV penetration, mode share, and access to home charging
3. Target areas for near- and long-term Level 2 and fast EV charging station installations are identified
4. Masterplan for equitable and abundant EV charging throughout San Francisco with a focus on fast charging hubs to meet current and future demand

### Phase III: Add Data Layers & Deepen Metrics

An expanded version of the tool will integrate additional data layers and expand metrics and computation to accommodate deeper analyses. For example, computing the average distance from registered EVs to the closest charger might give insight into where to place chargers close enough that users are likely to charge in different scenarios (e.g., overnight charging). In some cases, this will include updating the user interface to allow more interactivity and analysis such as selecting different layers and defining ranges of interest. Google and Environment staff will also work with PG&E to integrate its Integration Capacity Analysis (ICA) map via their forthcoming API for electrical capacity data, as this is a key element in understanding charger installation feasibility.

### Phase IV: Model, Predict

There is the potential to leverage Cloud platforms and specialized tools, (e.g., Google Big Query) to include more powerful modeling functionality of future scenarios that will impact charging demand in San Francisco. As the tool increases its scope of integrated data layers and increases its ability to surface insights for optimal charger placement, Phase IV begins exploration into more complex techniques to model and predict outcomes. This phase will require additional scoping, development and investment of resources, including from Google. Ideally, the tool will be able to model outcomes for predicted future EV adoption scenarios, various mixes of access to home charging compared to reliance on public charging, and reduced charging times due to advancements in charging technology.

## Key Deliverables

1. First and second iterations of EV Blueprint Mapping Tool (Phase I and II)
2. Third and fourth iterations of EV Blueprint Mapping Tool (Phase III and IV)
3. EV Charging Masterplan for San Francisco

## 4. Curbside Charging

Study curbside charging options and evaluate opportunities for EV street parking policies and pricing.

Action Lead(s)	Supporting Department(s)
SFMTA	SF Environment, SFPUC
Sub-actions	Timeline
Street Parking Policy	Long-Term
Tasks	
<u>Street Parking Policy</u>	
<ol style="list-style-type: none"><li>1. Complete Curb Management Strategy</li><li>2. Implement priority strategies identified in the Curb Management Strategy</li></ol>	

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### Potential Barriers

- Impacts of EV-designated parking further exacerbating already high curb demand
- Equity implications of on-street EV incentives
- Enforcement challenges regarding EV-designated spaces on the curb
- Grid and engineering challenges and unknowns, especially regarding fast charging
- Role of charging curbside in broader charging network (off-street charging is priority)
- High costs of curbside charging compared to other charging options (off-street charging)
- Relation of curbside charging to other priority uses and projected uses of the curb could lead to an increased risk of stranded assets as curb management and usage changes
- Feasibility of business model and the capital requirements needed to invest in a rapidly evolving technology
- Political challenges associated with creating exclusive EV-only spaces on-street

### Where We Are Now

SFMTA's curb management team was established in 2018 and charged with comprehensive planning and management of the city's high demand curb assets. In 2018, it began the planning and development of the Curb Management Strategy, which will be finalized in summer 2019 and will identify priority uses of the city's curb. It will serve as a foundational document that guides the



future use and management of San Francisco curbs. The strategy will consist of three primary components: a high-level policy framework and prioritization, leading design standards for project managers, and policy recommendations for process improvements and legislative changes. The strategy will elevate curb management to a key component of every streetscape project conducted by planners and engineers. The strategy will also be a

resource for agencies who use the curb to deliver their services.

While the Curb Management Strategy will guide agency policies moving forward, SFMTA continues to implement holistic curb management. SFMTA staff have completed, or are working on, curb management projects at several locations across the city; including the Dogpatch neighborhood, Northeast Mission and the Chase Center. Outreach has begun to key stakeholders, including advocacy organizations and merchant groups, and will continue through Spring and Summer 2019.

## Where We're Going

### *Desired outcomes*

1. Street Parking Policy – A holistic approach to curb management

The curb is a valuable resource in managing the transportation system and is in high demand for mobility services seeking access to the curb to deliver goods and people. While the City understands the importance of studying the utility of curbside charging within its EV Roadmap, any use of the right of way for electrification must happen within the context broader transportation goals and the Curb Management Strategy priorities and policy framework.

Additionally, there are several other factors to consider in the context of curbside, including (but not limited to) accessibility requirements, equity concerns, ownership and maintenance of the charging stations, public safety, and enforcement policies. Finally, the city is prioritizing actions that take pressure off the curb by using off street parking assets to further support the EV adoption. Therefore, this effort has been deemed long-term and the City is not prioritizing the advancement of this action.

## Key Deliverable

1. Curb Management Strategy

## 5. Workforce Training

*Develop a workforce training program to support charging infrastructure installation and EV maintenance at scale. Ensure underserved community members have access to the program by working with City College of San Francisco and CBOs.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
OEWD, City College	SF Environment	Near-term

### Tasks

1. Assess supply and demand for current EV and charging station workforce
  - a. Identify capacity of current workforce
  - b. Assess existing EV registrations and charging stations
2. Model scenarios of future EV uptake and EV charging deployment
  - a. Project future EV registrations expected in San Francisco based on projected growth factor assumptions
  - b. Project future need for charging stations based on projected EV growth rate
3. Perform gap analysis between future needs and currently available skilled labor based on findings from tasks 1 and 2
4. Establish City College workforce development program
  - a. Identify curriculum, requirements, length of program, etc.
  - b. Supply equipment to the program
5. Recruit students into City College program
  - a. Partner with SFUSD to recruit high school students, particularly at-risk students and those in schools with high dropout rates, into the program
  - b. Partner with CBOs to recruit non-students, particularly from economically disadvantaged communities, into the program
6. Refer interested job seekers to consider the program
  - a. Distribute information about job opportunities and recruiting efforts

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### Potential Barriers

- Technological innovations in the EV and charging station fields could lead to knowledge gaps and a shortfall in the workforce that affects both the public and private sector
- Shortage of qualified educators
- The workforce required for the EV and infrastructure industry has diverse occupations with unique skill sets; therefore, curriculum must be specialized by occupational classifications
- Entry-level positions may require an associate degree, which program graduates may not have

## Where We Are Now

SF Environment staff have assessed San Francisco's current EV registrations and charging station supply and will continue to do this, as needed. Staff have also completed future EV registration projections and have used these projections to leverage the CEC's EVI-Pro tool to model multiple charging needs scenarios, including various ratios of Level 2 chargers to fast chargers and home charging to public charging ratios.

City College of San Francisco's Automotive Technology program has developed curriculum that includes EV and charging station maintenance courses and has opened an automotive shop with one of San Francisco's high schools. EV and charging station maintenance experience are in high demand, which illustrates the need to develop additional workforce training.

## Where We're Going

### *Desired Outcomes*

1. City College workforce development program
2. An adequate pool of well qualified local employees to provide EV maintenance and charging station installation and maintenance
3. Reduced school dropout and unemployment rates, particularly in at-risk and economically disadvantaged communities

OEWD will identify the existing EV and charging station technician workforce in the City and use SF Environment's projections and model scenarios (completed) to identify the increase in the city's skilled labor base that will be necessary to support broad EV uptake. From there, SF Environment will work with City College, San Francisco Unified School District (SFUSD) and CBOs to expand and enhance the existing Automotive Technology program, recruit students into the program, and connect program graduates to internships and career opportunities.

## **Key deliverables**

1. Technician training curriculum at City College
2. Gap analysis between future needs and currently available skilled labor based

## 6. EV Charging Experience

*Evaluate options to make the charging experience across various vendors, owners and operators seamless and future-proof investments, reinforcing state-level initiatives on the use of standards.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
SF Environment	SFMTA, MTC	Long-term

### Tasks

1. Study current state of charging system technologies, including charging station hardware, connectivity software, and payment back-end, as well as the network operator; and assess for interoperability or standardization
2. Develop policy options to address challenges with current systems
3. Draft memo for circulation among City agencies

### Potential Barriers

- Industry resistance from market participants with vested interests in proprietary protocols or technologies

### Where We Are Now

City staff have been tracking state-level initiatives on the use of charging standards and industry responses to global standardization efforts. With one of the largest EV markets by sales share and annual sales volume in the country, San Francisco saw a 39% increase in EV registrations from 2016 to 2017. To support this growth, San Francisco has invested heavily in charging infrastructure. According to the International Council on Clean Transportation, the city has roughly four times the U.S. average of public Level 2 and fast charge ports per capita (Figure 6).

Despite the impressive number of charge ports per capita, San Francisco has just 0.07 publicly accessible charge ports per EV registered in the city. There needs to be significant investments to expand this charging network not only to better serve current EV registrations but also to prepare for a significant increase in EV adoption among San Francisco residents, businesses and visitors.



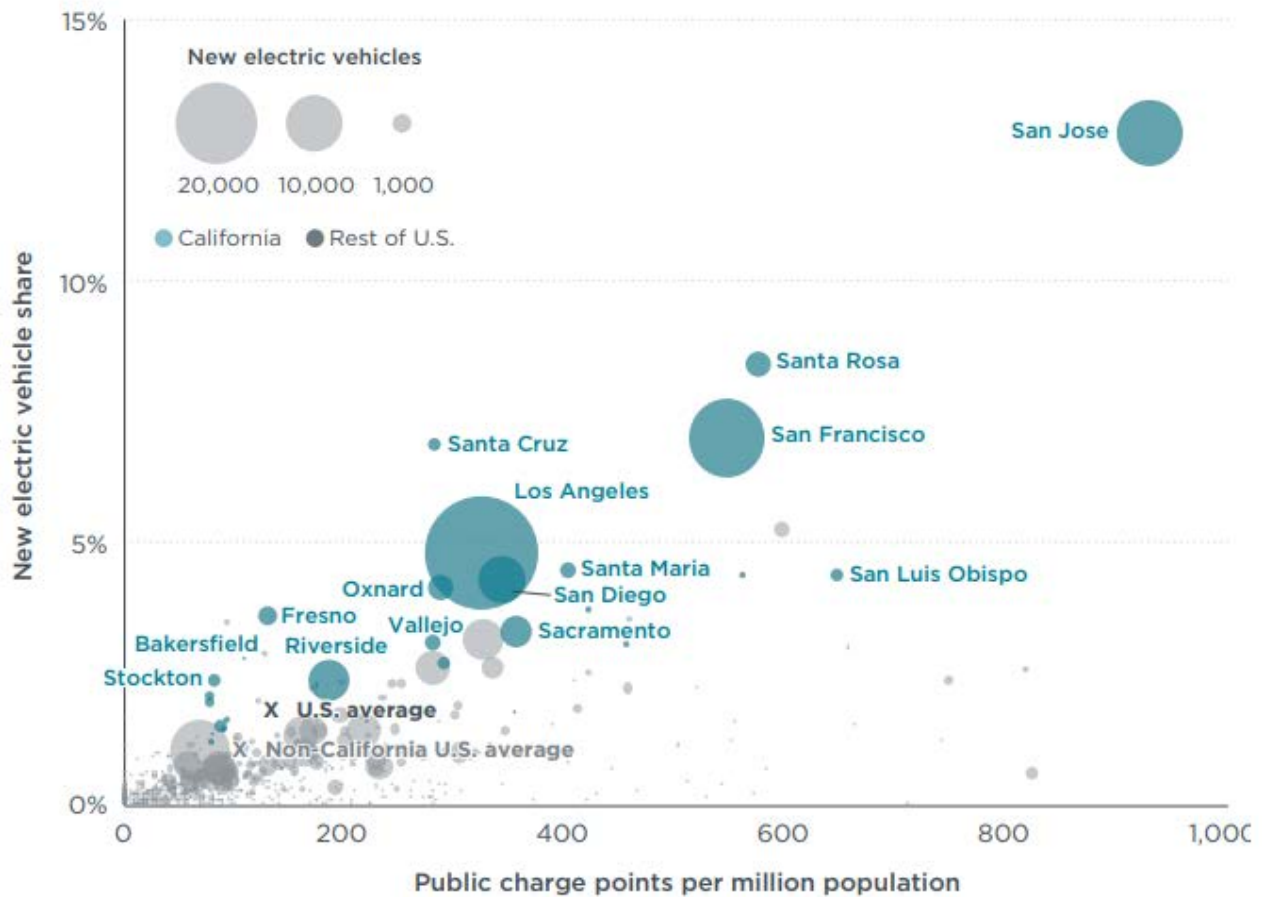


Figure 7. Electric vehicle market share and public charging infrastructure per capita for California and other U.S. metropolitan areas (Lutsey, 2018).

## Where We're Going

### Desired Outcomes

1. Easier, standardized integration of charging stations with building energy management systems and participation in demand response
2. Reduced risk of stranded assets
3. Payment interface accepting a standard form of payment

A lack of common technical standards prevents the creation of a single market and consequently, the ability to achieve economies of scale for charging infrastructure. It is critical to ensure that the vehicles of today and the vehicles of the future can leverage the same charging assets, regardless of how the vehicles or electrical grid evolve.

Government intervention is necessary to address these technical, regulatory and financial barriers and ease infrastructure development. A standardized charging experience will not only be good for

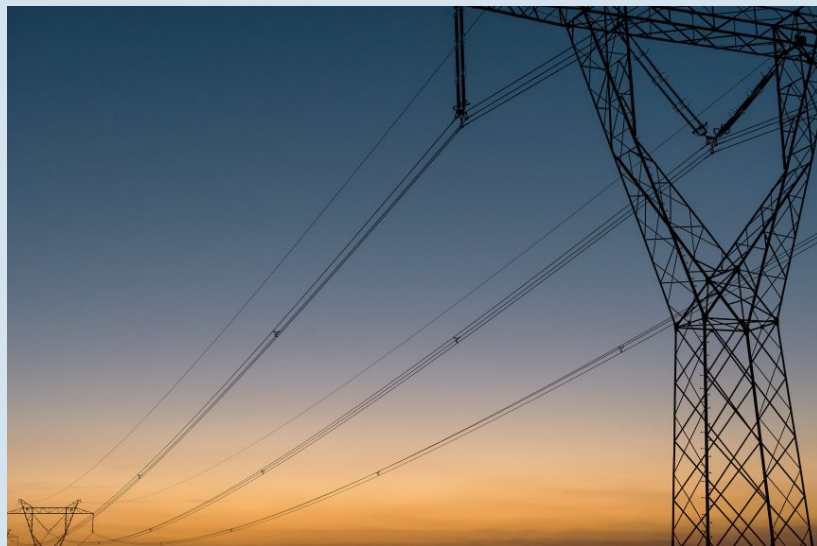
consumers, but a common framework will provide long-term stability for private investments and protect against stranded assets. Minimum technical standards outlined in a guidance document will ensure physical inter-operability of public infrastructure, provide reassurance to EV owners and encourage uptake.

## **Key Deliverable**

1. Guidance document highlighting best practices and recommendations, including implementation proposals

STRATEGY D:

## Electrical Grid



**Integrate EV charging with the electrical grid to maximize the benefits of charging infrastructure and support the transition to a renewable electricity future.**

### ACTIONS

1. Smart Charging Program
2. 100% Renewable Electricity
3. Stationary Battery Storage

# 1. Smart Charging Program

*Develop a home/workplace smart charging program that optimizes grid-responsive charging through remote demand response and price incentives.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
SF Environment	SFPUC	Long-term

## Tasks

1. Identify similar programs in other cities piloting smart charging technologies
2. Evaluate the type of smart charging capabilities, number of stations, pilot settings, and services offered
3. Develop a list of technical criteria
4. Evaluate the fiscal impact
5. Create a program and determine an implementation plan for roll out

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## Potential Barriers

- Policy barriers can complicate a large-scale rollout of a smart charging program
- Getting customers enrolled in pricing plans is a challenge

## Where We Are Now

SF Environment staff have been conducting research on other smart charging programs and best practices and are collaborating with SFPUC staff to evaluate factors to be considered when developing a new program.

## Where We're Going

### *Desired Outcomes*

1. Significant pool of participating chargers deployed to pilot smart charging incentives
2. Effective integration of charging station response to grid conditions

Smart charging can encompass a variety of different technologies including demand response, one-way controlled charging, or vehicle-to-grid functions. What these technologies have in common is that they all manage EV charging to promote grid stability. Smart charging allows for more effective peak shaving and can reduce levels of investment needed for the grid, as well as integrating a larger share of renewables.

Demand response is a well-tested and proven technology for managing electrical load and will allow for EVs to be used as distributed energy resources. This type of program not only benefits the grid,

but also passes along cost savings to the customer. By charging the EV during less expensive “non-peak” times, customers are rewarded with economic incentives.

Investor-owned utilities PG&E and Southern California Edison (SCE) have implemented demand response pilots in recent years, including PG&E’s BMW iChargeForward Pilot, and SCE’s Workplace Charging and Smart Charging Pilots.

San Francisco will take learnings from those pilot programs and design a new remote demand response program for residents, which will deploy home and workplace chargers enabled for demand response. It will offer incentives for participation which might include free chargers, enrollment incentives, low rates for off-peak charging, ongoing payments, or installation incentives, as well as referral bonuses. In the longer term, the city will pilot new technology and protocols that enable grid responsiveness of deployed charging equipment, truly enabling a smarter grid.



## Key Deliverables

1. Proposed program guide with incentives for participation
2. Budget proposal with funding options

## 2. 100% Renewable Electricity

*Require charging network providers operating on publicly-owned spaces to use 100% renewable electricity where feasible and increase the number of charging stations in privately owned spaces using renewable electricity.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
SFPUC	SF Environment	Near-term

### Tasks

1. Identify publicly owned areas not already served by renewable electricity
2. Identify privately owned areas not already served by renewable electricity
3. Investigate policy levers, if needed, to require these areas be served with renewable electricity upon EV charging station deployment
4. Identify appropriate City department/agency to enforce action
  - a. Convene relevant departments to discuss enforcement roles
5. Develop and implement policy, if needed

### Potential Barriers

- Enforcement challenges
- Higher cost of 100% renewable electricity in privately owned facilities

### Where We Are Now

The SFPUC is already supplying 100% renewable electricity in most of the public land, public right-of-way and City-owned facilities. Most of these areas are served by electricity from the City-owned Hetch Hetchy Reservoir hydropower generator.

Operated by the SFPUC, CleanPowerSF has a baseline option, which currently supplies nearly 50% renewable electricity. The SFPUC is expanding its network of private sector CleanPowerSF customers who have the option to procure 100% renewable wind power electricity, by helping them enroll in the SuperGreen program. In April, Mayor London Breed announced the largest and last enrollment period of CleanPowerSF, as well as calling for legislation to require the largest buildings in the city to use renewable electricity.





## Where We're Going

### *Desired Outcomes*

1. Further reduction in EV related lifecycle GHG emissions
2. Expansion of the CleanPowerSF SuperGreen program

Now that legislation requiring the largest buildings in the city to use 100% renewable electricity has been announced, the SFPUC will develop the ordinance and the correct department/agency will be identified to enforce the rules and regulations. This legislation, however, will only affect the largest buildings in the city. Therefore, the SFPUC will also need to identify the remaining areas of the city not served by GHG-free electricity.

The SFPUC aims to serve all of San Francisco with 100% renewable electricity by 2030. Further incentives and/or policies will need to be developed to be able to serve all of San Francisco with this electricity.

### **Key Deliverables**

1. Ordinance requiring largest buildings to use 100% renewable electricity
2. Documented expansion of CleanPowerSF program

### 3. Stationary Battery Storage

*Study options to incentivize fast charging station providers to invest in local behind the meter stationary battery storage to minimize impact on the grid.*

Action Lead(s)	Supporting Department(s)	Action Timeframe
SF Environment	SFPUC	Long-term

#### Tasks

1. Perform a cost-benefit analysis of fast charging and battery storage
  - a. Study the real-world costs of demand charges on existing stations in San Francisco and potential mitigating impact of storage
2. Consult with charging station providers
  - a. Interview providers to better understand the fast charging business model and the opportunities and challenges stationary battery storage could pose
3. Study potential grid impact
  - a. Model the potential grid impact of battery storage technologies
4. Survey available technology
  - a. Inventory current- and future-state technology solutions and associated costs
5. Develop program design recommendations
  - a. Draft a program proposal detailing funding, specific incentives, eligibility requirements, potential grid benefits, and potential demand charge savings

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#### Potential Barriers

- Economic complexity of deploying storage technology, including customer type, location, grid needs, regulations, customer load shape, as well as rate structure
- Safety concerns related to the materials, technologies, and deployment applications of stationary battery storage

#### Where We Are Now

Under a grant from the U.S. Department of Energy’s Solar Market Pathways Program, SF Environment worked closely with stakeholders to overcome regulatory, financial and technical barriers to create a road map for deploying solar with storage for resilience.

Like other cities working on issues in the intersection of sustainability and emergency preparation, the City and County of San Francisco faces the challenge of being unable to use its sustainable energy resources when the electric grid goes down. In response to these potential risks, SF Environment

explored the feasibility of solar plus storage installations to support community facilities during an emergency while advancing both the city's energy and emergency preparedness goals.

With the grant funding, SF Environment examined the possibility of solar plus storage in both individual and groups of buildings in the event of the next large-scale disaster in San Francisco, and developed resources and tools, such as Best Practice Guide and SolarResilient.org, for other municipalities nationwide to do the same.

## Where We're Going

### *Desired Outcomes*

1. Reduced impact on the grid from EV charging demand
2. More affordable charging by avoiding higher demand charges

Demand charges lie at the heart of the "chicken or the egg" problem impeding the growth of the EV industry. Utility demand charges can account for a significant portion a customer's electric bill and can make charging stations unprofitable. Start-up and maintenance costs are high, leaving investors reluctant to build stations, and because there are not enough charging stations, consumers have been slow to adopt EVs. Stationary battery storage has the potential to break this cycle.

An on-site battery storage system can charge, and discharge using direct current and connect to the grid through a large inverter. It can charge from the grid at off-peak times when costs are lower, store the power in battery cells, and release the energy when demand is higher. When an EV arrives, the battery can deliver electricity without drawing power from the grid. Whether one or multiple EVs are charging at one time, the cost of the electricity and the demand charges go down significantly. Pilot programs testing the viability of stationary battery storage are already underway. For example, PG&E is working with the San Joaquin Regional Transit District on an EV pilot, testing how smart charging and battery storage can lower operating costs and maximize efficiencies. Environment staff plans to engage with the utilities, as well as fast charging providers, and storage manufacturers to study the feasibility of deploying a pilot program in San Francisco.

## Key Deliverable

1. Program proposal detailing funding, specific incentives, eligibility requirements, potential grid benefits, and potential demand charge savings



STRATEGY E:

## **Fleet and Emerging Mobility Electrification**



**Lead the way in medium-and heavy-duty electrification and advocate for and encourage emerging mobility options to be GHG-free.**

### ACTIONS

1. Medium- and Heavy-Duty Pilots
2. Regulatory Efforts and Initiatives
3. Shared Mobility Services
4. Electric Car Rentals
5. Taxi Electrification
6. Zero-Emission Facility and Fleet Transition Plan



# 1. Medium- and Heavy-Duty Pilots

Develop pilot programs for deployment of electric medium- and heavy-duty vehicles in various fleet types, including school buses, waste haulers, and delivery vehicles.

Action Lead(s)	Supporting Department(s)
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SF Environment	SFUSD, Recology
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Key Outcomes	Timeline
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School Bus Contract Request for Proposals	Near-Term
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Pilot Project Proposals	Near-Term
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Tasks
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## School Bus Contract Request for Proposals

1. Evaluate existing electric school bus market
  - a. Identify existing models on California's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
2. Draft new school bus contract Request for Proposals (RFP)
3. Review draft contract and make EV requirement/prioritization recommendations
4. Finalize and publish RFP

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## Pilot Project Proposals

1. Develop inventory of medium- and heavy-duty fleets to target for potential pilot projects
    - a. Identify fleet type, number of vehicles, makes and models, model years, and average daily routes and use cases
  2. Develop inventory and assess potential pilot project funding opportunities
    - a. Identify funding agency, funding amount, funding project/vehicle type, and funding eligibility/requirements
    - b. Identify fleets that qualify for funding opportunities
  3. Identify fleet owners/managers to partner on potential pilots
    - a. Inform fleet owners/managers of existing and upcoming funding opportunities
    - b. Gauge pilot project interest and feasibility
  4. Develop pilot projects and submit proposals for funding
    - a. Secure formal commitments from partnering fleet owners and managers
    - b. Develop project proposals, including scope, timeline, budget, etc.
  5. Implement funded pilots, if applicable
    - a. Collaborate with fleet owners and managers to implement projects, and complete necessary deliverables and reports
-

## Potential Barriers

- Lack of cost-effective electric school bus and charging options
- Pilot project proposals may not be awarded funding
- Available funding opportunities may not address locally developed project proposals

## Where We Are Now

SF Environment staff and SFUSD are collaborating on an RFP for its new school bus contract. SF Environment staff have provided suggested RFP text requiring or prioritizing electric transportation options. These suggestions came from SF Environment analysis of available electric school bus technology, financial incentives and funding opportunities. SF Environment will continue working with SFUSD to evaluate the proposals submitted through this process.

SF Environment staff are implementing a pilot project funded by CARB to deploy electric medium- and heavy-duty vehicles engaged in the movement of produce along two adjacent California trade corridors: the San Francisco Bay Area and the Central Valley. This project will electrify up to twenty-one medium-duty trucks and nine heavy-duty trucks that deliver produce from and within the greater Sacramento area, Central Valley, and San Francisco Bay Area.

The project will also deploy Level 2 and fast chargers to support the demonstration fleets at their facilities. At one of the two San Francisco-based facilities, a 240-kilowatt (kW) solar photovoltaic array will also be installed to offset the fleet's costs from charging the electric trucks.

SF Environment staff recently secured funding for CalRecycles to help a CBO serving food pantries in San Francisco to purchase a medium-duty EV and will use this a model for other fleets. They have identified and collaborated with additional potential partner fleets and continue to research potential existing and upcoming pilot project funding opportunities.

## Where We're Going

### *Desired outcomes*

1. SCHOOL BUS CONTRACT REQUEST FOR PROPOSALS – requirements or priorities for implementing electric school buses in SFUSD's new fleet
2. PILOT PROJECTS AND PROPOSALS – fully developed pilot programs for electric medium- and heavy-duty vehicle deployment in San Francisco fleets

SF Environment staff will collaborate with SFUSD staff to evaluate RFP responses with a lens on electrification. They will continue to assess funding opportunities for electric school transportation, assist SFUSD staff in the development and submittal of project proposals, and assist SFUSD in the implementation of projects if awarded funding.

SF Environment staff will continue to implement the CARB pilot project through the first half of 2021. They will also continue to build an inventory of potential pilot partner fleets and continue to assess potential funding opportunities. When appropriate, staff will collaborate with fleet partners to develop



pilot projects and submit funding proposals. When awarded funding, staff will work with these partners to implement these projects and produce the necessary deliverables and reports required by the funding agency.

## **Key Deliverables**

1. SFUSD school bus contract RFP with electrification requirements/prioritization
2. Inventory of medium- and heavy-duty fleets
3. Submitted pilot project proposal(s)

## 2. Regulatory Efforts and Initiatives

*Evaluate opportunities and develop recommendations for policies and initiatives for the electrification of medium-/heavy-duty fleets and emerging mobility options.*

Action Lead(s)	Supporting Department(s)
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SFMTA, SF Environment

SFCTA, BAAQMD, MTC

Subtasks	Timeline
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Regulation Tracking Process and Recommendations      Near-Term

Automated Driving System Policy Framework      Long-Term

### Tasks

#### Regulation Tracking Process and Recommendations

1. Study regulatory approaches in other cities and at the state level
  - a. Identify where the City can bring a unique jurisdictional perspective
2. Collaborate with appropriate City departments and agencies to track State regulations, depending on areas of expertise
3. Identify possible options for City level regulations and incentives
  - a. Identify areas of legal authority
  - b. Study best practices and policies in the US and other countries
  - c. Incorporate analysis of TNC behavior and operations in efforts to develop a charging infrastructure network to serve this market
4. Conduct research and provide urban expertise for implementation of the California Clean Mile Standard and Incentive Program

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#### Automated Driving Policy Framework

1. Conduct research and analysis on automated technology, industry business models and existing policy landscape
  2. Conduct focus groups with key stakeholders to understand opportunities and risks
  3. Conduct workshops to develop and prioritize policies initiatives
  4. Incorporate findings and policies from research, focus groups and workshops
-

## Potential Barriers

- Lack of authority to mandate electrification of vehicles used by mobility providers
- Mandatory electrification interferes with, slows down, or even moves innovation to other cities without mandates
- Ensuring a holistic approach to electrifying emerging mobility (i.e., not appear to only regulate the new projects)
- Consistency in the application of policy to all emerging mobility service providers

## Where We Are Now

In 2018, SFTMA secured additional innovation team staff to lead research and policy development for ADS equipped vehicles in San Francisco. Staff have conducted significant research and analysis on automated technology; industry business models, standard and practices; and existing policy landscape. They have presented findings of preliminary research and conducted focus groups with key SFMTA and City stakeholders to understand opportunities and risks across a suite of transportation issues. Staff have begun scoping workshops with these stakeholders and other multi-stakeholder groups to develop and prioritize initiatives and policies that align ADS equipped vehicles and services with City goals.

City staff have been actively engaged with local and State policy makers on a proposed local tax on TNC rides. Some of the revenue generated from the tax, which will also apply to ADS equipped vehicle fleets and services, could go towards electrification of those services. California Assembly Bill 1184, enabling the City to impose the tax, sets a lower maximum tax rate for shared rides, and the tax could be reduced for rides provided by ZEVs. Finally, the SF Environment has had initial conversations with AV fleets, such as Cruise, about deploying EVs and associating charging infrastructure.

The City, in partnership with the SFCTA, has conducted extensive research and analysis on the impacts of TNCs on San Francisco's transportation system. In 2017, the SFCTA released a report which found that TNCs trips made up more than 170,000 daily trips, representing 15% of all intra-city trips. TNC vehicles comprised almost a quarter of downtown peak trips. In 2018, the SFCTA released the "TNCs and Congestion" report which found TNCs contributed to 47% of the increase in vehicle miles travelled between 2010 and 2016, contributed to 25% of the total vehicle congestion. As noted previously, the City's Transit First Policy, prioritizes transit, walking and biking over private automobiles, including TNCs. TNCs do not help the City reach its 80% sustainable trip goal, and those that are not electric generate harmful pollutants and emissions. Therefore, it is critical that an effort to electrify TNC trips align with broader transportation policy goals related to safety, public health and congestion.

Finally, staff have been and continue to actively track state-level efforts to promote electrification in the ride-sourcing sector. Staff provided comments on SB 1014 California Clean Miles Standard and

Incentive Program: Zero-Emission Vehicles and have been tracking planning and implementation via CARB communications and relevant program workgroups.

## Where We're Going

### *Desired outcomes*

1. REGULATION TRACKING PROCESS AND RECOMMENDATIONS – understanding statewide regulations and recommendations for local action
2. AUTOMATED DRIVING POLICY FRAMEWORK – ensure that ADS equipped vehicles and services contribute to achieving City goals and outcomes

It is critical that efforts to advance electrification of ADS equipped vehicles are done within the context of comprehensive ADS policies that support an array of goals across San Francisco— including those related to transportation, climate and equity. Staff will continue planning, analysis and policy work related to the development of the ADS Policy Framework. They will continue to monitor local and State policy venues and provide input as needed.

SFMTA will develop a San Francisco Automated Driving Policy Framework that will incorporate findings and policies from staff research, focus groups and workshops. The Automated Driving Policy Framework will be developed to align with the City's Guiding Principles for Emerging Mobility Services and Technology and will ensure that ADS-equipped vehicles and services contribute to achieving City goals and outcomes such as combating climate change, increasing street safety, making the transportation system more equitable, reducing congestion, and promoting access for people with disabilities.

It is also critical that San Francisco leverages efforts at the State to advance emission reductions among TNCs. Staff will continue to monitor local and State policy and provide input. Finally, staff will incorporate a TNC and emerging mobility lens into other priority actions identified in this Blueprint to ensure efforts such as charging infrastructure expansion meet the needs of various users. As those actions are undertaken, City staff will recommend strategies to promote zero-emission trips among San Francisco-based TNCs.

## Key Deliverables

1. Automated Driving Policy Framework
2. Advocacy and engagement efforts with state and federal agencies on critical policies and initiatives related to ride-hailing, automation, and other emerging mobility services and technologies

### 3. Shared Mobility Services

Evaluate options for electrifying shared mobility services.

Action Lead(s)	Supporting Department(s)	Action Timeframe
SFMTA, SF Environment	CPC, SFCTA, City Attorney	Long-Term

#### Tasks

1. Analyze current vehicle share policies and program levers
2. Develop recommendations for relevant policy and program updates to incentivize vehicle share electrification.

#### Potential Barriers

- Negative impacts of the action on operator’s business model
- Physical and operational constraints related to the installation and designation of charging infrastructure.
- Varying models of shared mobility services (bikeshare, scootershare, carshare etc.)
- Dependency on broader charging infrastructure network development

#### Where We Are Now

SFMTA oversees and permits several shared mobility services across including docked and stationless bikeshare, scootershare, mopedshare and carshare. These mobility services are in varying stages of electrification. The regional station-based bikeshare program, Bay Wheels, introduced electric-assist bicycles into its docked fleet in 2018, while stationless bikeshare, scootershare and mopedshare have offered electric mobility services since inception. SFMTA and the City continue to work with shared mobility providers to ensure equitable access to their services and to promote them—along with walking, biking and taking transit—as preferred options to SOV trips.

Additionally, staff from SFMTA and across the city have partnered in the development of an Off-Street Electric Mobility Framework, which provides an operational approach to enabling electric mobility projects in municipal parking facilities (more information in City-Owned Parking Facilities action). The Framework identifies priority electric mobility project typologies, including EV Charging Infrastructure projects that support permitted mobility services (i.e. carshare). As the City begins to receive project proposals, these have the potential to turn into projects that supply EV charging to current and future carshare designated spaces in municipal garages and other electric mobility services.

## Where We're Going

### *Desired Outcomes*

1. A path towards citywide availability of shared electric mobility options (including: bikeshare, mopedshare, carshare, scootershare and other shared mobility)

Electrifying shared mobility services and operations will be dependent on broader systemic strategies, and therefore considerations for shared mobility would be made within those contexts. For example, charging needs for shared mobility would be considered within the Charging Masterplan action and charging infrastructure related strategies. Similarly, a shared mobility lens would also be applied to incentive strategies like parking policies and pricing. That said, the city can analyze current shared mobility policies and program levers and determine how incentives or obligations could be incorporated to promote adoption of electric options in shared fleets of vehicles or devices. Recommendations could be outlined in a white paper which would articulate a path towards implementation.

Staff will also continue the planning and policy analysis needed to develop and implement recommended amendments to shared mobility permit programs in support of shared electric services and associated operations, while continuing to build and foster partnerships.

### **Key Deliverables**

1. Analysis to determine baseline conditions and how electrification of the entire operation can be advanced.
2. White paper outlining recommended permit program amendments and practices in favor of shared electric mobility options.



## 4. Electric Car Rentals

*Pilot electric car rentals at local airport (SFO) and evaluate opportunities to expand pilots to other car rental locations throughout the city.*

Action Lead	Supporting Departments/ Organizations	Action Timeframe
ENV, SFO	N/A	Long-term

### Tasks

1. Discuss options with car rental companies at SFO and throughout the city
2. Assess charging infrastructure needs/options at SFO
3. Assess charging infrastructure needs/options at hotels and to serve car rental customers
4. Evaluate potential pilot project funding opportunities
5. Develop pilot project proposals
6. Implement pilot projects, if funded

### Potential Barriers

- EVs may not yet compatible with car rental company business model
- Lack of charging stations at hotels
- Pilot project proposals may not be awarded funding

### Where We Are Now

SF Environment staff have convened several car rental companies to assess electrification options and collect information about this business model. They will continue to discuss these options with car rental companies in San Francisco.

SFO staff have begun developing the airport's Zero-Emission Vehicle Readiness Plan, and SF Environment staff has played a consulting role in this effort. This plan may include efforts around electrifying the car rental fleets that serve SFO passengers.

### Where We're Going

#### *Desired Outcomes*

1. Wide availability of EVs at car rental locations
2. Wide availability of charging stations at hotels

Moving forward, SF Environment staff will need to further collaborate with car rental companies and connect them to EV charging station providers to develop a plan that works with both partners' business models. SF Environment staff will also need to further advise SFO regarding its Zero-Emission

Vehicle Readiness Plan and how that could include recommendations for initiatives to pursue with car rental partners. Additionally, SFO will need to collaborate with San Francisco hotels and connect them with charging station providers.

Ideally, these efforts will lead to an EV rental program initially focused on SFO rental locations with an adequate charging network to charge EVs at both rental facilities between reservations and at hotels where car rental customers are staying. This could even include valet charging service at applicable hotels, which would remove the barriers of rental customers not being familiar and comfortable enough with EV charging to rent one of these vehicles instead of an ICE vehicle. This program could include informational and promotional material being made available to car rental and hotel customers when making reservations online or in-person.

## **Key Deliverables**

1. Pilot project proposals for SFO-based car rentals
2. Recommendations for expanding pilots to other locations

## 5. Taxi Electrification

Evaluate options for electrifying the city's taxi fleets.

Action Lead	Supporting Departments/ Organizations	Action Timeframe
SFMTA	ENV	Long-term

### Tasks

1. Identify best practice program and initiatives
2. Analyze current citywide taxi network and model future electrification scenarios
3. Analyze the economics and business models for conversion of taxi fleet
4. Analyze charging and grid capacity requirements
5. Develop recommendations

### Potential Barriers

- Current and future trends that place constraints on the demand for taxi services
- Costs and impacts of fleet conversion
- Infrastructure costs and siting challenges for fleet operators

### Where We Are Now

SFMTA oversees San Francisco's Taxi industry. The City's fleet of licensed taxis exceed clean-air vehicle standards. Over 90% are low-emission hybrid vehicles and play a critical role in meeting the City's ambitious climate goals. SFMTA offers a Clean Air Taxi Rebate Program, which offers \$2,500 per qualifying vehicle for hybrid to \$3,500 per qualifying vehicle for EVs. The SFMTA has awarded \$47,500 in rebates since July 2016. Additionally, SF Environment and SFMTA partnered with a small taxi fleet to submit a proposal to the US Department of Energy to procure eight hydrogen FCEVs.

## Where We're Going

### Desired Outcomes

1. Path to a fully zero-emission or plug-in hybrid taxi fleet



There are myriad existing barriers and potential burdens that could impact electrifying San Francisco's taxis. Current and future trends in mobility have the potential to constrain operations and impact the demand for services. Emerging mobility options such as TNCs and micromobility solutions like scootershare have, and can further impact, the taxi business model. Furthermore, while SFMTA is currently offering a rebate program for CAVs, it does not fully address the associated costs of fleet conversion, in particular those associated with charging infrastructure costs. The City recognizes that to make electrification feasible for the taxi industry, advancement of other actions, particularly those that support charging infrastructure expansion, will need to take place first.

Pending available resources, the City could analyze the current taxi network and model future electrification scenarios. These scenarios would determine projected fleet size and potential trip demand, analyze the economics of vehicle adoption for the projected demand and determine anticipated charging needs. This information would inform the development of recommendations for fleet operators as well as programs, policies, or initiatives the City could support to spur adoption. Findings and recommendations could culminate in a taxi electrification action plan.

This action has the potential to generate further interest in a zero-emission fleet for taxis. Additional funding for this effort could effectively facilitate the resources necessary to provide an increasing number of rebates, which in turn, could result in higher EV taxi usage.

## **Key deliverable**

1. Recommendations and implementation strategy

## 6. Zero-Emission Facility and Fleet Transition Plan

*Achieve a 100% zero-emission transit fleet by 2035.*

Action Lead	Supporting Departments/ Organizations	Action Timeframe
SFMTA	SFPUC, PG&E	Long-Term

### Tasks

1. Assess facilities for existing electrical supply and electrical demand baseline
2. Produce facility power needs and technology assessment
3. Produce battery electric bus (BEB) implementation facility master plan
4. Produce BEB operational planning and staffing master plan
5. Produce BEB rollout plan

### Potential Barriers

- Funding for necessary capital improvements and fleet procurements
- Maintenance and operation needs
- Change management, staffing and operational practices
- Mandatory electrification interferes / slows down / moves innovation to other cities without mandates
- Grid/Power availability

### Where We Are Now

SFMTA is a national leader in supporting sustainable, reduced, and zero-emission revenue transit vehicles. It currently operates the largest fleet of zero-emission electric trolley buses, running on 100% GHG-free electricity, in North America.

In May 2018, the SFMTA Board adopted a Zero Emission Vehicle Policy Resolution (ZEV Policy). Per the ZEV Policy, the SFMTA will begin procuring zero-emission buses starting in 2025, with a goal of achieving a 100% EV fleet by 2035. This goal exceeds CARB's mandate to achieve a zero-emission fleet by 2040. A key piece of the resolution is the Zero Emission BEB Program.

In 2017, the SFMTA adopted the Facilities Framework, a facility capital plan to rebuild and expand the SFMTA's facilities to accommodate future fleet growth. At the time of its adoption, the ZEV Policy had not yet been adopted. The Facility Framework program of capital improvement projects is collectively referred to as the Building Progress Program. The program implements improvements to rectify seismic, structural, or other safety hazards, and to modernize bus maintenance facilities to adequately service the modern bus fleet but does not currently incorporate facility transition to BEB.



The SFMTA has established a BEB Pilot to purchase nine 40-foot zero emission BEBs from various manufacturers. SFMTA plans to purchase three buses from each of the three major US electric bus OEMs and will test them extensively in regular revenue service within San Francisco. The goal of the pilot is to evaluate the performance, reliability, operability and maintainability of BEBs currently available on the market, and to gain experience with electric bus charging infrastructure in order to prepare for future fleetwide adoption. SFMTA will use this experience to pre-qualify electric bus OEMs for the future procurements starting 2025 and provide recommendation on the charging infrastructure strategy for all current vehicle yards.

SFMTA has internally arrived at the following baseline assumptions to reach its goal of achieving a 100% zero emission fleet by 2035:

- replace all motor coaches and trolley coaches with long range BEBs utilizing only on-board batteries as the primary source of power.
- charge all the BEBs with depot chargers at each of their 6 bus facilities.
- utilize a modular charging solution (150 kW) at all bus facilities to charge the buses overnight in approximately 4 hours, using smart charging methodology.
- busses will be equipped with overhead charging capabilities should SFMTA decide to install overhead chargers at end-of-line locations, terminals, or other strategic locations throughout the city.
- provide an updated Bus Fleet Management Plan and is planning its first procurement of battery electric coaches to replace 112 hybrid electric coaches in 2025.
- overnight depot charging at the facilities may be accomplished by utilizing an overhead inverted pantograph solution or a ceiling mounted solution.

## Where We're Going

### *Desired Outcomes*

#### 1. Zero Emission Transit by 2035

Funding for this project will aid in the procurement of a consultant to work with SFMTA's Zero Emission Fleet and Facility Technical Advisory Committee on the deliverables above. To meet SFMTA's goal of procuring BEBs starting in 2025, SFMTA will need to complete an in-depth facility and fleet assessment and to address the following topics:

- Existing electrical assessments for each of its 6 maintenance facilities
- Total future power requirement by facility and across the system for BEBs
- Capital infrastructure, building systems, and technology upgrades needed at each bus maintenance facility
- Coordination with PG&E, SFPUC, and all other stakeholders to determine power availability
- Risk management document identifying responsible agencies and utilities and outlying roles in ensuring successful transition
- Review of the existing bus yard management and operations practices and recommended modifications to operate BEBs out of each facility.

- Detailed schedule of cost and timeline for converting the facilities to accommodate BEBs, including the order of conversion considering other facility capital program priorities
- Proposal for a backup power solution at each facility
- Recommended replacement ratio of hybrid and trolley coaches to battery electric coaches
- Recommended emergency fleet solution
- Any additional details needed to successfully submit the CARB Innovative Clean Transit Zero Emission Bus Rollout Plan

The list below provides the expected scope of tasks associated with the above deliverables:

#### Existing Bus Facility Electrical Supply Assessment and Demand Baseline Report

Assess each of its 6 maintenance facilities, including the condition of the existing power demand and supply infrastructure in facilities and existing power capacity. These assessments should incorporate and build upon findings from prior Facilities Condition Assessments completed as part of the Facilities Framework

#### Facility Power Needs and Technology Assessment including background Methodology, Calculations and Assumptions, and Risk Management Analysis

This deliverable includes an analysis of bus and facility infrastructure technology

- A dynamic representation of the SFMTA bus system to determine and demonstrate the impact of transitioning to a fully battery-electric fleet.
- A calculation of power needs by facility and total power requirements for the SFMTA BEB system, and narrative recommendation of the total power required at each facility. This estimate will be based on the service operated out of each facility, accounting for future service as per the SFMTA Bus Fleet Management Plan (currently being amended). This recommendation will provide the minimum, maximum, and average amount of power required, and shall clearly and plainly state all assumptions utilized in the estimate methodology.
- A recommendation of the fleet vehicle charging solution that the SFMTA should employ, considering such factors as facility condition, required structural improvements, overall cost of improvements, and ease of operations and maintenance. This report will include a comparison of performance, cost, and logistical complexity of plug-in chargers versus inverted pantograph charging.
- Detailed scope and cost estimates for capital infrastructure upgrades required to convert each of the bus maintenance facilities to accommodate BEBs. The upgrades will include considerations for any facility modification, space required for housing power and PG&E equipment, yard management, and electric coach maintenance and service needs. This task requires coordination with PG&E, SFPUC, and all other stakeholders, which will culminate in written documentation of availability of required power at each of the maintenance facilities.
- Risk management considerations, including responsible agencies and utilities and outlying roles in ensuring successful transition, and steps to mitigate those risks.

### Battery Electric Bus Implementation Facility Master Plan

Prepare a comprehensive transition master plan, including detailed schedule and budget estimate for converting the facilities to accommodate BEBs, which will include the recommended order of facility conversion based on the vehicle makeup of each facility and the SFMTA Bus Fleet Management Plan. The schedule will also incorporate facility capital needs as expressed in the SFMTA's Building Progress program.

This Master Plan will include conceptual plans for each site and facility, workflow diagrams, workaround plans, implementation schedule, and project cost estimate report. Conceptual plans will include the physical dimension and recommended location of electrical equipment at each bus yard, and a conceptual layout of e-bus parking/charging lanes.

This transitional planning document will also include:

- Proposal for backup or redundant power at each facility to mitigate the effects of natural disasters, including a possible system for on-site energy storage and power generation.
- Operational and capital facility planning recommendation on emergency transit service planning. The report will provide a substantiated recommendation on whether the SFMTA should maintain a portion of its fleet as hybrid vehicles to serve as emergency response in the event of a disaster that compromises the power grid.

### BEB Operational Planning and Staffing Master Plan

This deliverable includes the production of a master plan to summarize all recommended modifications to SFMTA's current transit operation and staffing. It will review current bus yard management practices and recommend best practices for operating BEBs out of each facility. Best practices will include:

- maintenance and service staffing, including roles and responsibilities for operating and maintaining buses and charging infrastructure
- recommendations for yard management telematics solutions, including methodologies for operating the charging solution, parking assignment, and pull-in/pull-out practices
- operational modifications (i.e. service planning, route mapping, scheduling)
- ratio of replacement of hybrid and trolley coaches with battery electric coaches, including if any change in spare ratio is required for electric buses due to charging demands or maintenance needs

### Recommended reuse of existing overhead power distribution infrastructure

This deliverable will include research and recommendations on options potentially available to reuse existing overhead power distribution infrastructure for trolley buses as SFMTA eliminates trolley overhead lines throughout the city.

## Key deliverables

1. Zero Emission Facility and Fleet Transition Plan
  - a. Existing Bus Facility Electrical Supply Assessment and Demand Baseline Report
  - b. Facility Power Needs and Technology Assessment including background Methodology, Calculations, and Assumptions
  - c. Risk Management Analysis
  - d. Battery Electric Bus Implementation Facility Master Plan
  - e. BEB Operational Planning and Staffing Master Plan

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## CONCLUSION

With the City and County of San Francisco pledging to achieve net-zero GHG emissions by 2050, it will be vital for the City to implement the actions laid out in the EV Ready Community Blueprint. The transportation sector is the largest contributor of emissions, and private transportation is responsible for the vast majority of such emissions. Implementing the Blueprint Actions and using the Blueprint Mapping Tool will accelerate the City's transition to a zero-emission transportation sector by 2040 and incorporating the Blueprint Public Engagement Plan will ensure this is done in an inclusive and equitable way. Finally, the accessibility of the Blueprint Playbook will allow for the replication of any and all of these processes and resources well beyond San Francisco.

To implement this Blueprint, the greatest challenge will be a lack of available funding. Despite our creativity and successes thus far, this lack of funding has limited the strides the City has been able to make in spurring EV adoption and accelerating emissions reductions from the transportation sector. Securing funding to implement the Blueprint will allow the City to take a more sweeping and strategic approach to electrifying San Francisco's transportation sector. Therefore, SF Environment will be seeking Phase II funding from the California Energy Commission in addition to opportunities from other funding agencies such as the California Air Resources Board, the Bay Area Air Quality Management District, and others.

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## APPENDICES

### Appendix I: Blueprint Public Engagement Plan

SF Environment also developed a Blueprint Public Engagement Plan to carry out an electric mobility outreach and awareness campaign for the strategies and actions outlined in the EV Ready Community Blueprint. The Plan is separated into two parts. The first section documents how SF Environment engaged the community in the development of the Blueprint to ensure that the strategies and actions are aligned with community needs, concerns and interests and to ensure inclusivity and equitability. The second section of the plan outlines the outreach and engagement to CBOs, state and local agencies, residents, businesses, and industry that is expected to occur during Blueprint implementation. To read the document in full, see the accompanying Blueprint Public Engagement Plan.

### Appendix II: Blueprint Playbook

As part of this process SF Environment crafted a Blueprint Playbook to share the City's experience and best practices on how to accelerate EV adoption. This step-by-step guide outlines how San Francisco established and coordinated the EV Working Group, engaged with the community, and developed an EV Ready Community Blueprint and mapping tool.

The Blueprint Actions, Blueprint Mapping Tool, and the Blueprint Public Engagement Plan were all developed to be used and replicated in communities beyond San Francisco. To read the document in full, see the accompanying Blueprint Playbook.

### Appendix III: Blueprint Mapping Tool

In addition to the Blueprint Actions, SF Environment staff partnered with Google's Environmental Insights Explorer Team for the development of the Blueprint Mapping Tool. This dynamic interactive EV charging mapping and modeling tool will be used to identify sites in priority areas for EV charging infrastructure investments. The tool will identify gaps in San Francisco's existing public charging network to prioritize near-term infrastructure investments and use a variety of modeling scenarios to predict future needs for EV charging and identify target areas for long-term investments.

Initially, the tool will be for the use of City staff, but as development continues, the tool will be made available to EV charging station providers, utilities, property owners, and residents. The tool will be developed in four phases:

- Phase I: Data collection and mock tool development (completed)
- Phase II: Initial application and mapping (completed)
- Phase III: Add data layers and deepen metrics
- Phase IV: Modeling and predictions

This Blueprint Mapping Tool will not only help San Francisco develop its own EV Charging Masterplan but will also serve as a replicable model for other cities in California and beyond to

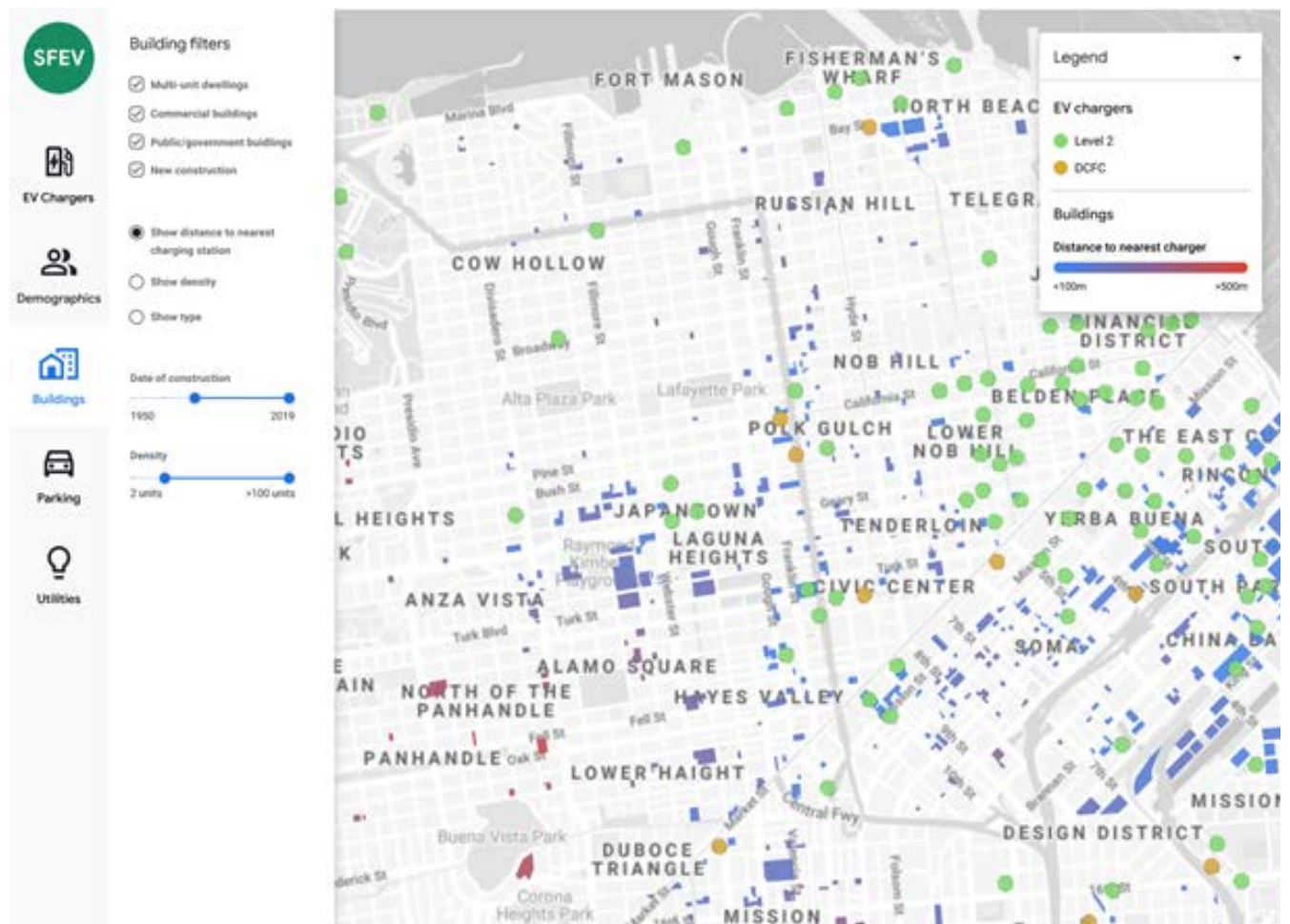
develop their own charging plans. Both SF Environment and Google have engaged other municipalities in the Bay Area to share the results of this work and solicit feedback on the tool's applicability in their communities. The team has also begun to engage with other government agencies, utilities and charging station providers regarding further development of the tool.

For more information on the tool, refer to Blueprint Action: Off-Street EV Charging Masterplan in the previous section of this document. For an example Blueprint Mapping Tool user experience flow, see steps 1-5 below.

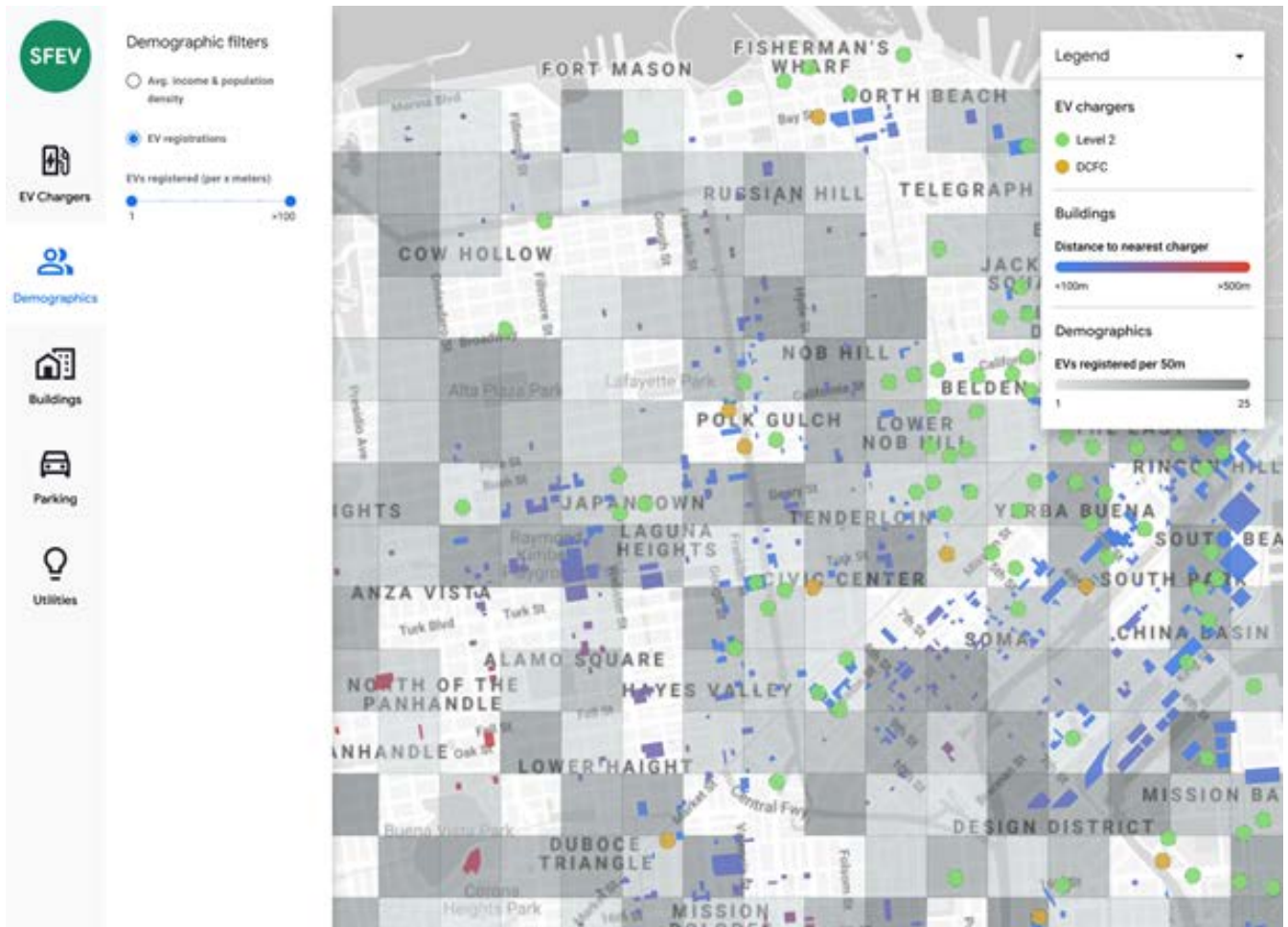
1. User loads the mapping surface (default view: L2 and DC fast charging stations)



2. In order to understand where candidate sites for L2 chargers should be, the user wants to identify areas of opportunity (view: MUDs + time/distance to charger heatmap + chargers)

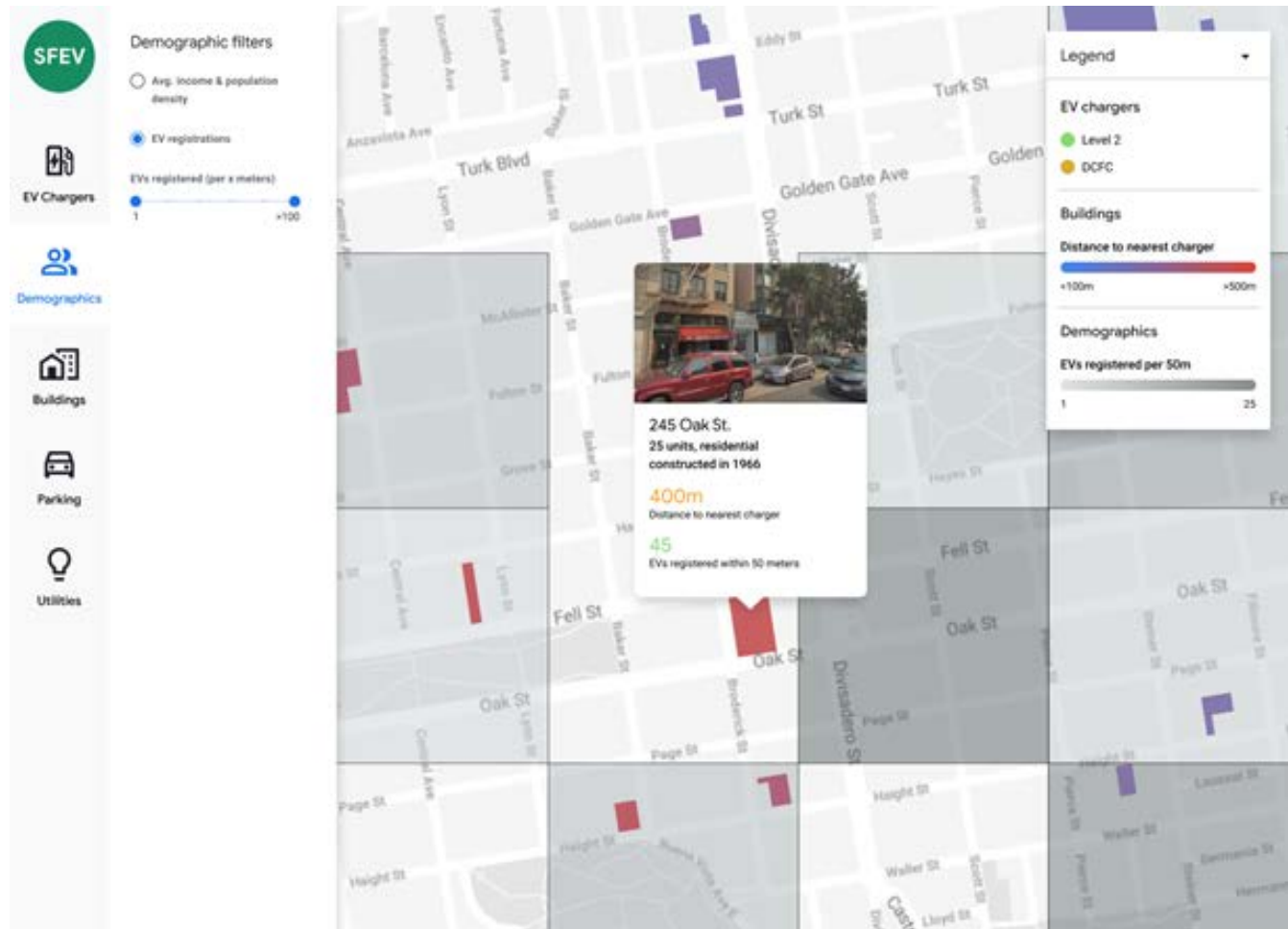


3. To refine the search, the user wants to understand where EVs actually are located (view: MUDs + time/distance to charger heatmap + chargers + EV registrations)



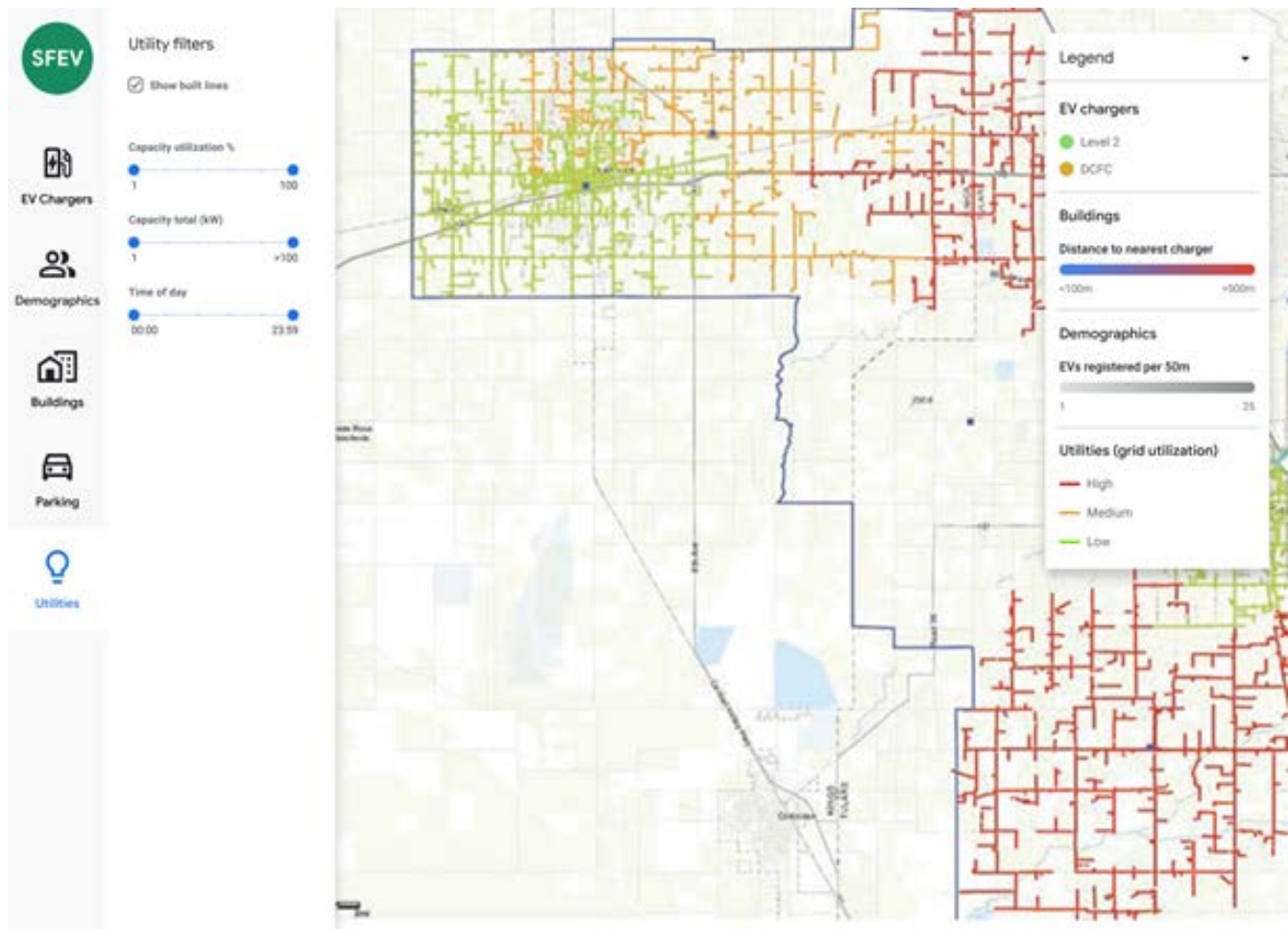


4. The user has found a promising set of buildings in a neighborhood and wants to see more information about a particular MUD (view: popover showing info - # of EVs in registered in area, income/demo data, current distance/travel time to nearest charger)





5. The user wants to also know about grid utilization in the area and zooms back out and turns on the ICA overlay from PG&E (DCFC validation)



PG&E grid utilization visualization source: <http://alphabetengineering.com/blog/2018/9/5/distributed-energy-resource-der-siting>

## Appendix IV: Transit First Policy Directives

1. To ensure quality of life and economic health in San Francisco, the primary objective of the transportation system must be the safe and efficient movement of people and goods.
2. Public transit, including taxis and vanpools, is an economically and environmentally sound alternative to transportation by individual automobiles. Within San Francisco, travel by public transit, by bicycle and on foot must be an attractive alternative to travel by private automobile.
3. Decisions regarding the use of limited public street and sidewalk space shall encourage the use of public rights of way by pedestrians, bicyclists, and public transit, and shall strive to reduce traffic and improve public health and safety.
4. Transit priority improvements, such as designated transit lanes and streets and improved signalization, shall be made to expedite the movement of public transit vehicles (including taxis and vanpools) and to improve pedestrian safety.
5. Pedestrian areas shall be enhanced wherever possible to improve the safety and comfort of pedestrians and to encourage travel by foot.
6. Bicycling shall be promoted by encouraging safe streets for riding, convenient access to transit, bicycle lanes, and secure bicycle parking.
7. Parking policies for areas well served by public transit shall be designed to encourage travel by public transit and alternative transportation.
8. New transportation investment should be allocated to meet the demand for public transit generated by new public and private commercial and residential developments.
9. The ability of the City and County to reduce traffic congestion depends on the adequacy of regional public transportation. The City and County shall promote the use of regional mass transit and the continued development of an integrated, reliable, regional public transportation system.
10. The City and County shall encourage innovative solutions to meet public transportation needs wherever possible and where the provision of such service will not adversely affect the service provided by the Municipal Railway.

# Appendix V: EV Roadmap Executive Summary



SF Environment  
Executive Summary

## EV ROADMAP

Electric Mobility Subcommittee Recommendations



The role of the Electric Vehicle Working Group, established in 2015, is to advise the Mayor's Office on how to accelerate private vehicle electrification in San Francisco, while also helping the City lead by example.

The initial focus of the Electric Vehicle Working Group (EVWG) was electrifying the City's own fleet and increasing publicly available charging infrastructure in all new buildings. The City Administrator's Office crafted and implemented a path forward for electrifying the municipal non-revenue fleet, and SF Environment took lead on adoption of an ordinance requiring all new construction to include charging infrastructure.

In 2017, the EVWG created the Electric Mobility Subcommittee to develop this Roadmap for accelerating electrification of private sector transportation. In 2016, San Francisco's transportation sector was responsible for **46% of all greenhouse gas (GHG) emissions** [Figure 1], with **71% of those emissions** coming from privately owned cars and trucks [Figure 2].

San Francisco, as a Transit First city, recognizes that to reduce emissions and congestion, sustainable modes of transportation, such as public transit, biking, and walking must be prioritized. In addition, to further reduce and eventually eliminate remaining transportation emissions to meet the City's goal of net zero emissions, all remaining forms of transportation must be electrified [Figure 3]. Two technical breakthroughs will make this possible:

1. Electric vehicle (EV) technology is approaching a tipping point, as new models are better performing and more affordable.
2. The fuel for EVs, electricity, is getting cleaner through the transition to renewables on the grid.

EV ROADMAP, continued →

Figure 1, 2016 GHG Emissions by Sector

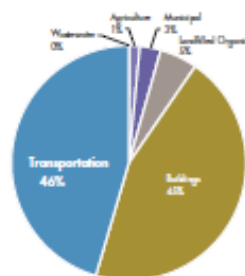


Figure 2, 2016 Transportation Sector GHG Emissions

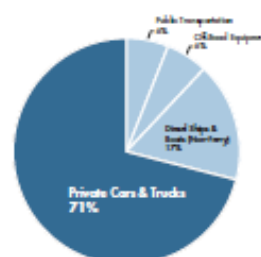
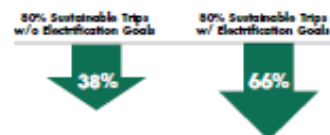


Figure 3, Projected Transportation Emissions Reductions by 2030



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San Francisco has a goal of **100% renewable electricity by 2030**. When powered by renewable electricity, EVs – including hydrogen Fuel Cell EVs – provide a pathway to eliminate virtually all GHG emissions from transportation, which will have a significant impact on improving local air quality.

The Electric Mobility Subcommittee is led by SF Environment and is co-chaired by the San Francisco Municipal Transportation Agency, and the San Francisco Public Utilities Commission. Representatives from fifteen City departments and agencies joined stakeholders representing regional and state agencies, non-government organizations, and industry partners to develop the City's EV Roadmap. Over the last year, the Subcommittee gathered nine times for workshop-style meetings, hosted two community listening sessions, and collaboratively designed strategies that will make emission-free transportation in San Francisco a reality. The EV Roadmap puts forward an accelerated path toward electrification of all forms of private transportation and proposes a bold vision for the future:

### Make all transportation in San Francisco emission-free by 2040

To inspire near term action and reduce emissions quickly, the EV Roadmap proposes interim targets for 2025 and 2030. The targets focus on reducing vehicle miles traveled and rapidly electrifying vehicles that remain on the road. Furthermore, the targets aim to reduce the sale of new gasoline and diesel vehicles, so that **all new cars sold in San Francisco are electric by 2030** [Figure 4].

To achieve these targets, the EV Roadmap proposes six strategies, each addressing a major barrier to EV adoption, and identifies key actions necessary to implement each strategy.

Figure 4, Proposed Targets

#### By 2025 EVs will be:

50% of new passenger vehicle registrations with no increase in total vehicle registrations per household

50% of emerging mobility vehicle miles traveled

2,000 medium- and heavy-duty commercial vehicles registered in the city

1/3 of incoming commuter vehicles

#### By 2030 EVs will be:

100% of new passenger vehicle registrations with no increase in total vehicle registrations per household

100% of emerging mobility vehicle miles traveled

10,000 medium- and heavy-duty commercial vehicles registered in the city

2/3 of incoming commuter vehicles

#### 2040 Vision

All trips originating in, ending in, or passing through San Francisco will be emission-free

EV ROADMAP, continued →







### STRATEGIES



#### Public Awareness

*Achieve broad public awareness, understanding, and consideration of the options and benefits of electric mobility.*

**Target outcome:** by 2020, drivers and the general public will be fully informed on key EV benefits, and that electric options are always considered when mobility investments and choices are made.

- Develop and fund a city public awareness campaign
- Develop and fund a city EV Help Desk
- Evaluate options to offer community groups/neighborhoods extended test rides in EVs
- Explore opportunities to align the transportation demand management program and policies with electrification goals
- Develop branding and signage standards for EV charging infrastructure



#### Incentives

*Create a preference for electric mobility over gasoline and diesel vehicles.*

**Target outcome:** by 2020, clear price signals and other incentives will be in place to encourage electric mobility over gasoline and diesel.

- Evaluate options for a city EV purchase and/or lease incentive
- Collaborate regionally to evaluate EV lane access policies on managed lanes
- Evaluate incentives for EVs on airport roadways, in queues, and in parking facilities
- Develop recommendations to use garage parking policy to create incentives for EVs
- Develop recommendations for EV street parking policies and pricing
- Develop recommendations for low-emission or EV-only parking and/or driving zones
- Evaluate transportation pricing strategies that base fee structure on the emission factors of vehicles



#### Charging Infrastructure

*Ensure that charging infrastructure for EVs is available and convenient for all residents, businesses, and visitors.*

**Target outcome:** by 2022 there will be an effective and scalable range of charging options for all residents, fleets, and visitors across the City supporting full electrification.

- Evaluate options for broad deployment of charging infrastructure in multi-unit dwellings
- Develop a home and/or workplace smart charging program
- Develop a Direct Current Fast Charger (DCFC) Masterplan
- Install/expand publicly accessible charging infrastructure at City owned parking facilities
- Accelerate deployment of charging stations in privately owned, publicly accessible garages and lots
- Study curbside charging options
- Develop a workforce training program to support charging infrastructure installation
- Make the charging experience more seamless and investments future proof





### Grid

*Integrate EV charging with the electrical grid to maximize the benefits of charging infrastructure and support the transition to a renewable energy future.*

**Target outcome:** by 2025, most EVs will be powered by GHG-free electricity, and all have access to electricity rates that make EVs an economical alternative to gasoline and diesel-powered transportation.

- Convene City agencies and local utility to identify solutions to electrical infrastructure limitations to supply EV charging infrastructure
- Evaluate pricing to customers for public and residential Level 2 and DCFC chargers, and identify options to make charging more affordable
- Study options to incentivize DCFC station providers to invest in onsite “stationary battery storage”
- Require charging network providers operating on public property to use 100% renewable or GHG-free power where feasible



### Medium- and Heavy-Duty

*Lead the way in medium- and heavy-duty electrification.*

**Target outcome:** from 2020 to 2025, the City establishes lighthouse projects of early adoption of EV technology for all major categories of medium- and heavy-duty transportation.

- Identify, catalog, and support pilots in medium- and heavy-duty fleets
- Work with School District to support electric transportation for students
- Work with Recology to expand pilots for electric trucks for waste operations
- Develop recommendations for incentives and/or regulations for electrification of medium- and heavy-duty fleets
- Evaluate options to install charging infrastructure for trucks parked at Port property



### Emerging Mobility

*Advocate for and encourage emerging mobility options to be emission-free.*

**Target outcome:** by 2020, emerging mobility fleets commit to a clear path to full electrification before 2025, and any new forms of mobility are fully electric from the start.

- Develop recommendations to electrify transportation network companies and similar light-duty passenger fleets
- Evaluate options to electrify vehicle sharing
- Evaluate options to electrify taxi fleet
- Pilot electric car rentals at San Francisco International Airport
- Set expectation and encourage private and fleet autonomous vehicles to be electric





