California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

EV Ready Communities Challenge

Phase I - EV Blueprint City Council Draft

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Prepared by: City of Santa Clara

California Energy Commission

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PREFACE

Assembly Bill (AB) 118 (Nùñez, Chapter 750, Statutes of 2007), created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). The statute authorizes the California Energy Commission (Energy Commission) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. AB 8 (Perea, Chapter 401, Statutes of 2013) re-authorizes the ARFVTP through January 1, 2024, and specifies that the Energy Commission allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The ARFVTP has an annual budget of approximately $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and non-road vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the ARFVTP, a project must be consistent with the Energy Commission's annual ARFVTP Investment Plan. The Energy Commission issued ARV-17-044 to fund project teams to accelerate the deployment of electrified transportation within the local and regional levels with a holistic and futuristic view of regional transportation planning. In response to ARV-17-044, the recipient submitted an application which was proposed for funding in the Energy Commission's Notice of Proposed Awards April 4th, 2018 and the agreement was executed as CEC-ARV-17-044 on August 17th, 2018.

ABSTRACT

The primary purpose of this EV Blueprint was to develop a program of initiatives the City of Santa Clara will lead to support increased EV adoption and the many benefits which derive from that adoption. The City's EV Blueprint development process established a firm planning foundation which involved engaging internal and external stakeholders, analyzing the current state of transportation electrification, forecasting long-term impacts of Plug-in Electric Vehicle (PEV) adoption, and prioritizing key requirements to help the City meet greenhouse gas emissions reduction targets 55% below the 2008 baseline levels by 2035 as identified in the City's Climate Action Plan. The EV Blueprint team developed supporting analysis and resulting recommendations that provided the City with a clear understanding of the technical and economical requirements to promote EV adoption specific to the City's ecosystem. The supporting analysis conducted throughout the planning process provided the City a clear understanding of how and when PEV adoption could occur, how Silicon Valley Power and other City departments might support adoption, and the potential benefits of that adoption. The resulting EV Blueprint recommends an EV acceleration program comprised of fourteen program initiatives to ensure Santa Clara is an EV Ready Community by the end of 2030. For the program and each initiative, the team developed specific goals, timelines, resource requirements, and budgets to facilitate subsequent planning activities.

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LIST OF ACRONYMS

AB	Assembly Bill
ACC	Advanced Clean Cars
ADMS	Advanced Distribution Management System
AFDC	Alternative Fuels Data Center
AMI	Advanced Metering Initiative
ANSI	American National Standards Institute
ARFVTP	Alternative and Renewable Fuel and Vehicle Technology Program
B2C	Business to Consumer
BAAQMD	Bay Area Air Quality Management District
BEV	Battery Electric Vehicle
C&I	Commercial & Industrial
CA	California
CAGR	Compound Annual Growth Rate
CAISO	California Independent Service Operator
CAP	Climate Action Plan
CARB	California Air Resources Board
CCS	Combined Charging System
CDR	Charge Detail Record
CEC	California Energy Commission
CHAdeMO	Charge de Move
CMUA	California Municipal Utilities Association
CO2(e)	Carbon Dioxide Equivalent
CPO	Charge-Point Operator
CPUC	California Public Utilities Commission
CVRP	Clean Vehicle Rebate Project
DAC	Disadvantaged Community
DCFC	Direct Current Fast Charger
DER	Distributed Energy Resource
DERMS	Distributed Energy Resource Management System
DICE	Dynamic Integrated Climate-Economy
DMV	Department of Motor Vehicles
EPA	Environmental Protection Agency
EV	Electric Vehicle
EV-IF	Electric Vehicle Implementation Framework
EVI-Pro	Electric Vehicle Infrastructure Projection
EVSE	Electric Vehicle Supply Equipment
EVSP	Electric Vehicle Service Provider
FCEV	Fuel Cell Electric Vehicle
FRAP	Federal Rate Assistance Program
FUND	Climate Framework for Uncertainty Negotiation and Distribution
GHG	Greenhouse Gas
GVWR	Gross Vehicle Weight Rating
HBO	Home-based Other
HBW	Home-based Work
HOA	Homeowners Association
ICE	Internal Combustion Engine
IOU	Investor-owned Utility
IRP	Integrated Resource Plan
IT	Information Technologies

L1, L2, L3	Level 1, Level 2, Level 3 Chargers
LCFS	Low Carbon Fuel Standard
LDV	Light-duty Vehicle
LEV	Low-emission Vehicle
LMP	Locational Marginal Pricing
MSP	Mobility Service Provider
MUD	Multi-unit Dwelling
NBH OR NHB	Not Home-based
NIST	National Institute of Standards and Technology
NOx	Nitrogen Oxide Gases
NPV	Net Present Value
OCPP	Open Charger Point Protocol
O&M	Operating & Maintenance
OT	Operational Technology
P3	Public-Private Partnerships
PEV	Plug-in Electric Vehicle
PAGE	Policy Analysis of the Greenhouse Effect
PHEV	Plug-in Hybrid Electric Vehicle
PMO	Program Management Organization
POU	Publicly Owned Utility
RFID	Radio Frequency Identification
RFP	Request for Proposal
RKS	Reichman, Karten, Sword, Inc. Research & Consulting
SCADA	Supervisory Control And Data Acquisition
SCC	Social Cost of Carbon
SDG&E	San Diego Gas & Electric
SOC	State Of Charge
SOV	Single Occupancy Vehicle
SVP	Silicon Valley Power
TAZ	Traffic Analysis Zone
TDM	Transportation Demand Management
TE	Transportation Electrification
The City	The City of Santa Clara
TOU	Time Of Use
V1G	Vehicle to Grid – Unidirectional Flow
V2G	Vehicle to Grid – Bidirectional Flow
VGI	Vehicle to Grid Integration
VMT	Vehicle Miles Traveled
VRF	Vehicle Replacement Fund
VTA	Valley Transit Authority
VTP	Valley Transportation Plan
ZEV	Zero-emission Vehicle

EXECUTIVE SUMMARY

In 2018, California established a goal to increase the number of zero-emission vehicles (ZEVs) on the road from just under 1.3 million as of December 2018 to 5 million by 2030. Meeting this goal will require a concerted statewide effort to incentivize ZEV purchase at the state, county, and local level. To assist local agencies in developing EV Blueprints with actions and timelines for EV ready communities, the California Energy Commission (CEC) provided grant funding from the Clean Transportation Program.[1] The City of Santa Clara (The City) and Silicon Valley Power (SVP) teamed with Siemens, together as the EV Blueprint Team, to prepare the City's EV Blueprint.

The EV Blueprint Team followed Siemens' tried and tested electric vehicle implementation framework (EV-IF) stakeholder guided planning to develop The City's EV Blueprint for the 2020 to 2030 timeframe. The EV Blueprint Team consulted Stakeholders from the following groups throughout the process: City residents, City businesses, Silicon Valley Power (SVP), City Public Works, City Information Technologies (IT), City Community Development, Transit Authorities, electric vehicle service providers (EVSPs), financial institutions, and governmental agencies. As a result, the Blueprint aligned with major City strategic initiatives and plans including: The City Climate Action Plan, SVP's Strategic Plan, and SVP's Integrated Resource Plan. For reference, The City Climate Action Plan has goals to reduce emissions 55% below baseline levels by 2035.

The EV Blueprint Team worked with leaders across the Stakeholder community to gather data and information to inform the Blueprint. In the process, the EV Blueprint Team recognized the unique nature of Santa Clara as regards to PEV development. For instance, about 46% of residents reside in multi-unit dwelling (MUD) apartments, which pose a challenge for EVSPs. It was also noted that while in aggregate it appears Santa Clara has a significant number of public charge connectors, 93% of all Level 2 charge connectors and 57% of all direct current fast charger (DCFC) charge connectors are in a single zip code. The City is fortunate to have significant workplace charging infrastructure as well. Unlike most cities, Santa Clara's electric hourly load profile is relatively flat as it is driven by significant datacenter/industrial demand. With The City's unusually high load factor – a result of 90% of the power sales going to industrial customers – there is little concern that electric load volatility will be significantly impacted by PEV charging and peak shifting will add less value, at least at a system level. Further, traffic analysis revealed that more than 60% of traffic resulted from commuters. Therefore, basing PEV charging demand solely on a forecast founded on vehicles registered in The City would have grossly underestimated the potential charging demand, so commuters were explicitly included.

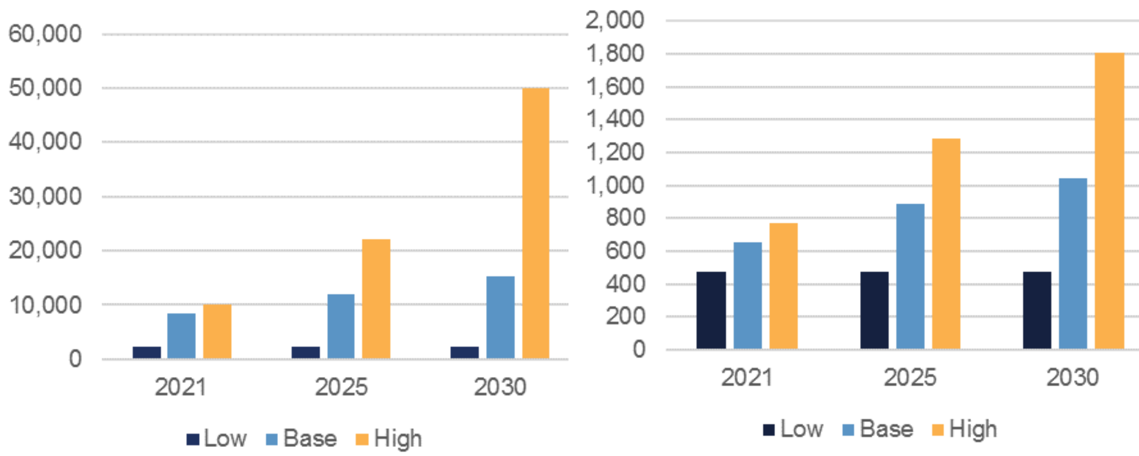
Core to the EV Blueprint is the forecast of plug-in electric vehicle (PEV) adoption which includes both person and commercial vehicles. Recognizing the inherent uncertainty in any forecast, and especially in a nascent technology, the EV Blueprint Team developed three forecast cases: low, base, and high. The base case was based on SVP's 2018 Integrated Resource Plan (IRP) using the

1 The Clean Transportation Program was formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP)

"2017 SB 350 Common Assumptions Guidelines for Transportation Electrification Analysis." To place that forecast in context, the EV Blueprint Team set a low case assuming no further PEV adoption and a high case based on Siemens proprietary PEV adoption forecasting tool, which resulted in adoption rates closely aligned with California's statewide five million zero-emission vehicle (ZEV) goal by 2030. Figure 1 shows the number of PEVs and number of required charge connectors[2] forecasted for each of the adoption scenarios.

Figure 1: Number of PEVs, Cumulative

Charging Requirements, No. Charge Connectors



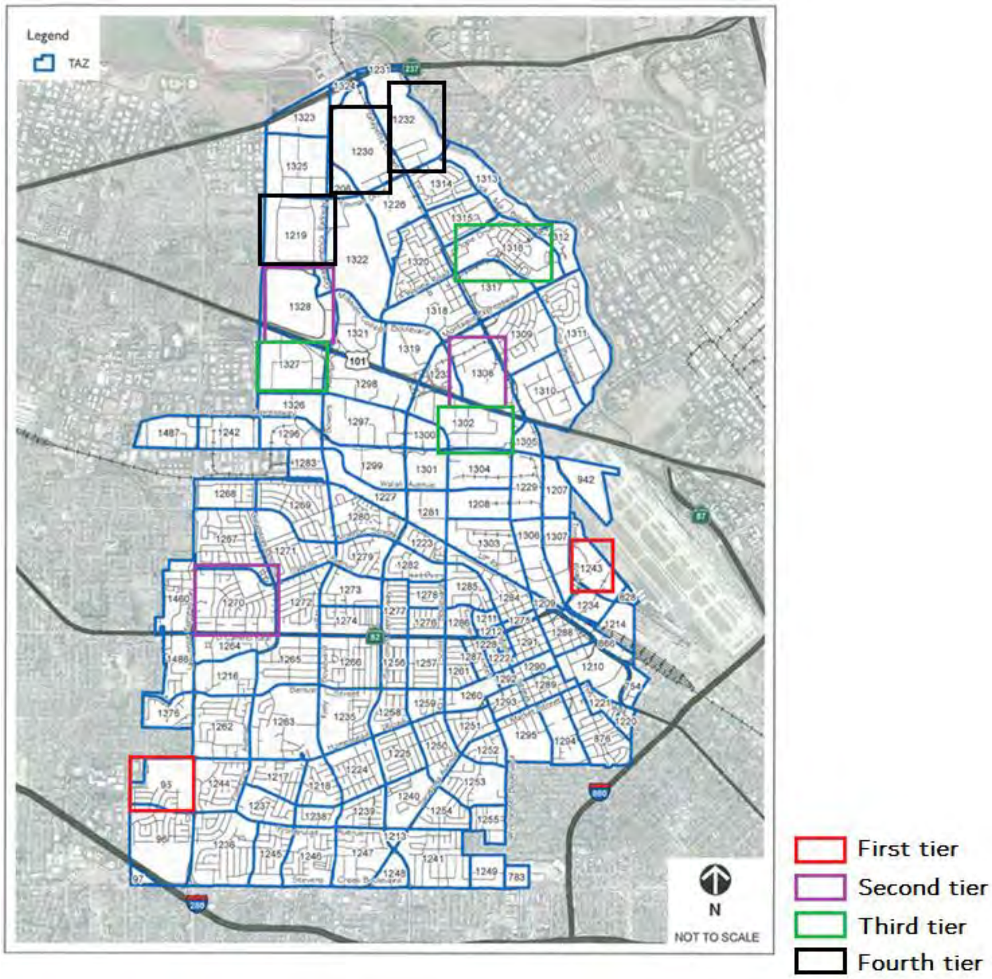
Source: EV Blueprint Team

The three PEV adoption forecasts also provided the foundation for estimating PEV charging infrastructure and the resultant incremental electric load SVP could expect. The EV Blueprint Team forecast the number of Level 2 and DC Fast Charge connectors required within The City to support each adoption scenario. Based on the PEV adoption forecasts, the EV Blueprint Team calculated the greenhouse gas impacts and the social cost of carbon for each adoption scenario and found the base case adoption scenario is expected to reduce CO_2 emissions by 33,456 MT CO_2 by 2030, reducing City transportation emissions by 14% from 2008 levels and by 7% from 2016 levels. Further, the high case adoption scenario offers potential to reduce emissions 26% from 2008 levels and 19% from 2016 levels by 2030 totaling to 96,700 MT CO_2.

The EV Blueprint Team also applied current California PEV charging patterns from the CEC to determine the PEV charging hourly load profile and the impact on The City's system peak. Combining these forecasts with local traffic analysis and current SVP feeder load and limits, revealed traffic analysis zones (TAZs) where PEV charging will be needed and the electric network may be challenged to support charging. Figure 2 maps prioritized TAZs based on traffic pattern demand and current charger availability. Table 15 further details the rationale for each tier.

2 The EV Blueprint uses the term "connectors" as defined by the CEC to refer to what is commonly known as "ports" or "plugs".

Figure 2: PEV Charging Demand by TAZ



Source: EV Blueprint Team

With the foundation in place, the EV Blueprint Team identified the key drivers of light-duty, commercial and city-owned PEV adoption. Many drivers were noted and discussed. Some, such as PEV model availability, could substantially spur adoption, but Santa Clara will have no ability to steer auto manufacturers to accelerate PEV development. Others, such as site permitting and local building codes, can impact PEV charger development by driving development schedules or increasing costs, and these The City can influence.

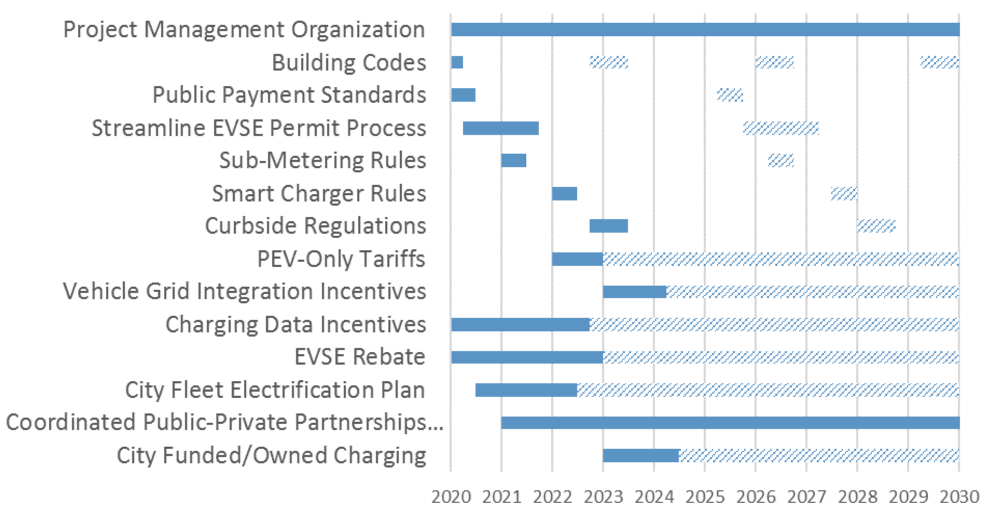
Through a series of workshops, the drivers and The City's ability to influence each were discussed, and ultimately the drivers were prioritized to provide a basis for Blueprint development. Fundamentally, The City determined that it could have the most impact on adoption by increasing charger availability through a variety of means. The identified priorities were as follows:

- Priority 1: MUD/Low-Income Charging Availability, City Fleet Electrification, and DAC Charging Availability
- Priority 2: Electric Grid Modernization, City-owned Site Charger Availability, Retail Site Charging Availability, and Other Public Charging Availability

- Priority 3: Workplace Site Charging Availability, Transit Fleet Electrification, PEV Total Cost of Ownership, and PEV Model Availability

The EV Blueprint Team then determined a series of projects which would become elements of the Blueprint that would propel or enable those drivers designated priority 1 or 2. The EV Blueprint Team developed high-level project plans for each, including a description, EV Blueprint Team roles and members, timeline, level of effort, funding requirements, and risk mitigation plans. Figure 3 presents the timeline for these program initiatives. It was agreed that a program spanning many City departments, extending for years, and requiring millions in funding needed a formal program management organization to drive delivery, ensure continuity, and provide stakeholder transparency. While the program is expected to continue through 2030, the bulk of the total $5.13 million and 22,420 hours of effort will be applied before 2025.

Figure 3: Timeline of EV Blueprint Program Initiatives[3]



Source: EV Blueprint Team

The detailed process and analysis by which the EV Blueprint was developed is presented in Tasks 2 through 4 of this report. While the resultant Blueprint is specific to Santa Clara, the design process and the lessons learned, and design process developed through this effort provide a starting point for other cities seeking to develop robust quantifiable EV Blueprints.

3 Timeline shows dashed-blue bars, highlighting optional continuation of each program initiative; these are not included within the budget and effort of the program initiatives.

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CHAPTER 1: Introduction

This introduction highlights goals of the California Energy Commission (CEC) grant – award number GFO-17-604 – and includes descriptions of the City of Santa Clara (The City), Silicon Valley Power (SVP), and Siemens Energy Business Advisory (Siemens).

California Energy Commission (CEC) Grant – Award GFO-17-604

California (CA) intends to revolutionize the way we travel. While the stakes are high, mass Plug-in Electric Vehicle (PEV) adoption is not guaranteed. The lack of a holistic plan that incorporates the multiple and complex building blocks needed to enable widespread Transportation Electrification (TE) poses a very real threat to the state's transit goals.

On December 14, 2017, the California Energy Commission (CEC) released a Grant Solicitation and Application Package entitled "Electric Vehicle (EV) Ready Communities Challenge, Phase I – Blueprint Plan Development" under the Clean Transportation Program. This competitive grant solicitation was an offer to fund project teams to accelerate the deployment of electrified transportation within the local and regional levels with a holistic and futuristic view of regional transportation planning. This solicitation was for Phase I of an expected two-phase effort for electric vehicle (EV) ready communities. Phase I is for the development of the planning blueprints to identify the actions and milestones needed to proceed toward implementation of the EV ready community. Successful applicants under this solicitation will have the opportunity to submit completed blueprints to compete for and receive future funding under Phase II for implementation of their completed blueprints.[4] The CEC's grant solicitation is for the development of an EV Blueprint applicable not only to one specific city (in this case the city of Santa Clara), but is also a Blueprint that can be used repeatedly in other California cities.

The City of Santa Clara received approval for the Santa Clara EV Ready Communities Blueprint Development in July 2018. This project consists of $199,921 in CEC funds with $100,286 in matched funds by the project team. The Santa Clara EV Ready Communities Blueprint Development is to be delivered to the CEC no later than July 1st, 2019 to be eligible for Phase II funding.

Our team – City of Santa Clara (The City), Silicon Valley Power (SVP), and Siemens Energy Business Advisory (Siemens) – together described as **"the** EV Blueprint T**eam"** has created a strategic and comprehensive plan based on the Siemens EV-Implementation Framework (EV-IF).

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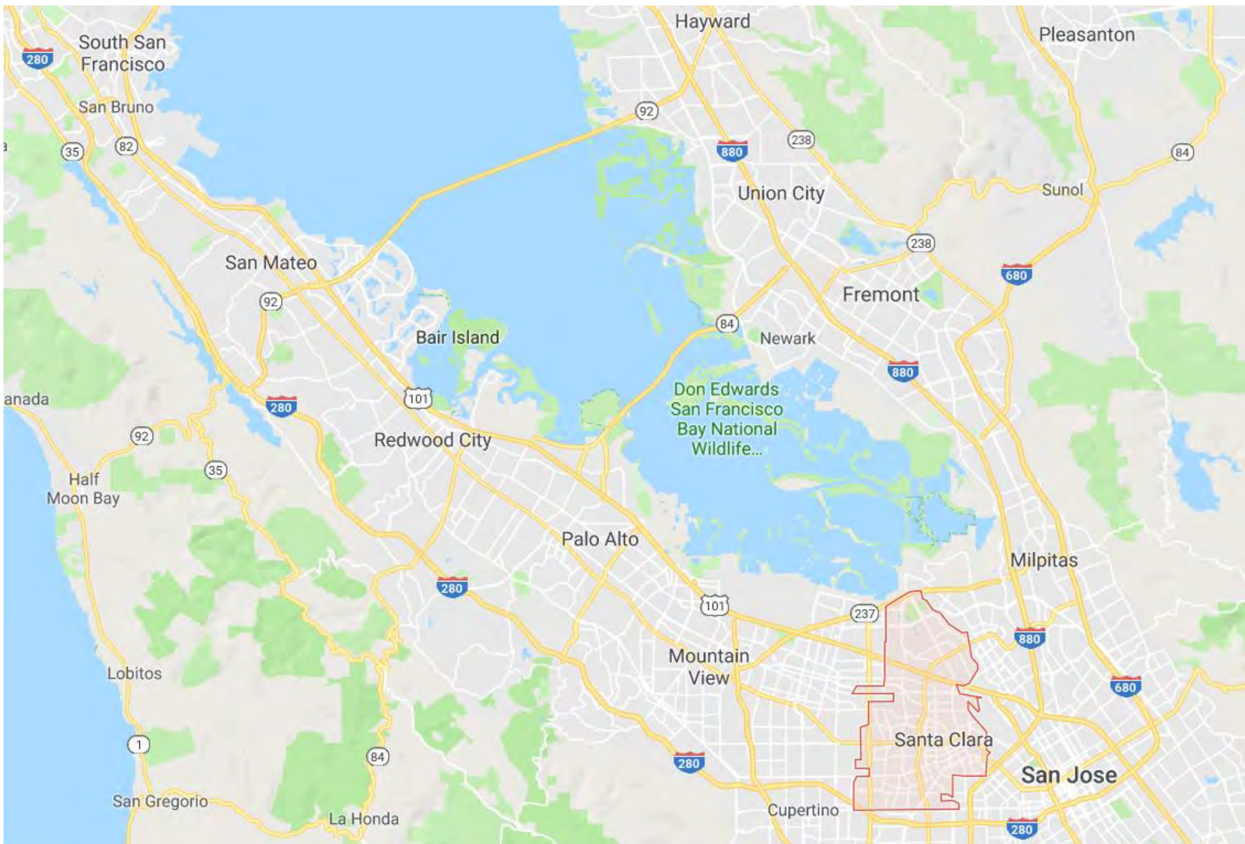
4 https://www.energy.ca.gov/contracts/GFO-17-604_NOPA_revised.pdf

City of Santa Clara (The City)

Located in the heart of the Silicon Valley, the City of Santa Clara is a typical, mid-size city in California, representative of perhaps 90 other cities. With its population of approximately 129,000, Santa Clara is sized roughly at the median of this representative cities group starting with the 9th largest, Bakersfield, at 347,000, and decreasing to the 100th largest, Napa, at 77,000. The City is located within the San Jose metropolitan area located south of the San Francisco Bay, as shown in Figure 4.

Figure 4: Map of the City of Santa Clara

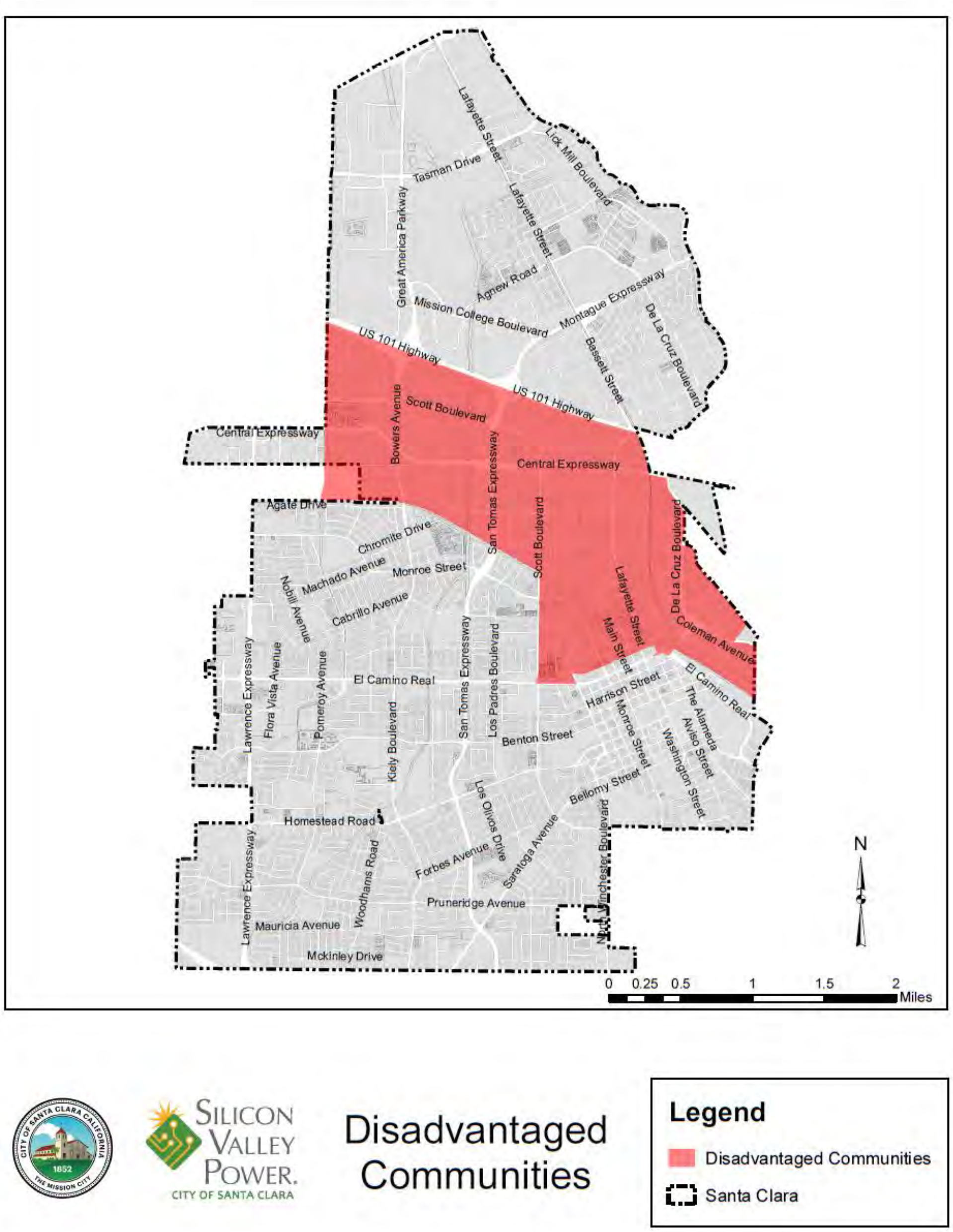


Source: Google Maps

The City, like nearly all the others in this group, has a school system, public safety agencies, a variety of engaged community groups, a mix of public and private transit, a range of streets and roads, both residential and business districts, urban and suburban characteristics, and so on. Like many mid-size cities, The City also has a university. In addition, The City has a substantial

Disadvantaged Community (DAC)[5], in part a result of having a heavily-traveled portion of U.S. Highway 101 and the San Jose International airport; the DAC is shown in Figure 5.

Figure 5: Santa Clara Disadvantaged Community



Source: SVP

The City is also home to the world's most innovative companies, several of which have already changed the way the world lives, works, learns, plays, and communicates. The EV Blueprint Team

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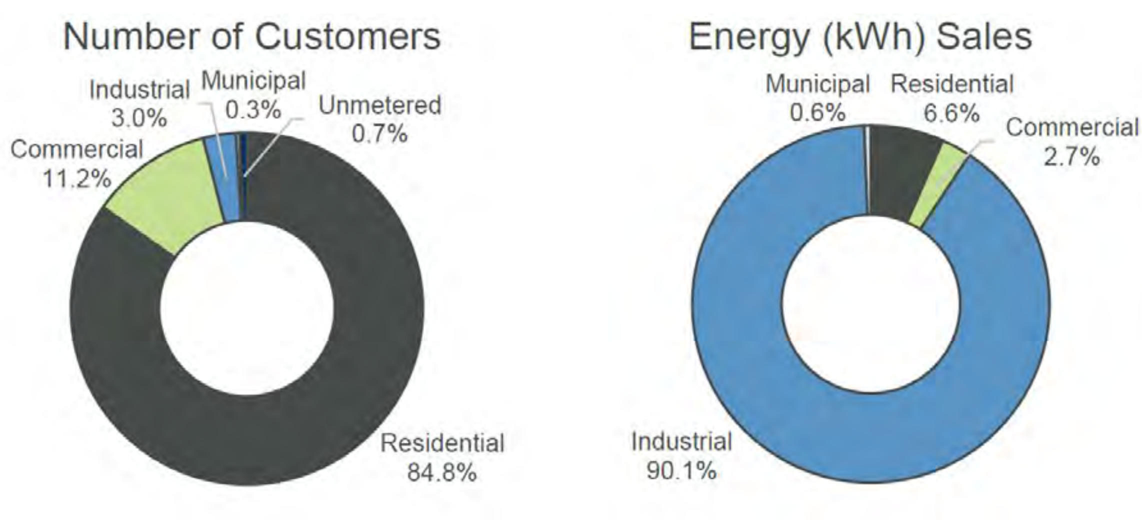
5 Disadvantaged communities are defined by the Office of Environmental Health Hazard Assessment, on behalf of the California Environmental Protection Agency as the top 25% scoring areas from CalEnviroScreen along with other areas with high amounts of pollution and low populations. (https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30)

has received letters of support from Tesla, Bay Area Council, Mission College, Santa Clara Intel, Silicon Valley Clean Cities, Nvidia, Northern California Power Agency, and the Environmental Defense Fund, and received input from a wide range of city stakeholders. It seems to be the ideal community to lead a revolution in the way we travel.

Silicon Valley Power (SVP)

Like 43 other cities in CA, Santa Clara has a municipal electric utility. On July 23, 1896, the Santa Clara Board of Town Trustees authorized the creation of the municipal electric utility. Over 120 years later – in March 1998 – the electric utility took the name Silicon Valley Power (SVP). The name change was in recognition of the vital role the utility plays in serving a growing community of innovation and technology, as SVP powers some of the largest world-class high-tech companies. As a city-owned, not-for-profit municipal electric utility, SVP runs a socially and environmentally responsible business, and partners with their customers and the broader community to promote and support environmental and social goals. SVP owns and operates seven generating plants and 30 substations, in addition to contracting for a share of numerous hydro, wind, solar, and gas resources in CA and neighboring states. SVP serves customers through approximately 56,000 meters in the City of Santa Clara; these customers are categorized by class in Figure 6.

Figure 6: Silicon Valley Power Customer Base, 2017



Source: SVP Utility Fact Sheet, Jan – Dec 2017

SVP has a unique customer makeup, as it serves both a livable residential community and a hub for the large commercial and industrial enterprises that make Silicon Valley the thriving technology center it is today. SVP is also in the unique position of experiencing load growth and has been making significant investments to serve new customer demands on the electric system. From 2011-2014, SVP saw a steady 2 to 3 percent increase in demand, and from 2015-2017 the average growth increased 5 percent or more each year. As more large-scale projects (including data center new builds, and mixed-use commercial and residential projects) are being developed and planned in The City, SVP will continue to expand the system to meet the needs of their growing customer base.

SVP's mission is to provide safe, reliable, affordable, and sustainable energy services dedicated to the benefit of The City and its customers. SVP understands, within this mission, that the utility role is core to the creation of an EV ready community. That role is unique, works hand in hand with The City administrative departments and agencies, and includes:

- Ensuring the grid is prepared to support PEV charging;
- Planning for and participating, as appropriate, in the cost-effective deployment of the PEV charging infrastructure; and
- Providing education for its customers – who are also The City's residents and businesses – on the benefits of PEVs and associated information, such as smart charging and time-of-use (TOU) rates to reduce the cost of PEV ownership.

Siemens Energy Business Advisory

A $90 billion company that has been in business for over 165 years, Siemens has focused on delivering safe, scalable, and cost-effective energy solutions across the globe. Siemens manufactures tens of millions of electrical distribution products for residential, commercial, industrial, and utility customers each year. Our software is used to manage tens of millions of smart meters and the data that they generate, as well as thousands of electric vehicle supply equipment components. Siemens is at the forefront of digitalization, decarbonization, and decentralization in the energy industry. Our global footprint enables us to leverage equipment and solutions developed and applied around the world, to bring best practices to our customers.

Transportation electrification requires subject matter experts in fields that typically do not work together. During the last 10 years, Siemens Energy Business Advisory has worked aggressively with various stakeholders, globally, to enable the shift from conventional to electric vehicles. Siemens collaborates with governmental and regulatory bodies, automobile OEMs, utilities and other industry partners (e.g., automotive and battery manufacturers, start-ups, etc.) to support the development of eMobility markets. As a matter of policy, we support open standards, interoperability, and socio-economic development. In efforts to provide turnkey eMobility solutions, Siemens brings knowledge from each of these core competencies together using our proprietary Electric Vehicle Implementation Framework (EV-IF).

CHAPTER 2: Task 1: Project Management

The CEC funding has been budgeted into four approved Tasks for completing the EV Blueprint, and the EV Blueprint chapters follow the Task structure for the report structure. Task 1 included funding for general project management throughout the twelve month EV Blueprint development. Both Siemens and SVP worked together to:

- provide monthly project update submittals to the CEC
- present a mid-project critical path review to the CEC
- meet weekly to monitor schedule, budget, and quality
- manage all miscellaneous tasks associated with delivery of a complete EV Blueprint

Task 1 has been completed to ensure Task 2 through 4 deliver quality analysis to The City within the budget provided by the CEC's grant funding.

CHAPTER 3: Task 2: Defining Blueprint Goals and Requirements

This section describes the first stage of the Siemens EV-IF in which the foundation for development of the Blueprint was established. The process for setting this foundation was conducted in four steps. The first step was to identify and understand the perspectives of impacted and interested internal and external stakeholders. The second step was to determine the current state of Transportation Electrification (TE), particularly with regards to vehicle adoption, charging infrastructure, and supporting programs and policies. The third step was to forecast long-term Plug-in Electric Vehicle (PEV) adoption scenarios for The City and analyze their influence on emissions reductions, grid impacts, Electric Vehicle Supply Equipment (EVSE) installations, societal benefits, disadvantaged community assistance, interoperability, and funding. The fourth step was to identify and prioritize a range of quantifiable and qualitative goals the Blueprint should meet.

To establish the Blueprint fact foundation, the EV Blueprint Team interviewed key stakeholders, reviewed numerous planning, policy, and program documents from The City, and developed three PEV adoption scenarios to forecast the quantitative impacts of PEV adoption on emissions and the grid. This foundation provided The City a clear understanding of how PEV adoption could occur, how SVP and other departments of The City might promote adoption, and the potential effects of that adoption. From this basis, the EV Blueprint Team developed quantifiable and qualitative Blueprint goals.

The foundational research and analysis are discussed below in four sections: *Stakeholder Identification and Perspective, Current Transportation Electrification Status, Long-Term Planning Analysis, and Blueprint Goal Development and Selection*

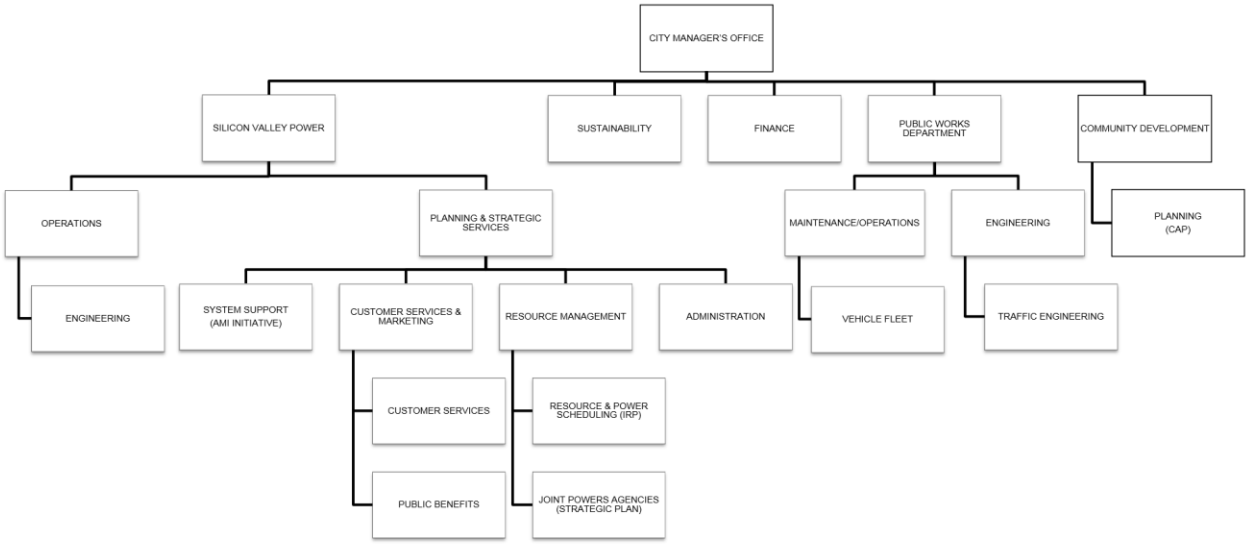
Stakeholder Identification and Perspective

Developing an EV Blueprint began with identifying the internal and external stakeholders to create a unified city plan for TE. Through requests for information, interviews with department and program managers, and stakeholder survey questions, the EV Blueprint Team identified key internal and external TE stakeholders.

Internal Stakeholders

Leaders for the affected departments within The City received data requests and were interviewed by the EV Blueprint Team. The interviews focused on understanding the potential impact of TE on the department's operations and their contribution to the EV Blueprint development project. Figure 7 illustrates The City's internal departments that are stakeholders for the EV Blueprint.

Figure 7: Internal Stakeholders – City of Santa Clara Organizational Chart



Source: EV Blueprint Team

The EV Blueprint Team determined points of contact, department specific inputs available to support Blueprint development, and what those departments would like to receive from the Blueprint project. Table 1 describes the information that the EV Blueprint analysis uses from each internal stakeholder, as well as the information each internal stakeholder is most interested in receiving from the EV Blueprint analyses.

Table 1: Internal Stakeholder EV Blueprint Roles

Internal Stakeholder	*Internal Stakeholder Organization*	*Inputs*	*Outputs*
Resource & Power Scheduling	*SVP > Planning & Strategic Services > Resource Management*	• *Integrated Resource Plan Assumptions*	• *PEV Load Impacts* • *PEV Adoption Scenarios*
Joint Powers Agencies	*SVP > Planning & Strategic Services > Resource Management*	• *2018 Strategic Plan Goals and Initiatives*	• *Requirement Gaps*
Customer Services	*SVP > Planning & Strategic Services > Customer Service & Marketing*	• *Stakeholder Outreach*	• *Survey Results*
Public Benefits	*SVP > Planning & Strategic Services > Customer Service & Marketing*	• *PEV Rebate Program* • *PEV Pilot Programs*	• *Funding Analysis*
System Support (OT)	*SVP > Planning & Strategic Services*	• *Advanced Metering Infrastructure Plan* • *Smart Meter Equipment Capabilities*	• *Separate PEV Charging Rates* • *Protocols/Standards* • *Data/Billing System*
Engineering	*SVP > Operations*	• *Substation Feeder Data* • *Distributed Energy Resource (DER) Solar* • *Distribution Master Delivery Plan*	• Charging Station Location Analysis
Vehicle Fleet	*Public Works > Maintenance & Operations*	• *City-owned Vehicle Fleet Data* • *Procedure for Acquiring New Vehicles/EVs* • *PEV Procurement plans*	• *Charging Station Location Analysis*
Traffic Engineering	*Public Works > Engineering*	• *Traffic Analysis Zones (TAZ) Region Data*	• *Charging Station Location Analysis*
Planning	*Community Development*	• *Climate Action Plan (1.0) Assumptions* • *Permitting Processes* • *Zoning*	• *Climate Action Plan (2.0) Considerations* • *PEV Greenhouse Gas (GHG) Impacts* • *Recommended Charger Permit Processes* • *Charging Station Location Analysis*
Assistant to City Manager	*Sustainability*	• *Council Goals* • *Stakeholder Outreach*	• *Council Communication and Liaison*

Source: EV Blueprint Team

As the electric utility for The City, SVP is the main stakeholder engaged in the development of the EV Blueprint. Within SVP, the Planning & Strategic Services Department plays a major role in developing the EV Blueprint. The EV Blueprint Team worked closely with SVP, which released both a Strategic Plan and an Integrated Resource Plan in 2018. Both these long-term planning engagements provide inputs and guidelines for the goals and capabilities of SVP with regards to TE.

The EV Blueprint Team collaborates with SVP's Resource Planning and Customer Engagement Division. This division spearheads the customer engagement led by the Key Customer Services program and the PEV promotional and pilot programs led by the Public Benefits program. The Advanced Metering Initiative (AMI) is led by SVP's Systems Support (Operational Technology) division.

Aside from SVP's Planning & Strategic Services Department the EV Blueprint required technical analysis of grid impacts caused by added consumption of electricity and of installation requirements for safe/reliable EVSE. Thus, SVP's Engineering division within the Operations Department was a critical stakeholder to provide information to and receive information from the EV Blueprint.

Outside of SVP, The City's Public Works Department encompassed some of the necessary teams to ensure a coordinated EV Blueprint analysis. Within this department, the Engineering division contains a team of transportation engineers. This team is responsible for providing city transportation data to analyze flow of traffic. Meanwhile, the Public Works Department's Maintenance & Operations division has a team responsible for The City's vehicle fleet. Understanding of current vehicle fleet data and future procurement plans helped development of the EV Blueprint.

The City's Community Development Department also has a role in the EV Blueprint.[6] Their mission is to plan for, and review, the development and maintenance of the privately-owned physical environment of The City. The Planning division is responsible for general planning, permit application processes, and zoning. In addition, the Planning division has a team responsible for The City's Climate Action Plan (CAP). A new CAP 2.0 is planned to be developed by the end of 2019, but the assumptions from the CAP 1.0 2018 update were assessed for the EV Blueprint.

The Assistant to the City Manager has a role in all sustainability activities within The City. With regards to the EV Blueprint, this new city position provides input based on City Council goals and will help to lead communication of the EV Blueprint findings and implementation to City Council.

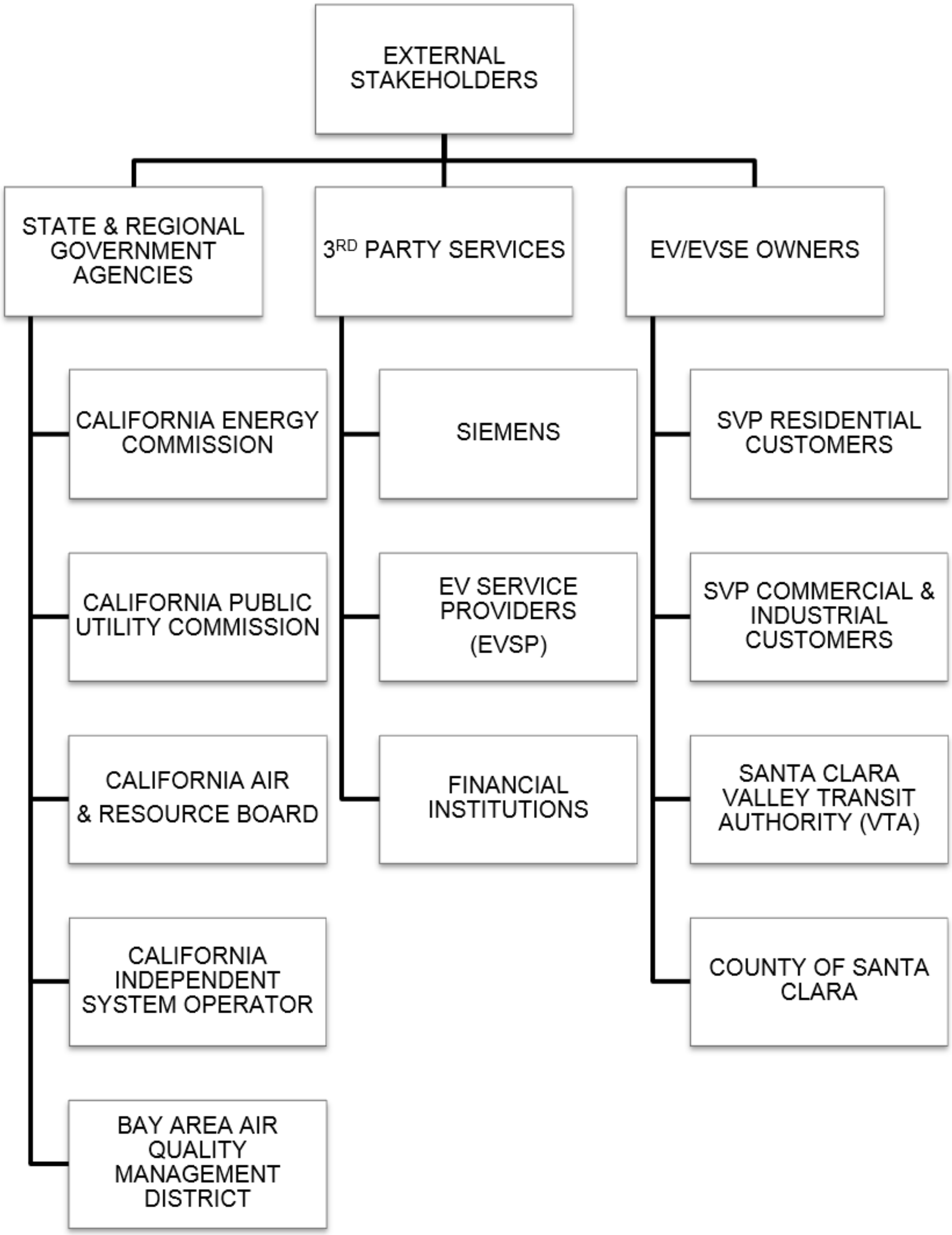
External Stakeholders

External stakeholders were identified from Santa Clara's electric customers, professional service providers, and regulatory entities that oversee The City.

Figure 8 presents an organizational chart of the external stakeholders involved in the EV Blueprint. Each external stakeholder received data requests, stakeholder engagement surveys, and/or necessary action items for further involvement in the EV Blueprint. For each stakeholder, the EV Blueprint Team determined points of contact, inputs available to support Blueprint development, and what those stakeholders would like to receive from the Blueprint project; these are shown in Table 2.

6 http://santaclaraca.gov/government/departments/community-development/planning-division

Figure 8: External Stakeholders – Organizational Chart



Source: EV Blueprint Team

Table 2: External Stakeholder EV Blueprint Roles

External Stakeholder	Internal Stakeholder Organization	Inputs	Outputs
California Energy Commission	*Government Agencies*	• *Grant Funding* • *Deliverable Reviews* • *Policy Requirements*	• *Repeatable*[7] *City EV Blueprint*
California Public Utilities Commission	*Government Agencies*	• *Policy Requirements*	• *Repeatable City EV Blueprint*
California Air Resources Board	*Government Agencies*	• *Policy Requirements*	• *Repeatable City EV Blueprint*
California Independent Service Operator	*Government Agencies*	• *Grid Modernization Requirements*	• *N/A*
Bay Area Air Quality Management District	*Government Agencies*	• *Policy Requirements* • *Requests for Proposals*	• *Proposed Partnership Opportunities*
SVP Residential Customers	*Citizens & City Commuters*	• *Stakeholder Survey*	• *PEV Charger Rebate Programs* • PEV Tariffs
SVP Commercial & Industrial Customers	*PEV/EVSE Owners*	• *Stakeholder Survey*	• *Time of Use Rate Impacts* • *EVSE Ownership Models* • *Infrastructure Costs*
Santa Clara Valley Transit Authority	*PEV/EVSE Owners*	• *Bus Fleet Data* • *Bus Procurement Plans*	• Charging Station Location Analysis
County of Santa Clara	*PEV/EVSE Owners*	• *"Driving to Net Zero" Study*	• N/A
Siemens	*3rd Party Services*	• *EV Implementation Framework*	• *N/A*
EV Service Providers	*3rd Party Services*	• *Plans for The City*	• *N/A*
Financial Institutions	*3rd Party Services*	• *Available Funding*	• *N/A*

Source: EV Blueprint Team

To ensure that the state's energy is safe, affordable, reliable, and clean, California has four primary governing institutions: the California Energy Commission (CEC), the California Public Utilities Commission (CPUC), the California Air Resources Board (CARB), and the California Independent System Operator (CAISO). Although these four state institutions have similar goals and often work together, their roles, responsibilities, and structures are distinct from each other. The CEC serves as the state's primary policy and planning agency and has specific and limited regulatory authority over the state's 44 publicly owned utilities (POUs) that together serve approximately one-quarter of the state's electricity demand. The CPUC establishes policies and rules for electricity and natural gas rates and services provided by private utilities in California. While the CPUC does not regulate publicly owned utilities such as SVP, such utilities may

7 The CEC's grant solicitation is for the development of an EV Blueprint applicable not only to the city of Santa Clara, but one that can also be replicated in other California cities.

consider CPUC policies when developing their own approaches. CARB, partnered with the Federal Environmental Protection Agency (EPA), is charged with protecting the public from the harmful effects of air pollution and developing programs and actions to fight climate change. The CAISO manages flow of electricity to keep power moving to homes and communities. All four of these government agencies develop regulations that must be considered in the EV Blueprint for any city, though the CPUC's role is much smaller for publicly owned utilities. Regionally, the Bay Area Air Quality Management District (BAAQMD) serves as an air quality authority in the development of policy and establish the Bay Area as a leading area for emissions reductions through incentives and partnerships. As mentioned in the Introduction, the CEC provided the funding for this EV Blueprint and thus is a large external stakeholder. In addition to reviewing the methodology, the results, and the deliverables, the CEC provides The City with public studies on transportation electrification.

In addition to government agencies, the EV Blueprint Team included PEV and EVSE owners as external stakeholders of the EV Blueprint. Electricity customers that own either PEVs or ESVEs can be broken into two categories: Residential or Commercial & Industrial (C&I). Both stakeholder types provided input on their equipment/vehicles and expectations from the EV Blueprint via the stakeholder survey. For both sets of customers the EV Blueprint provided knowledge on PEV rebates and public charging processes. For C&I customers specifically, the EV Blueprint provided additional knowledge on Time of Use (TOU) rate impacts and demand response considerations.

As part of the development of an EV Blueprint for any city, 3rd party stakeholders should be considered. The City is using Siemens' EV-IF process and expertise to facilitate the EV Blueprint and provide the extensive analysis required for the EV Blueprint. Additionally, Electric Vehicle Service Providers (EVSPs) and financial institutions were approached to request their plans for servicing The City.

Current Transportation Electrification Status

The next step of the EV Blueprint for The City was a thorough assessment of the current state of electrification. This assessment included estimating the current plug-in electric vehicle adoption, current electric vehicle charge connectors, external stakeholder survey results, city programs in place for PEV adoption, and current funding availability.

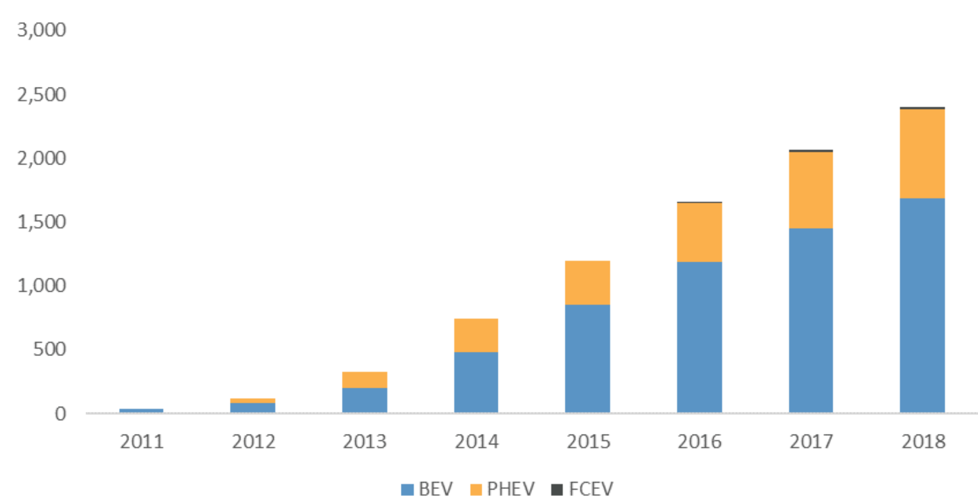
Current Plug-in Electric Vehicle Adoption

Estimated Number of PEVs Within The City

Using CARB's Clean Vehicle Rebate Project (CVRP), which began tracking rebates for purchased zero-emission vehicles (ZEVs) in 2011, the EV Blueprint Team estimated the number of light-duty[8] PEVs registered within The City.[9] Note that not all plug-in hybrid, all-battery, and fuel cell electric vehicles sold/leased in the state are captured in this database. Not every eligible vehicle owner applies to the CVRP, and not every clean vehicle is eligible for the rebate. Over the first five years of the program, owners of about 75% of eligible vehicles participated in the rebate project. If available, using Department of Motor Vehicle (DMV) registration data is a preferred source for a more accurate estimate of current PEV adoption within a city; that data can also provide information on vehicle class for commercial vehicles. However, neither of these sources' forecasts vehicle ownership trends or inflow of traffic from surrounding areas.

From 2011 through November 19th, 2018, ZEV rebates have been collected on 2,427 vehicles within SVP's territory, accounting for $5,530,378 in incentivized rebates for PEV adoption. Vehicle types eligible for ZEV rebates included Battery Electric Vehicle (BEV), Plug-in Hybrid Electric Vehicle (PHEV), and Fuel Cell Electric Vehicle (FCEV) types. Figure 9 shows the cumulative growth of ZEV rebates within SVP territory, by vehicle type, from 2011-2018. A slight decline in annual rebates is most likely to occur in 2019 due to popular rebate-eligible vehicles sold in the U.S. reaching a cumulative total of 200,000, as measured by manufacturer. Any of those vehicles purchased after that point receive declining federal PEV rebates that eventually go to zero.

Figure 9: Cumulative SVP ZEV Rebates by ZEV Type, 2011-2018



Source: EV Blueprint Team; CARB CVRP

Nationally, the number of PEVs is split roughly equally between BEVs and PHEVs (at 49% and 44% of total U.S. light-duty vehicles, respectively).[10] However, The City ZEV adoption is primarily BEV with 69.5% of cumulative rebates, while PHEVs account for 29% of cumulative rebates.[11]

8 Light-duty vehicles are defined as personal vehicles with a maximum Gross Vehicle Weight Rating (GVWR) < 8,500 lbs. Vehicles >8,500 lbs. are considered commercial vehicles within the EV Blueprint.
9 https://cleanvehiclerebate.org/eng/rebate-statistics
10 https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/
11 FCEVs account for 1.5% of ZEV rebates.

The City has approximately 75,000 light-duty vehicles registered[12], so the 2,427 ZEVs mentioned above represent roughly 3.2% of the registered light-duty vehicles within The City are PEVs. The City PEV market share is well above the national average (1%) but slightly below the California average (4%).

The City Vehicle Fleet

Note that the above data does not include fleet vehicles that entities, like The City, have acquired. In total, The City owns 489 vehicles; these are presented by vehicle class in Table 3.

Table 3: Santa Clara City-owned Vehicle Fleet Summary

Vehicle Type	Vehicle Class	# of Vehicles	% of Fleet
Motorcycles	Light-duty	15	3%
Sedans	Light-duty	90	18%
Full Size Patrol	Commercial	52	11%
Vans	Commercial	28	6%
Truck (1/2 Ton)	Commercial	65	13%
Truck (3/4 Ton)	Commercial	60	12%
SUV	Light-duty	60	12%
Truck (1 Ton)	Commercial	27	6%
Truck (> 1 Ton)	Commercial	92	19%
Total Fleet		489	100%

Source: City of Santa Clara Public Works Department

Although The City owns a variety of class 1-8 vehicles[13], The City is currently focused on electrifying the sedan fleet; a total of 90 vehicles (18% of the fleet). As more commercial trucks and SUV models are available, The City may consider electrifying these vehicles as well. Also note that The City does not own the bus fleet, which would present a prime target for vehicle electrification.

Typically for procurement, The City's Fleet Management group[14] manages a vehicle replacement fund (VRF), and all vehicles/equipment within the fund are analyzed on a yearly basis for replacement. As units are identified for replacement, Fleet Management meets with using departments to determine the needs of the replacement units. At this time PEVs or other alternative fueled options are considered if cost effective. A Green Fleet Policy is currently being developed; this will allow The City to purchase PEVs, providing that the life-cycle costs for the PEVs are within a certain dollar amount of life-cycle costs of their non-PEV counterparts.

The City is currently working on electrification of the 90 city-owned sedans[15], thus the team has analyzed the sedan vehicle data such as model type, fuel type, model year, current mileage, and

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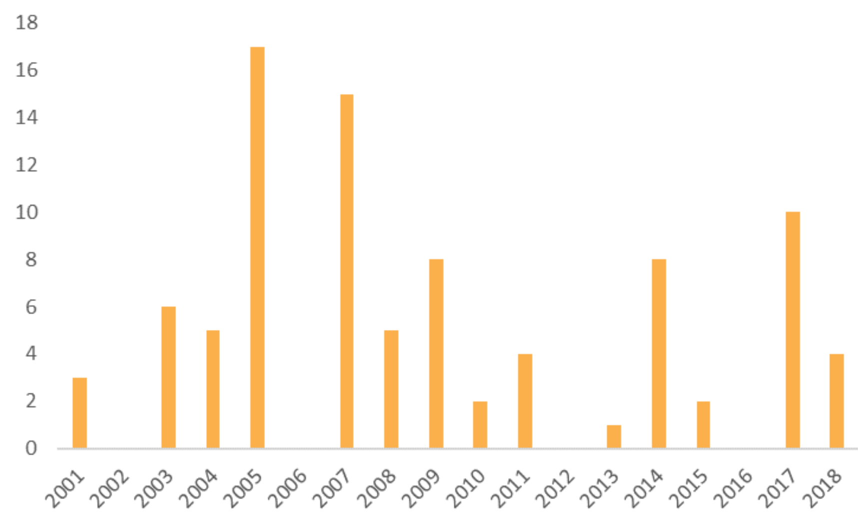
12 https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
13 https://www.arb.ca.gov/msprog/mailouts/ecars1801/atch_3_vehicle_class_definitions.pdf
14 The City's Fleet Management group operates within The Public Works Maintenance and Operations division.
15 Sedans are considered light-duty vehicles.

life expectancy. The City has begun introducing PEVs to their sedan fleet by adding four Chevrolet Bolts (BEVs) and two Chevrolet Volts (PHEVs). Figure 10 presents the 90 vehicles in the sedan fleet by model year, to illustrate the potential replacement rate of the fleet.

Figure 10: Santa Clara Sedans by Model Year



Source: EV Blueprint Team; City of Santa Clara Public Works Department

With a 12-year life expectancy assumed by The City, there is a potential to replace the entire sedan fleet by 2030 with electric vehicles. By 2020, there will be significant opportunity to replace 58% of the sedan fleet purchased before 2009 with PEVs. However, total mileage also plays a role in vehicle replacement. The City sedan fleet has a low average annual vehicle mileage of 3,643, well below the state average for light-duty vehicles. Thus, life expectancy may last longer than the 12 years expected by The City. Only three vehicles within the fleet have over 100,000 miles.

Transit Fleets

Unlike some other cities, The City does not own the transit authority. In 1994, the Santa Clara Valley Transit Authority (VTA) became the Congestion Management Agency in Santa Clara County, undertaking the responsibility for countywide transportation planning and funding and for managing the county's blueprint to reduce congestion and improve air quality. VTA provides bus, light rail, and paratransit[16] services, as well as participates as a funding partner in regional rail service including Caltrain, Altamont Commuter Express, and Capital Corridor, all of which make scheduled stops in the southeastern corridor of The City across from Santa Clara University and the San Jose International Airport. Caltrain has a project which will electrify the line through The City.[17] SVP currently owns nine overhead utility lines that cross the involved Caltrain railroad tracks. In order to facilitate the Caltrain project SVP will have to raise six of these crossings to remove conflicts with the electrification projects. Design on the affected crossings

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16 Paratransit is recognized in North America as special transportation services for people with disabilities, often provided as a supplement to fixed-route bus and rail systems by public transit agencies.
17 https://calmod.org/wp-content/uploads/Caltrain_fsheet_1.2018_v3.pdf

started in the fall of 2017 and construction is expected to be completed in the summer of 2019. In order to support this project SVP has a $2,750,000 budget.

The VTA is currently developing their Valley Transportation Plan (VTP) which provides a planning and policy framework for developing and delivering future transportation projects over the next 25 years. The previous VTP[18] developed in 2014 does not plan for adoption of electric transit buses. However, as recently as December 2018, CARB approved a regulation that sets a statewide requirement for public transit agencies to gradually transition to 100% zero-emission bus fleets by 2040.[19] In light of California's statewide public transit goal, CARB is considering mandates that would start in 2020 to transition toward that goal. Buses last a minimum of 12 years, so to achieve the 2040 goal, no bus using diesel, natural gas or gasoline could be purchased after 2027. VTA has procured five Proterra electric buses for passenger services. In the passenger side, the VTA considers allocating 2% to 3% parking spaces for L2 PEV chargers in their commuter lots; however, partnerships and(or) incentives may help to increase charging availability at commuter parking lots.

In addition to the fleet transition to electric, VTA is teaming up with Prospect Silicon Valley, and Bay Area tech companies, to pilot a cutting-edge system that will charge those buses and track energy consumption while reducing the impact on the state's electricity grid. This four-year "Vehicle to Grid Integration" (VGI) project will be closely followed by the public transit industry and other transportation providers, as they begin planning for their own fleet transitions to electric buses.[20] One issue with V2G[21] applications for the VTA fleet, and many other bus fleets, is that buses tend to be in operation during the peak hours when V2G is required to support the grid.

Within The City, there are two main VTA bus route corridors within Santa Clara

1) Stevens Creek uses 60-foot buses, but this route is located on the outskirts of The City.
2) El Camino uses 40 to 60-foot buses within The City.

Both corridors have a local and rapid[22] route for buses. There are no VTA bus depots within The City boundaries; however, some of the buses end their route within Santa Clara. At the end of a route, buses typically stop for up to 30 minutes, an opportunity for on-route charging if needed in the future. These end of route stops are at Cal Train station and Tasman.

Based on data provided by VTA, Table 4 estimates which current VTA bus routes impact The City.

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18 http://vtaorgcontent.s3-us-west-1.amazonaws.com/Site_Content/VTP2040_final_optimized.pdf
19 https://ww2.arb.ca.gov/news/california-transitioning-all-electric-public-bus-fleet-2040
20 http://www.vta.org/News-and-Media/Connect-with-VTA/VTAs-New-Electric-Buses-Roll-Out-for-Passenger-Service#.XEdfuVVKiLs
21 V2G is defined as Vehicle to Grid bidirectional flow and is further defined in Task 4.
22 Rapid routes only go to major bus stops.

Table 4: VTA Bus Routes within The City

VTA Bus Routes through Santa Clara	Total[23]	Weekdays	Saturdays	Sundays
# of bus lines	74	58	41	33
Total Weekly Miles	40,123	6,294	4,691	3,961
Total Pounds of CO_2(e)	178,147	27,946	20,828	17,588
Daily Average Miles per Route	76	69	84	81

Source: VTA

The City bus routes together account for 9,263,657 pounds of CO_2 annually.[24] Although data is not available on the buses specific to The City routes, the average age of the active VTA bus fleet is 9.45 years. One major concern for electrifying bus fleets are requirements for on-site backup fuel. When bus fleets are electric fuel based, there is a need for back up generation which in the past has been dependent on diesel generators. Future electric bus depot designs may consider microgrid designs to ensure backup fuel – electricity – is available for fueling during SVP system outages.

In addition to the VTA, there are private fleets within The City that have the potential to adopt electric vehicles. A list of the largest private fleets within The City is included as Table 5.

Table 5: Largest Private Vehicle Fleets within The City

Organization	Address	Within DAC
US Postal Office	1451 Walsh	Yes
Santa Clara Unified	1889 Lawrence Rd	No
JJ Albanese	851 Martin	Yes
U-Haul	2440 Lafayette	Yes
Penske Truck Rental	2380 Lafayette	Yes
Mission Trail	1313 Memorex	Yes
Garden City Sanitation	1080 Walsh	Yes
Hertz	1000 Walsh	Yes
Meals on Wheels	1675 Walsh	Yes
Avis/Budget	2390 Lafayette	Yes
Wonder Ice Cream	1061 Martin	Yes
Owens Corning	960 Central	Yes
Rotten Robbie	2550 Lafayette	Yes
Costco	1601 Coleman	Yes
Carbonic Service	1920 De La Cruz Blvd	Yes
Air Products	1515 Norman	No

Source: EV Blueprint Team

23 Note that bus lines overlap between days and thus the total is not the sum of weekdays, Saturdays, and Sundays.
24 Estimates for pounds of CO_2 were made assuming 4.44 pounds of CO_2 per mile.

These organizations with fleet vehicles are important to consider in developing an EV ready community. Furthermore, the majority of these vehicle fleets are within The City's DAC.

Zero-Emission Vehicle (ZEV) Manufacturers

Of vehicles registered within The City, the six most popular manufacturers of ZEVs captured the vast majority of all electric vehicle rebates, as shown in Table 6.

Table 6: Top Auto Manufacturer Choices for ZEVs within SVP

Auto Manufacturer	Cumulative Vehicle Rebates (2011-2018)	Compound Annual Growth Rate (CAGR) 2015-2017
Nissan	611	-32%
Chevrolet	562	32%
Tesla	389	5%
Volkswagen	197	-6%
Toyota	181	60%
Ford	175	-6%

Source: EV Blueprint Team; CARB CVRP

While Nissan produced the most vehicles sold within The City through 2018, a negative compound annual growth rate (CAGR) indicates that their vehicle options are becoming less popular. However, ownership in PEVs from Chevrolet, Tesla, and Toyota has grown recently as evidenced by their strong CAGRs, which further suggests continued adoption of these manufacturers' vehicles in the near future.

Understanding of the new PEV model characteristics including range, cost, charging standards, etc., leads to important inputs in the long-term planning for The City. For example, Tesla vehicles have a charge connector that is not compatible with universal public charger protocols J1772[25] for Level 2 (L2) chargers and CHAdeMO for Direct Current Fast Charger (DCFC) chargers. A separate charging adapter is required. As a result, only five of the charge connectors within The City are compatible with those Tesla vehicles which do not have the adapters.

ZEV Consumer Information

In addition to vehicle type, consumer information is considered for the EV Blueprint. Of the 2,427 rebates collected for ZEVs, only 80 vehicles are for businesses; the remainder are owned by individuals. Zip code 95051, located on the west side of The City, is where the greatest number of the vehicles – 1,162 – are located. Furthermore, the majority of residences on the west side of The City are single-family homes. In addition, 96 rebates have been collected by consumers within The City's Disadvantaged Community (DAC), which represents approximately 4% of all ZEV consumers within The City.

25 SAE J1772 is a North American standard for electrical connectors for electric vehicles specific to Level 2 chargers.

Commuter Traffic

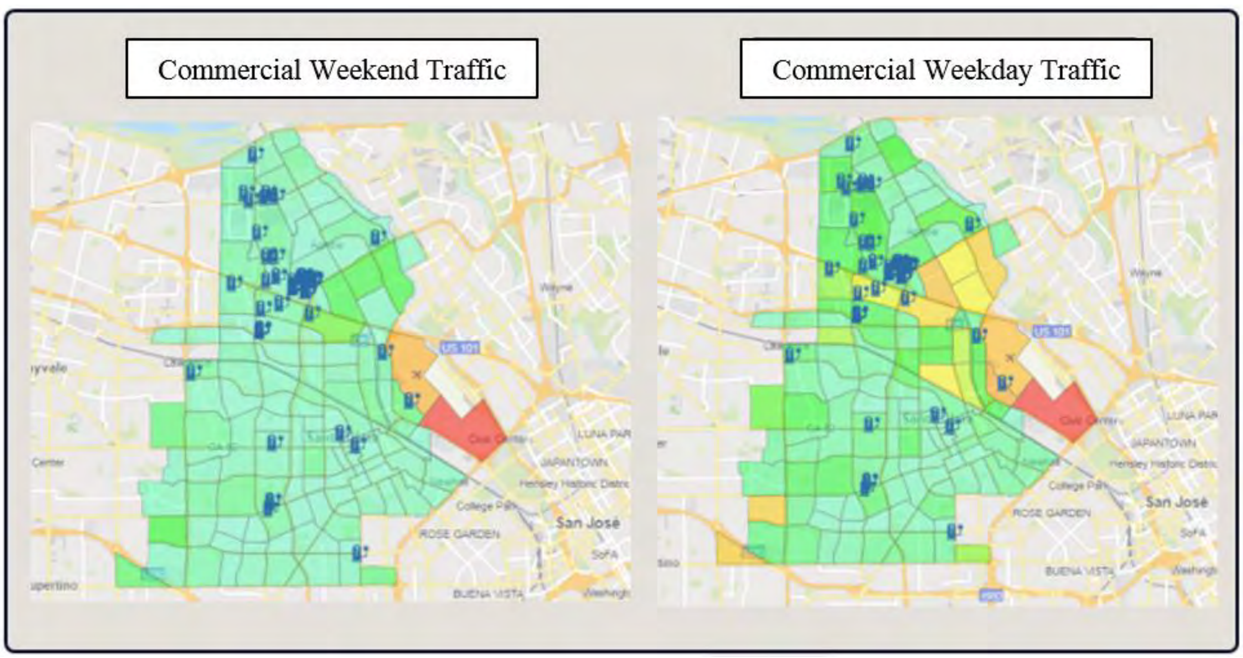
As mentioned earlier, since The City is home to many large businesses, there is considerable vehicle traffic from commuters who live outside the city limits, and work within its boundaries. As a result, there is also a significant commuter inflow of PEVs. Siemens developed a tool to analyze traffic flows through The City which will be discussed in detail in Task 3 of the EV Ready Communities Challenge.

The City has an unusually large number of commuters driving into the city. Depending on the time of day, the traffic from outside The City zip codes ranges from 15%-67% of the total traffic within The City. The City consistently experiences more than 60% of traffic from commuters between 8:00 am and 7:00 pm. Thus, the EV Blueprint needs to plan PEV infrastructure to support the commuters who will adopt PEVs.

Commercial and Light-duty Traffic, Weekends and Weekdays

In addition to commuter traffic, grid impacts to be assessed in Task 3 are dependent on evaluating commercial vs. light-duty vehicle traffic and weekend vs. weekday traffic. Figure 11 and Figure 12 present heatmaps of the traffic by traffic analysis zones (TAZ) for commercial vehicle and light-duty vehicle traffic respectively.

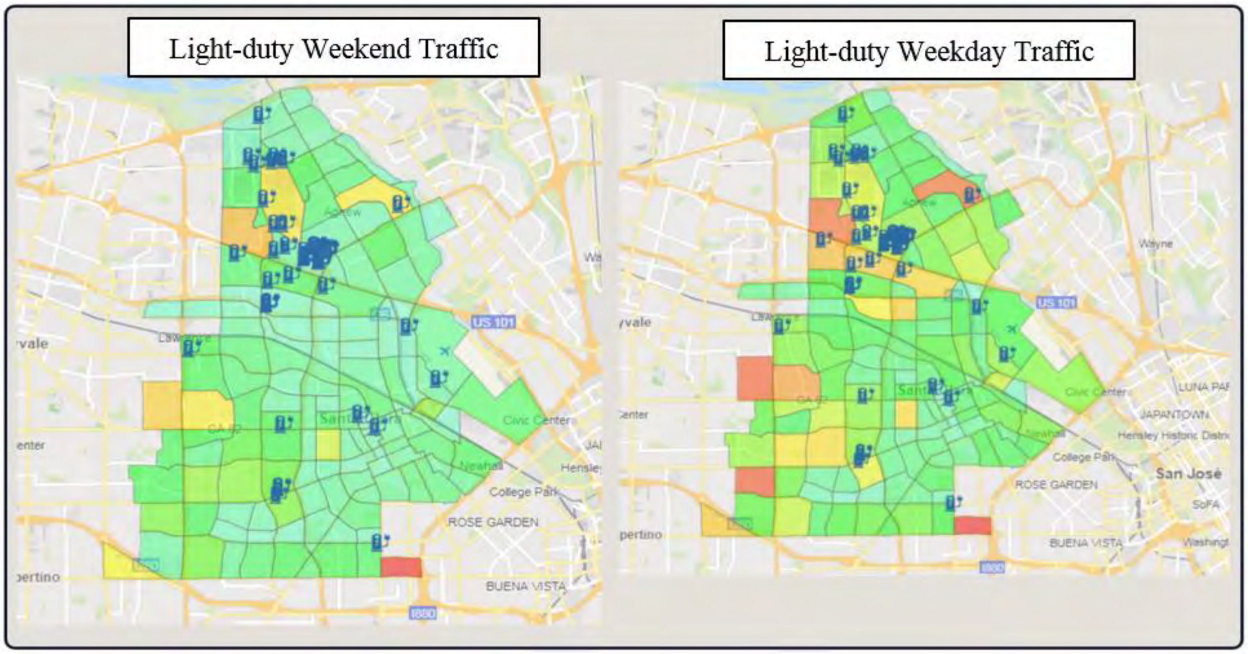
Figure 11: Santa Clara Commercial Vehicle Traffic by TAZ, Weekend vs. Weekday



Source: EV Blueprint Team; Streetlights Data

As seen in Figure 11, commercial vehicle traffic is only slightly heavier on weekdays compared to weekends, with most commercial traffic centered near the airport on the east side of The City. Roughly 3% of all traffic within The City is from commercial travel.

Figure 12: Santa Clara Light-duty Vehicle Traffic by TAZ, Weekend vs. Weekday



Source: EV Blueprint Team; Streetlights Data

As seen in Figure 12, light-duty vehicle traffic is somewhat heavier on weekdays compared to weekends. Unlike commercial traffic, however, light-duty traffic is largely spread out across the western half of The City. Roughly 97% of all traffic within The City is from light-duty travel.

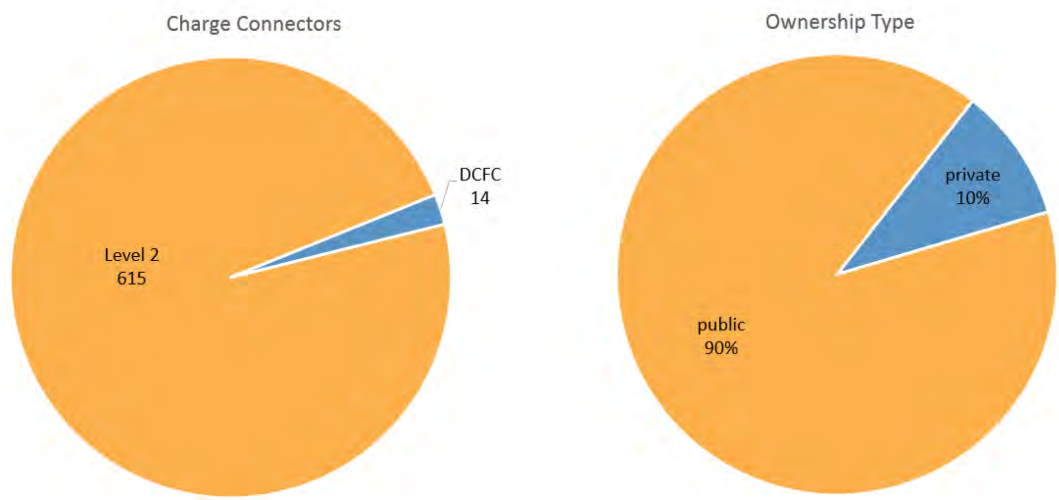
This evaluation of consumer location, vehicle type, and traffic pattern will help The City better plan for installation of electric vehicle supply equipment (EVSE).

Current Electric Vehicle Charge Connectors

A typical charging station contains multiple charger with multiple charging connectors[26] to plug into multiple vehicles. In Santa Clara, the average charging station has six charge connectors. Using the Alternative Fuels Data Center (AFDC), The City tracks installation of public and private charge connectors.[27] Through 2018, The City had installed 629 charge connectors; 615 connectors were Level 2 (L2) chargers and 14 were DCFC chargers.[28] This information, as well as ownership type, is detailed in Figure 13.

26 The EV Blueprint uses the term "connectors" as defined by the CEC to refer to what is commonly known as "ports" or "plugs".
27 https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC
28 Detailed descriptions of the type of chargers (L1, L2, and DCFC) are in the Electric Vehicle Supply Equipment (EVSE) section.

Figure 13: Current Charge Connector Installations by Type and Ownership



Source: EV Blueprint Team; AFDC

The 629 public and private charge connectors currently within The City are found in 106 different locations, for an average of six charge connectors per location. However, specifically for DCFC, there are only one or two charge connectors per location. Most of the charging infrastructure is in the northern part of The City, zip code 95054, with 93% of all L2 charge connectors and 57% of all DCFC charge connectors. The location with the most accessible charge connectors is 2910 Tannery Way – a parking garage – with 158 L2 charge connectors open 24 hours, 7 days a week. The City currently has a total of 70 city-installed public charge connectors located at Central Park Library, Santa Clara Convention Center, Tasman Garage, City Hall, and, most recently, the Northside Library. Two DCFC connectors at the Central Park Library have been identified for replacement. Figure 14 maps where PEV charging stations are located within The City, based on city permitting data.[29]

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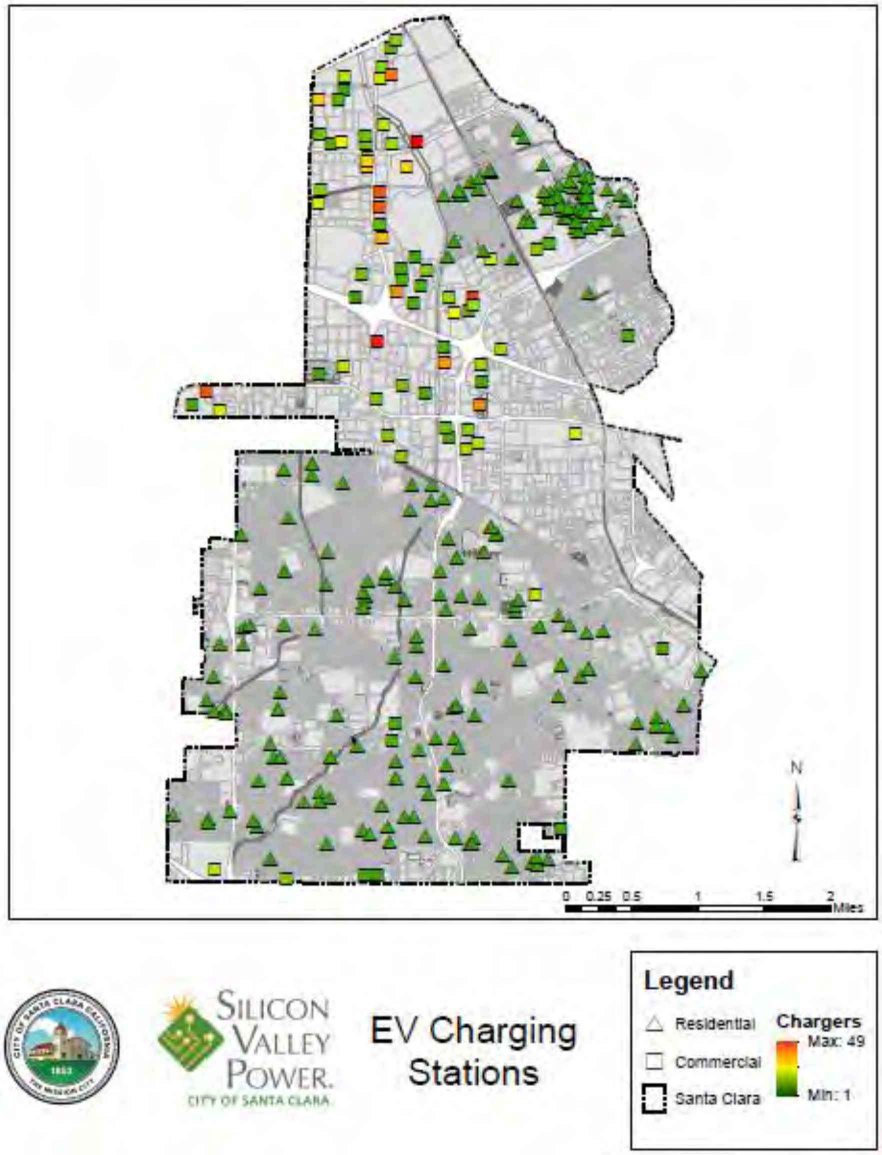
29 This data illustrated is not a complete list as EVSE data has not consistently been captured in previous years.

Figure 14: Map of PEV Known Chargers within The City



Source: EV Blueprint Team

Roughly 90% of The City's non-residential charging infrastructure is publicly accessible, and all the DCFC connectors are publicly accessible. The remaining 10% in private ownership may include multi-unit dwellings, private businesses, and city-owned vehicle fleets. However, this data suggests that many of the private businesses installing charge connectors are not limiting access to those charge connectors to only their employees.

Further, many residents have acquired chargers for their homes, with the help of an accommodative building code that has expedited the permitting process. The City has tracked 202 residential chargers; however, there may be additional residential chargers within The City not tracked by SVP. The City is also currently undergoing a zoning code update in which new amendments will require new non-residential and multi-family residential developments to include L2 chargers and parking spaces.

External Stakeholder Survey Results

Gathering input from external stakeholders was an important component of developing the EV Blueprint goals. To gather feedback, The City has conducted a variety of surveys to external stakeholders. The results from participants in each stakeholder survey are highlighted in this section.

2018 California Municipal Utilities Association (CMUA Customer Oversample)

The California Municipal Utilities Association (CMUA) contracts with Reichman, Karten, Sword, Inc. Research & Consulting (RKS) to provide market research, analysis and reporting on behalf of its members. SVP together with a dozen other California municipal utilities support the CMUA statewide effort. SVP contracted with RKS directly to participate in the statewide effort and perform additional market research in The City as a way to specifically benchmark SVP's customer satisfaction trends and other metrics against the statewide results. This research includes surveying customers by phone, by email with a link to the online survey and occasionally through focus groups. Over the three-year term of the agreement, residential customers will be researched/surveyed in 2018 and 2020, and businesses in 2019. RKS reported 2018 findings after a deep analytical review that benchmarks achievements and trends over time and across a large number of California utilities.

Key results from the residential customers include:

- The City's residents' demographics are favorable for PEV adoption.
- Interest in PEV adoption is in line with other statewide municipal regions. However, interest has slightly declined since 2016.
- The City's PEV owners' charging profile is different from the statewide average.
- PEV owners show favorable opinions of SVP and support of their efforts compared to all SVP residential customers.
- The City has general support for development of public PEV chargers.

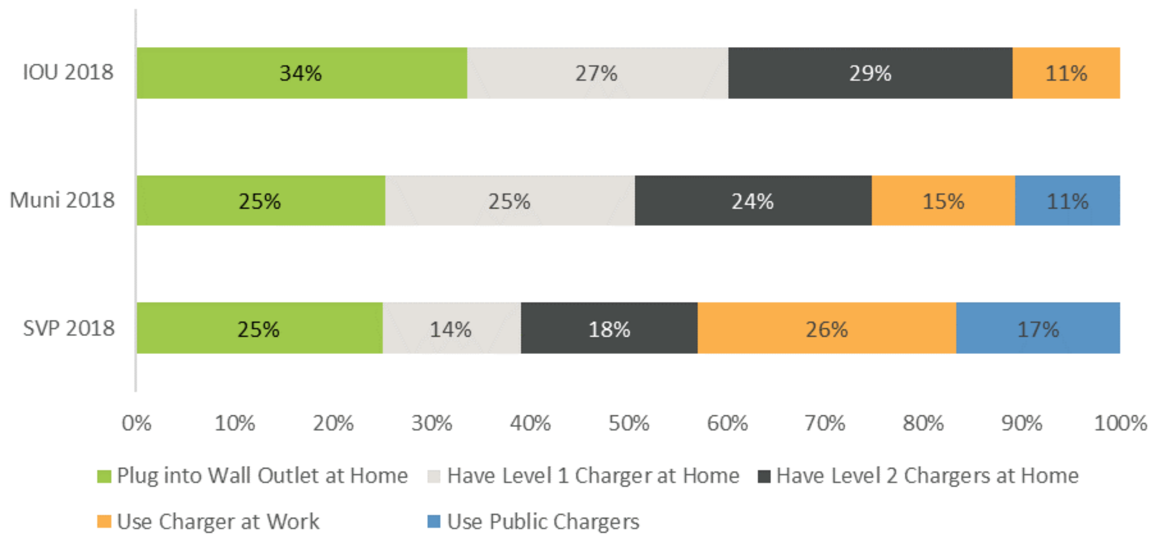
PEV owners within The City have the following demographics which are favorable to PEV adoption:

- 73% are homeowners vs. 26% renters
- 75% of PEV owners live in single-family homes (vs. 44% of Santa Clara)
- 59% of PEV owners have incomes $100K+ (vs. 53% of Santa Clara)
- 43% of PEV owners are between 31-40 (vs. 31% of Santa Clara)
- 53% of PEV owners have graduate degrees or more (vs. 46% of Santa Clara)
- 65% of PEV owners in The City are female (vs. 51% of SVP customers as a whole)

However, there needs to be a continued effort through the EV Blueprint to encourage residential PEV adoption. Only 9% of SVP customers either own or lease a PEV while the average for statewide municipal territories is 14%. Meanwhile, 23% of SVP customers who do not presently have a PEV are interested in acquiring a PEV. Though this 23% is in line with the average for statewide municipal territories, this result has declined from SVP's 2016 survey where 30% of SVP customers showed interest.

The City is unique in its PEV owner charging profiles. Figure 15 shows survey results from the SVP PEV owners on their charging preference in comparison to aggregate IOU and municipal utility survey responses.

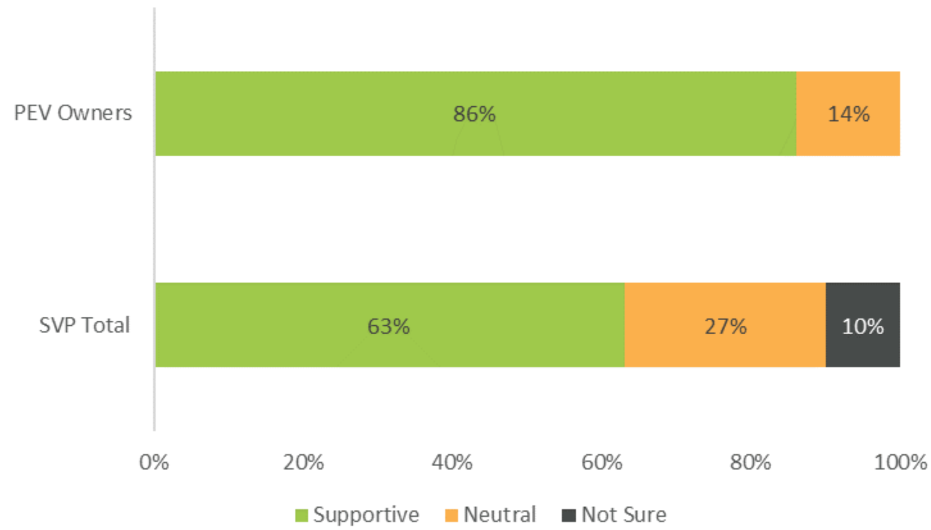
Figure 15: Residential PEV Owner Charging Profiles, % of survey responses



Source: SVP; RKS

The residents within The City are significantly more dependent on workplace charging than statewide averages – most likely due to free charging incentives provided by many of the large corporations within The City. However, even though many residents are mostly dependent on workplace and home charging, more Santa Clara residents feel there is a greater need for public charging than statewide residents. Figure 16 shows results of both the general SVP customers' and PEV owners' specific opinions on SVP's role in building public charging stations.

Figure 16: SVP Role in Building Public Charging Stations, % of survey responses



Source: SVP; RKS

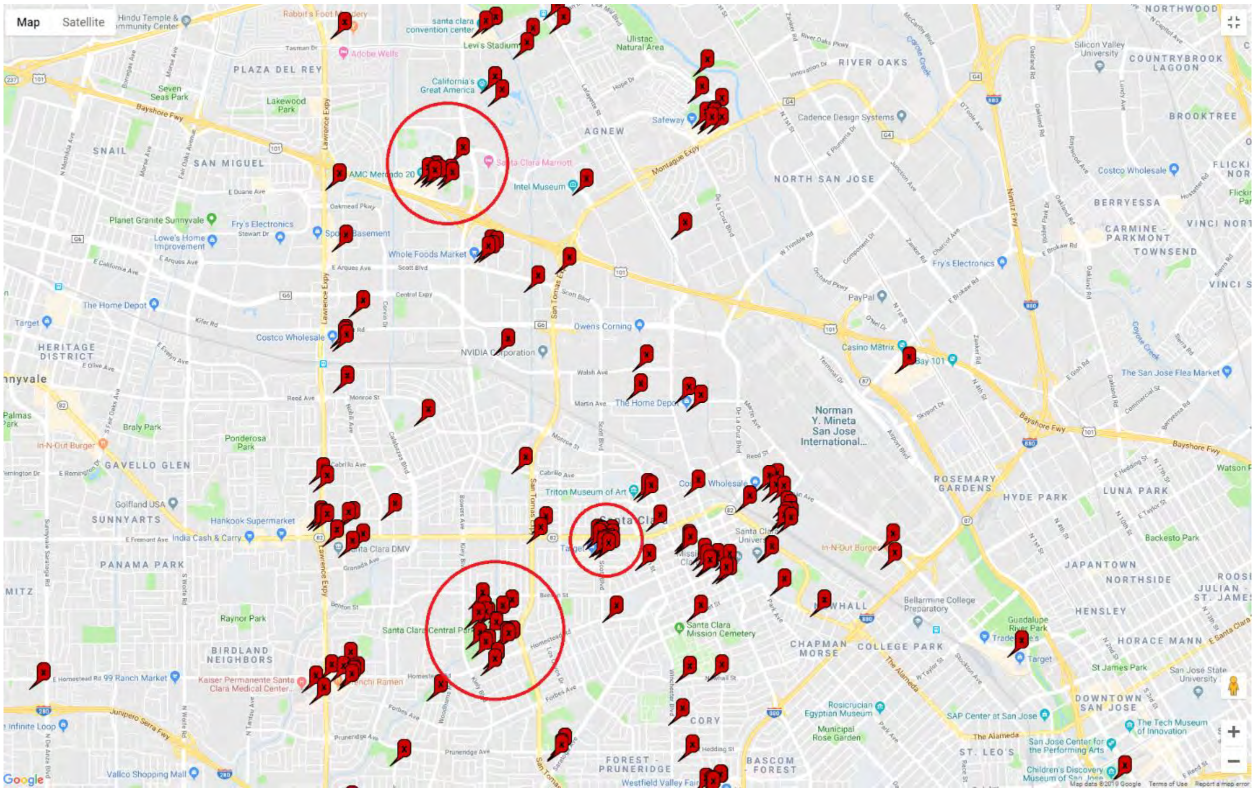
Not only are PEV owners supportive of SVP's role in building public charging stations, but also 63% of the general SVP customer base is supportive of SVP's role in building public charging stations. Less than 10% of the general SVP customer base is hesitant toward SVP's role. Furthermore, SVP PEV owners tend to hold higher opinions on SVP's customer satisfaction and price satisfaction. Arguably, PEV owners are more likely to be supportive of other SVP sustainability targets, as 8% of SVP's PEV owners (vs. 2% of SVP customers as a whole) report that they have solar, and another 17% of SVP's PEV owners (vs. 6% for SVP customers as a whole) report that they are very likely to acquire solar panels within the next 12 months.

2019 Santa Clara Citizens & Commuters Survey

The EV Blueprint Team conducted "The Electric Vehicle (EV) Survey" on behalf of The City; the survey garnered 180 responses. One hundred fifty-four (154), or 91% of participants, were Santa Clara residents. One hundred forty-five (145), or 85% of participants, own housing, while the remainder rent housing; primarily single-family houses were owned by residents and multi-family housing rented. The majority do not work within The City; however, over half have PEV charging available at their workplace. Half the participants (50%) commute less than 10 miles, 20% commute 10-20 miles, and 17.5% do not commute at all.

The highest concentrations of desired charging station locations were at Central Park, Santa Clara Town Centre, and the AMC 30 by Mission College, as shown in Figure 17.

Figure 17: The EV Survey Responses for Desired Locations of Public Charging Stations



Source: SVP

The majority of participants stated that more PEV chargers would positively impact their purchasing decisions, increase vehicle miles traveled, and reduce range anxiety. Survey results are provided in an Appendix to the final report to the CEC.

2019 SVP Business Survey

The EV Blueprint Team conducted this survey on behalf of The City; the survey garnered 78 responses. A strong majority of responses, 80%, were the President/CEO, manager, or owner with a business size of 0-50 people. Figure 18 shows responses to the question "If your company does not own or lease an EV, what is the reason?"

Figure 18: Survey Reponses to "If your company does not own or lease an EV, what is the reason?"

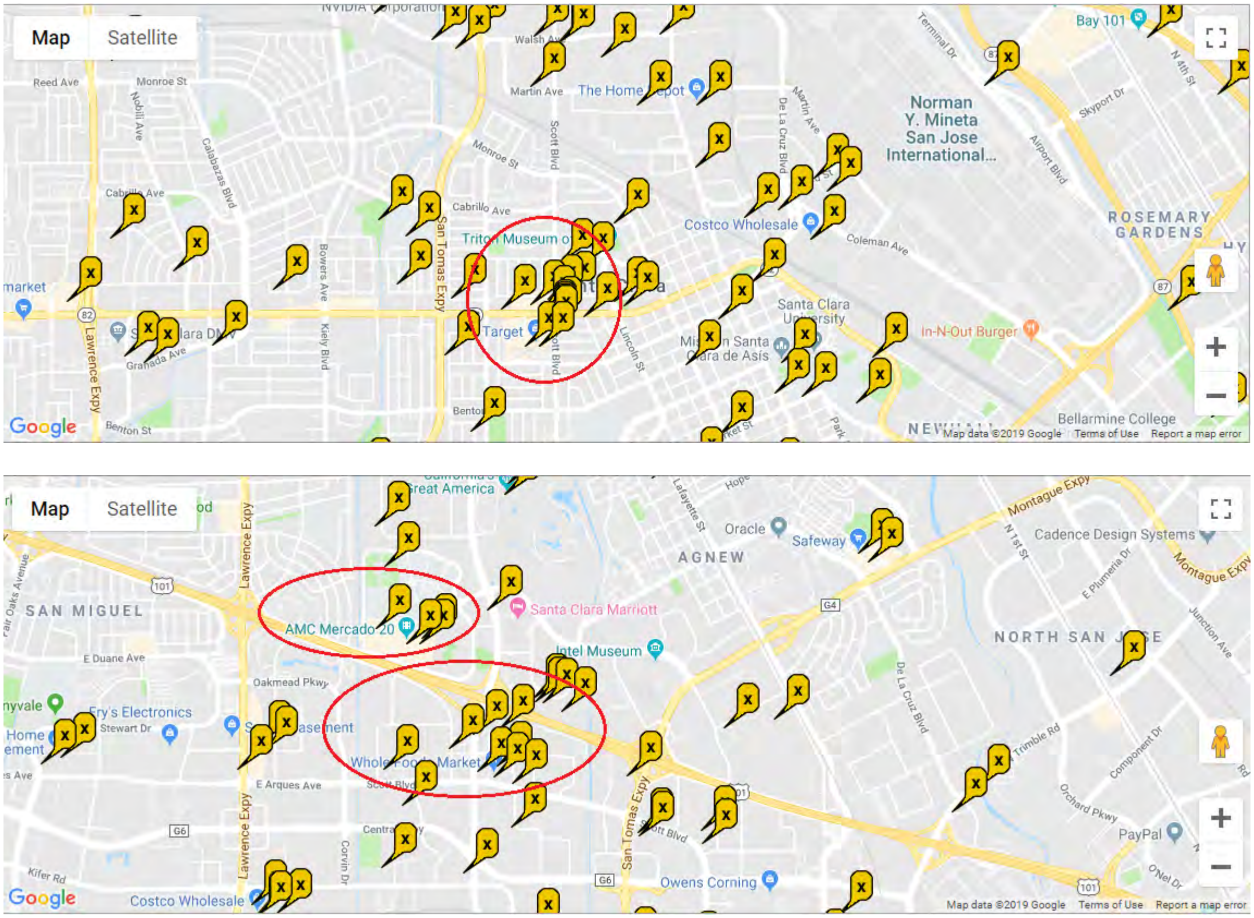
If your company does not own or lease an EV, what is the reason?

	Response Percent	Response Count
Range anxiety (i.e. worried that the battery would run out before reaching destination)	19.2%	15
Cost of vehicle	37.2%	29
Cost of EV charging infrastructure (i.e. panel upgrade, charger, permit, trenching)	28.2%	22
Other	34.6%	27
Don't know	9.0%	7

Source: SVP

Most respondents (73%) were not PEV owners and own/work for a business that does not own/lease PEVs. Their responses spanned across all choices, but it is worth noting that 46% of their responses were categorized as "Other" or "Don't Know." This high percentage highlights the need to implement further education and outreach to businesses within The City to create an EV ready community. Figure 19 shows the survey responses for desired locations of public charging stations.

Figure 19: SVP Business Survey Reponses for Desired Locations of Public Charging Stations



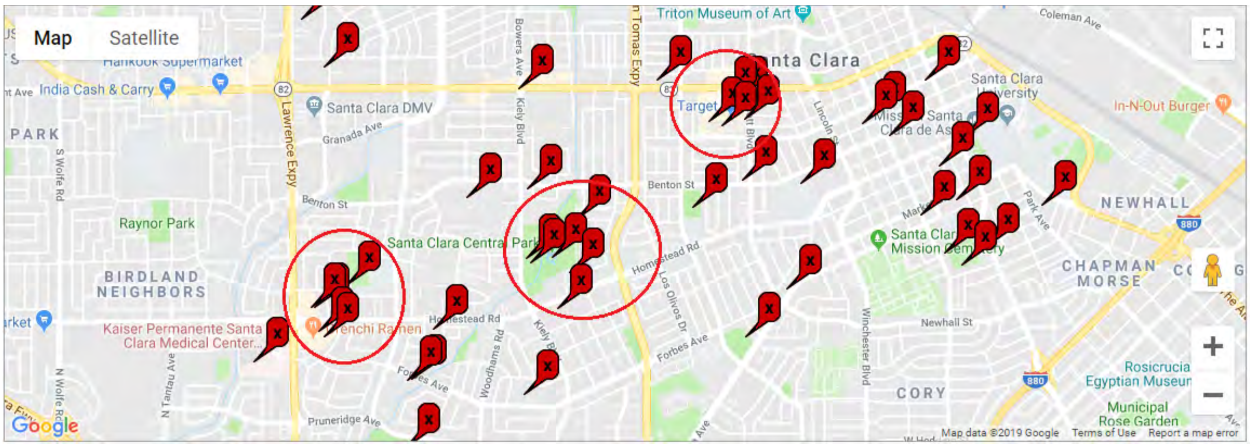
Source: SVP

Survey respondents selected the highest concentrations of desired charging station locations at the Target near the Santa Clara University train depot, the Mercado shopping center, and the Santa Clara Square shopping complex near the Highway 101 and Bowers Expressway. Survey results are provided in an Appendix to the final report to the CEC.2019 SVP School Districts Survey

The EV Blueprint Team conducted this survey on behalf of The City; the survey garnered 13 responses. The survey was offered in both English and Spanish, but there were no responses to the Spanish version. Though the responses are limited, the majority of responses were from School/School District Staff (53.8%), followed by Parent/Guardian of a Student (38.5%), and Other (7.7%). Most were residents of The City who already own or lease a PEV (61.5%). However, the remaining respondents who do not own/lease a PEV because of lack of parking refer to parking already being a “premium.” Although some show support to cleaner transportation initiatives, this dataset requires a larger sample size to justify the need to invest in charging infrastructure for schools in The City.

In this survey, the highest concentrations of desired PEV charging station installation were located at Santa Clara Town Centre (i.e., Target), Central Park, and Lawrence Station Shopping Center near Lawrence and Homestead as shown in Figure 20.

Figure 20: SVP School Districts Survey Reponses for Desired Locations of Public Charging Stations



Source: SVP

Survey results are provided in an Appendix to the final report to the CEC.

City Programs for PEV Adoption

The City believes that with convenient, publicly accessible charging incentives, and with community outreach and engagement, SVP can enhance The City's PEV adoption. Residents and businesses will accelerate the deployment of transportation electrification and thus reduce carbon emissions from the transportation sector. City programs are described below.

Low Carbon Fuel Standard (LCFS) Credits

In October 2016, SVP entered a voluntary California Air Resources Board (CARB) program called the Low Carbon Fuel Standard (LCFS) Program. The LCFS Program was created through Assembly Bill (AB) 32, California Global Warming Solutions Act of 2006 and Governor's Executive Order S-01-07. The LCFS Program is a key part of a comprehensive set of programs in California to cut greenhouse gas (GHG) emissions and other smog-forming and toxic air pollutants by improving vehicle technology, reducing fuel consumption, and increasing transportation mobility options. The LCFS Program is designed to decrease the carbon intensity of California's transportation fuel pool and provide an increasing range of low-carbon and renewable-powered alternatives. The goal of this program is to reduce by at least 10 percent the carbon intensity of California's transportation fuels by 2020.

SVP receives LCFS credits by filing quarterly reports that comply with CARB's program. These credits are sold in an exchange, and these funds are to be used to comply with Title 17 of the California Code of Regulations Section 95483(e) (1) (A-D). LCFS Program proceeds may only be used in accordance with the following requirements.

For electricity used as a transportation fuel, the regulated party who is eligible to generate credits is determined as specified below:

For on-road transportation fuel supplied through PEV charging in a single- or multi-family residence, the Electrical Distribution Utility is eligible to generate credits in its service territory. To receive such credits, the Electrical Distribution Utility (SVP) must:

- Use all credit proceeds to benefit current or future PEV customers;
- Educate the public on the benefits of PEV transportation (including environmental benefits and costs of PEV charging, or total cost of PEV ownership, as compared to gasoline);
- Provide rate options that encourage off- peak charging and minimize adverse impacts to the electrical grid; and
- Include in annual compliance reporting the following supplemental information: an itemized summary of efforts and costs associated with meeting these requirements.

Currently, there are two ways for SVP to obtain LCFS credits.

1. Credits can be obtained for the quarterly addition of PEVs within a utility's service territory. Records of PEV additions must be obtained through DMV registration data.
2. Credits can be obtained for the electric consumption for vehicles from owned or delegated chargers within a utility territory.

SVP has previously captured LCFS credits for PEV registrations, but data for additional funding through electric consumption from public chargers is more difficult to file – requiring additional procedures and staffing. Later in this section, SVP's PEV blockchain-enabled consumption tracking pilot program is discussed as a potential method to help SVP report energy consumption from electric vehicle charging, in order to collect on additional LCFS funding.

The LCFS credits help SVP fund public electric vehicle chargers at City-owned facilities, such as at the new Reed and Grant Sports Park (eight charge connectors) and the Raymond G. Gamma Dog Park (six charge connectors): both are expected to be complete by the end of 2019. In addition, new rebate programs for electric vehicle charging equipment are supported by LCFS credits.

Plug-in Electric Vehicle Charging Equipment Rebates

Beginning in 2019, The City is promoting PEV adoption through SVP's electric vehicle charging equipment rebates. Rebate for equipment are given based on owner classifications as follows:

- Residential: $750 rebate per installed electric vehicle charger
- Multi-Family: $3,000 rebate per installed public electric vehicle charger
- Schools & Non-Profit entities: $5,000 per installed electric vehicle charger

Qualifying charging station requirements are as follows:

- Must be a Level 2 (240-volt) charger with an SAE J1772 standard connector plug
- Must be a new charger. Chargers that are portable, resold, rebuilt, or received from warranty insurance claims are not eligible for rebates under this program
- New construction is not eligible
- Must be wall or pedestal-mounted

- Must be certified by Underwriters Laboratories Inc. (UL Listed), ETL Listed, or approved by the City of Santa Clara Building Department
- If networked chargers are installed, SVP shall be provided access to the charging information
- Physical signage for easy identification of charging station location *(Recommended)*
- Information posted about the charger on the U.S. Department of Energy Alternative Fuel Data Center website[30] *(Recommended)*

Low-income PEV Charger Grant for Multi-family Properties

Under its low-income programs, SVP offers a grant of up to $1,000 per charger for multi-family properties where 15% of customers residing at the property qualify for SVP's low-income programs. The utility provides charger rebates for all eligible customers. This $1,000 rebate is in addition to the $3,000 rebate per installed public charger for all multi-family dwellings as mentioned previously, totaling $4,000 of rebates per installed public charger.

LCFS Blockchain-enabled PEV Consumption Tracking Pilot Program

In June 2018, SVP partnered with Australian energy blockchain startup, Power Ledger, and its North American partner, Clean Energy Blockchain Network to develop a proof-of-concept audit trail to track PEV charger consumption. The accounting process for earning LCFS credits is complicated when conducted in real time, using metering data to calculate the amount of fossil fuel displaced per unit of PEV charging. Also, quarterly manual tracking could lead to serious problems further down the road in the LCFS credit-trading process, exposing participants to significant risk. Because of these issues in managing LCFS accounting at scale, although the credits via PEV charging consumption are available to any utility, it is only the big three investor-owned utilities – Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric – that have capabilities to manage at scale. This pilot project helps SVP and other cities/utilities with limited staffing apply for LCFS credits from PEV charger consumption within their territory.

The pilot is currently being tested in a parking lot near the San Francisco 49ers football stadium with on-site generation from solar panels. Originally the pilot was planned for 48 L2 chargers and 1 DCFC. However, the DCFC is not made by the same vendor as the L2 chargers (ChargePoint), and the DCFC has battery storage involved as well – overly complicated for a proof-of-concept project. Therefore, the pilot does not test the DCFC, but the proof of concept shows SVP that they are capable of tracking for DCFC in the future as needed.

This pilot project has been used for 2018 Q3 reporting of LCFS credit electric consumption to CARB. The pilot autonomously tracks kWh generating from solar production through PEV charging consumption to develop an audit trail that can track electric generation to the charging of the vehicle asset. During the pilot, the 2018 Q3 reporting was also completed manually to confirm the accuracy of the results. The 2018 Q4 reporting will be tested with the blockchain-enabled pilot as new regulations are expected to be released by CARB early Q1 2019.

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30 www.afdc.energy.gov/fuels/electricity_locations.html

DCFC Plus Storage Pilot Program

SVP is continuing to pilot an energy storage project at the Tasman Drive Parking Structure through a CEC grant program to reduce customer-side peak demand charges due to high energy electric vehicle fast charging. The City's Streets Department is SVP's customer at this parking structure. Green Charge Networks, a Santa Clara based energy storage company, approached SVP to install a 30 kW "GreenStation" battery energy storage system along with an electric vehicle DCFC station at this location. The cost of the energy storage system, the DCFC, and the installation was covered by a CEC grant program, resulting in no costs to Santa Clara or SVP. The GreenStation is installed behind the meter and dampens the demand spikes that occur when the DC fast charger is used. This helps the Streets Department avoid higher electricity bills due to the increased demand charges that would otherwise occur from use of the DCFC station.

Based on 2018 data, the pilot has shown a savings of $45-$200 per month, depending on the season, which equates to $1.00/kW in savings for a customer opting to install storage with DCFCs.

Funding

Funding is a main driver for developing an EV ready community. The City funding for PEV programs is currently funneled through SVP. SVP's current funding derives from the LCFS credits and grant applications. Other funding opportunities include utility rebate programs and further grant funding from CARB and Bay Area Air Quality Management District (BAAQMD).

In 2017, SVP collected 10,999 LCFS credits. Approximately 75% of the credits collected were received for registered vehicles, and 25% of the credits collected were from electric fork lifts. This breakdown of received credits is important as the credits are subject to different rules for program funding based on how the credits were collected. In 2018, SVP sold these credits on the market for approximately $1.9 million which will fund the planned PEV programs through 2019. In addition to the LCFS funding, The City is receiving $199,921 from the CEC to conduct this EV Blueprint, Phase I of the EV Ready Communities Challenge. The City hopes to use Phase II funding from the EV Ready Communities Challenge to help implement near-term programs planned for The City in the EV Blueprint.

CARB's Cap & Trade Program allots approximately $1 billion annually in California funding to reduce GHG emissions. A majority of this funding is available for Transportation Electrification programs. SVP is currently setting up a plan to apply for grant funding through the Cap & Trade in 2019. BAAQMD also provides grant funding opportunities that SVP plans to apply for in 2019.

Some California cities are within investor-owned utility (IOU) territories, and therefore have the ability to submit proposals to the CPUC for rate-based PEV programs through customer energy sales. However, SVP is not currently rate-basing any PEV programs to its customers because Proposition 26[31] does not allow SVP to shift costs for a particular set of customers – PEV owners – within The City. Any rate-based upgrades would need to be approved by SVP's Chief Electric

31 https://ballotpedia.org/California_Proposition_26,_Supermajority_Vote_to_Pass_New_Taxes_and_Fees_(2010)

Utility Officer and presented to The City Council for approval. At this point in time, SVP has only rate-based PEV charging related upgrades to the electric grid due to general increases in electric demand.

SVP is currently setting up a long-term budget plan specific to PEV programs and plans to have at least $2 million annually in available funding. While The City will look toward the CEC's Phase II funding to support near-term goals, a funding plan will be developed to ensure long-term funding sustainability for the EV Blueprint. Funding requirements for each Blueprint Initiative are detailed in Task 4.

Long-Term Planning Analysis

After the review of the current state of PEV adoption within The City, the EV Blueprint Team focused on forecasting long-term impacts of PEV adoption to help determine goals of the Blueprint. First, an overview of statewide goals to be considered was reviewed. Research suggests PEV program goals often fall into several categories including: PEV adoption, emissions reductions, grid impacts, EVSE installations, societal benefits, disadvantaged community assistance, interoperability, and financing.

Then, The City developed three future-state scenarios (High, Base, Low) since using a single deterministic forecast for long-term planning places too much risk on assumptions without analyzing sensitivities. These three scenarios were used to forecast potential PEV adoption for The City. Other parameters such as emissions, grid impacts, EVSE support, and societal benefits were quantified to help The City determine goals. Other goals that are not quantified by PEV adoption were analyzed qualitatively; these include DAC assistance and interoperability.

California Goals

Due to a combination of global auto manufacturer commitments to more PEV models, U.S. policy on ZEVs, and billions of dollars in funding, the U.S. has sold over one million PEVs.[32] PEV market growth has been, and will continue to be, dependent in significant part upon regulatory standards and incentives, at least for the near future. Some analysts predict BEV costs will begin to reach parity with internal combustion engine (ICE) vehicles around 2025.[33] Below are brief descriptions of the major regulatory and legislative considerations impacting PEV adoption.

California State GHG Goals

California calls for a 40% reduction in GHG emissions from 1990 levels by 2030 and an 80% reduction by 2050 per Executive Order S-3-05 (2005). Air quality goals include a 90% reduction in emissions of nitrogen oxide gases (NO_{x}) from 2010 levels by 2032. In January 2018, Executive Order B-48-18 called for 5 million ZEVs by 2030. In December 2018, CARB passed the

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32https://insideevs.com/1-million-electric-cars-sold-us/
33 Electric Vehicle Outlook 2017, Bloomberg New Energy Finance, July 2017.

"Innovative Clean Transit" policy stating that by 2023, one-quarter of purchased transit buses need to be zero-emission, and by 2029, 100% of new buses purchased need to be zero-emission.

The Advanced Clean Cars (ACC) Program

This program adopted by the California Air Resources Board (CARB) has low-emission vehicle (LEV) regulations and zero-emission vehicle (ZEV) regulations. CARB's Low-emission Vehicle Program, now in Phase III (LEV III) focuses on exhaust emission limits through 2025 implemented over the same timeframe as the U.S. EPA's GHG emission standards for light-duty vehicles (LDVs). By 2025, LEV III is expected to result in a 75% reduction in smog plus NO_x emissions.[34] The ZEV program assigns each automaker "ZEV credits" based on the type of ZEV and its performance metrics. The credit requirement is set at 4.5% of non-ZEV sales in 2018, rising to 22% in 2025. It is worth noting that in 2018, PHEVs can account for only 55% of credits.[35][36]

PEV Adoption

Considering policy impacts, technology improvements, traffic patterns, and consumer preferences, estimating the long-term PEV adoption for a city cannot be accurately derived by using a single source or forecasting methodology. Thus, the recommended approach is to use three PEV adoption scenarios described below for light-duty PEV ownership within The City.

Base Case

The Base Case for vehicle adoption is based on SVP's 2018 Integrated Resource Plan (IRP) PEV adoption scenario. This vehicle adoption forecast was calculated using the "2017 SB 350 Common Assumptions Guidelines for Transportation Electrification Analysis" produced by the CEC in consultation with CARB and CPUC.

High Case

The High Case for vehicle adoption is based on a Siemens proprietary PEV adoption forecasting tool. Siemens applied the Oak Ridge National Laboratory's consumer choice model as a foundation for national light duty PEV adoption and applied screening methodologies to develop independent adoption scenarios by utility territory.

Low Case

The Low Case for vehicle adoption assumes no further PEV adoption takes place over the planning period. This scenario was not used as a realistic outcome for The City; rather, this case allowed The City to quantify gaps between current PEV adoption and expected PEV adoption from the Base Case and High Case throughout the planning period.

The three adoption scenarios for light-duty PEV ownership within The City are shown in Figure 21.

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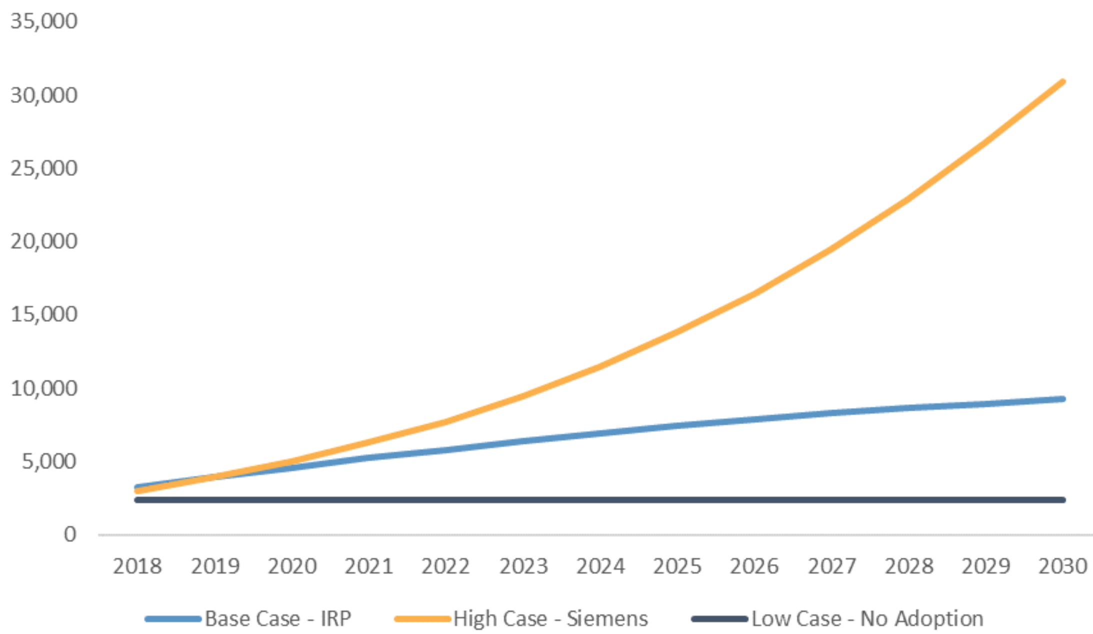
[34] http://www.meca.org/regulation/epa-tier-3-and-california-lev-iii-rulemakings
[35] https://www.ucsusa.org/clean-vehicles/california-and-western-states/what-is-zev#.WmYIwa6nGLs
[36] https://www.autoblog.com/2017/05/05/california-zero-emissions-cars-goal/

Figure 21: SVP PEV Stock, cumulative # of LDVs



Source: EV Blueprint Team

For further analysis, The City assessed what proportion of PEV stock will be BEV versus PHEV. The Base Case assumes 49% PHEV to 51% BEV, sourced from the CEC[37], which is similar to the current national average. Then a -1.33% CAGR, estimated from the CEC source, is applied to the ratio of PHEVs through 2030. We expect more models to be developed and more consumers to prefer BEVs as the technology develops and prices decline. The High Case assumes a current PEV split of 30% PHEV and 70% BEV, which more accurately depicts The City's portfolio of vehicles from the CVRP rebate data. A similar CAGR is applied to forecast a growth in BEV adoption over PHEV adoption in the future.

Like many publicly available forecasts of PEV adoption, the cases shown in Figure 21 only account for light-duty vehicle adoption within a region. To further improve these scenarios for City PEV readiness, the EV Blueprint Team accounted for city vehicle fleets, private commercial vehicles, and inflow of commuter traffic to evaluate the impact of PEV adoption for the Blueprint. Using a variety of sources, the EV Blueprint Team forecasts the number of commercial vehicles within The City and the expected adoption of commercial BEVs as shown in Figure 22.

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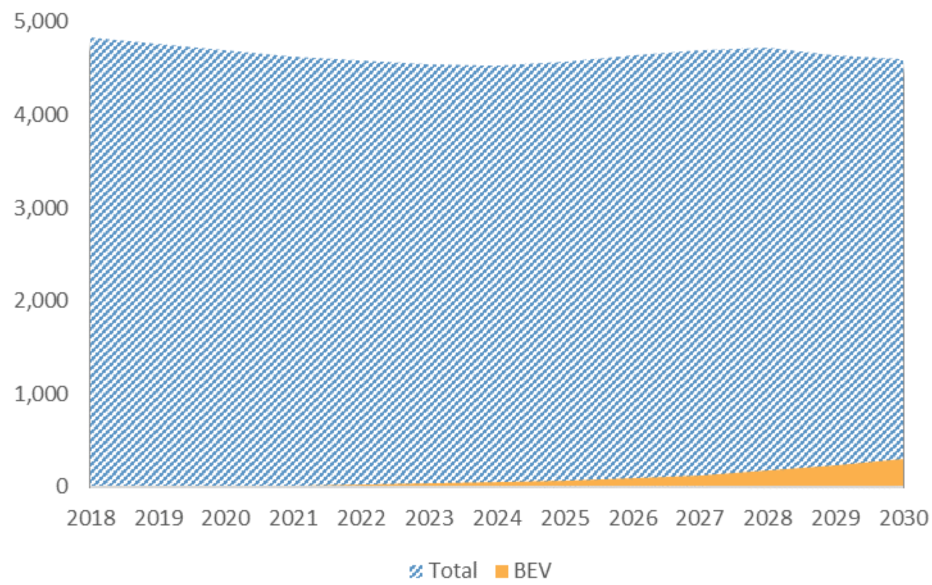
37 Based on LA County 2017 Data from Appendix A of CEC 2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program (17-ALT-01), released March 2018

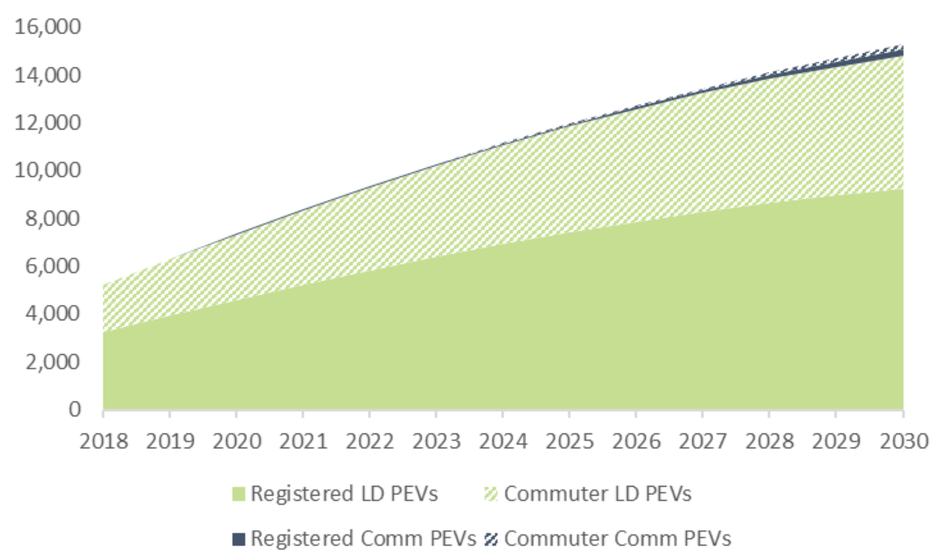
Figure 22: SVP Commercial BEV vs. Total Stock, cumulative # of Vehicles



Source: EV Blueprint Team; CEC; Statistica; EPA

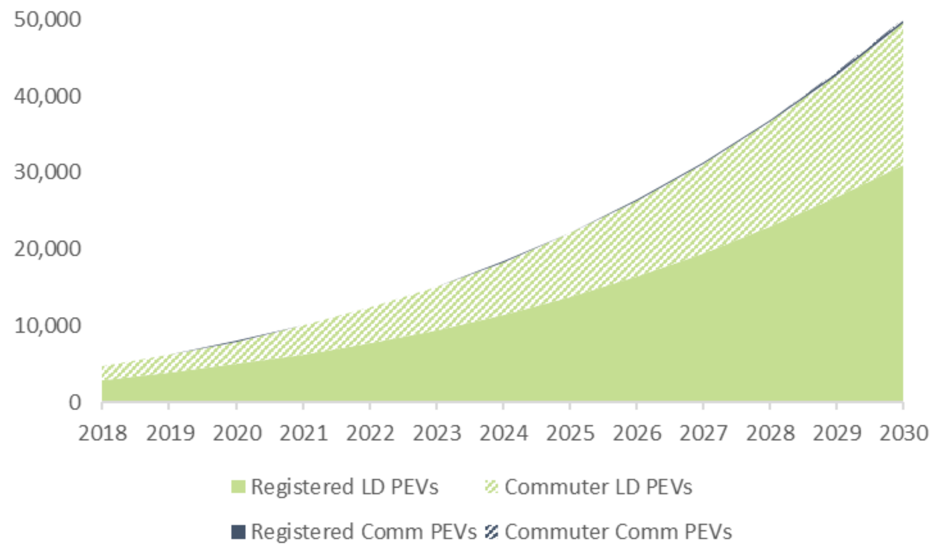
Based on transportation analysis developed for the second stage of the Siemens EV-IF in Task 3, an estimated additional 60% of the PEV stock within The City was assumed to be commuting to The City. With commuter traffic and commercial vehicles now incorporated into the forecasts, Figure 23, Figure 24, and Figure 25 break down the complete PEV adoption through 2030 for each scenario. (In these exhibits, the PEVs that are shown as "registered" are those registered (at the DMV) to be within The City zip codes; they are not commuting into The City, because they are already in The City.)

Figure 23: Base Case Total Cumulative PEV Adoption Forecast, # of Vehicles



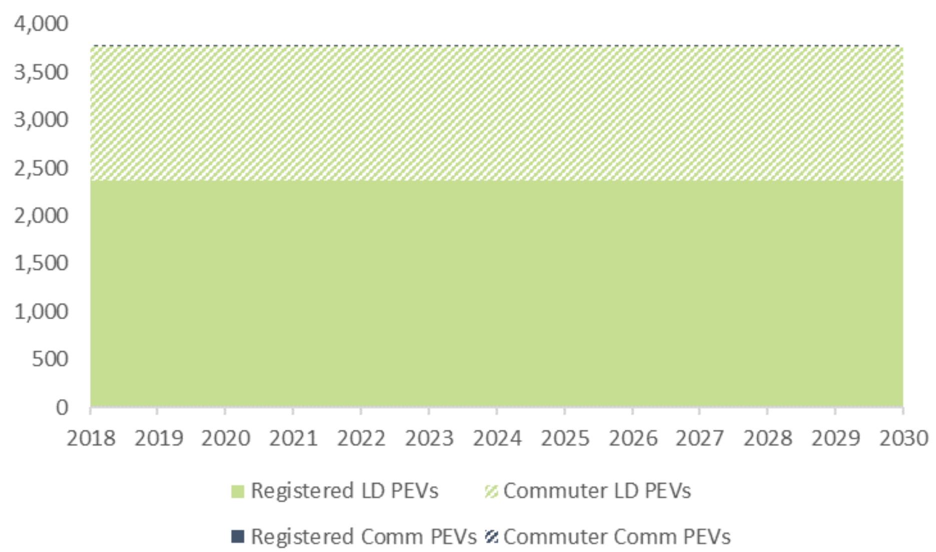
Source: EV Blueprint Team

Figure 24: High Case Total Cumulative PEV Adoption Forecast, # of Vehicles



Source: EV Blueprint Team

Figure 25: Low Case Total Cumulative PEV Adoption Forecast, # of Vehicles



Source: EV Blueprint Team

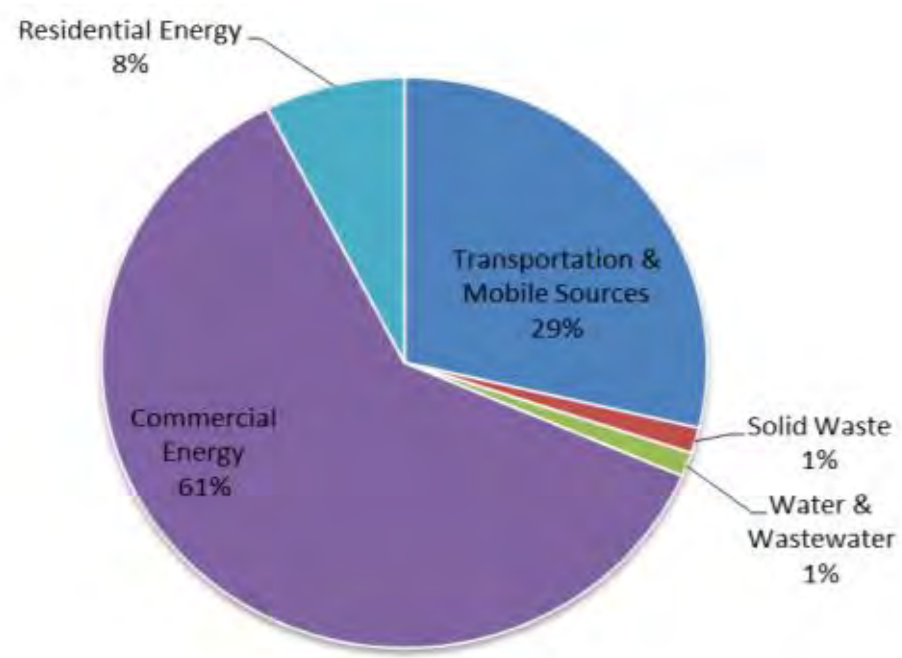
With these scenarios, The City quantified impacts on emissions, grid impacts, electric vehicle supply equipment, and societal co-benefits.

Emissions

For the U.S., the transportation sector contributed 28%[38] of all greenhouse gas emissions. The City has a long-standing commitment to creating a sustainable city for all community members. Under Assembly Bill 32 (AB 32), The City is required to reduce GHG emissions 15% below 1990 levels by 2020. The City's first Climate Action Plan (CAP) was adopted in December 2013. This CAP identified 19 actionable measures to reduce GHG emissions 15% below 2008 baseline levels and three "reach measures" to reduce emissions 55% below baseline levels by the recommended target year of 2035.

In The City's 2018 Annual Climate Action Plan update, GHG Inventory Emissions were tracked for 2016 and are illustrated in Figure 26.[39]

Figure 26: 2016 Community GHG Inventory Emissions by Sector



Source: Santa Clara 2018 Climate Action Plan

The City produced a total of 1,769,178 MT CO_2e in 2016, of which 505,989 MT CO_2e was produced by the transportation sector.[40] The transportation sector has reduced emissions from 2008 (554,300 MT CO_2e) by 9%. However, The City emissions from 2016 only represented a 4.5% reduction of GHG emissions from the baseline. The City needs to reduce GHG emissions by 10.5% to reach 2020 goals; accomplishing this will require relying heavily on the continued decline in GHG emissions from the transportation sector.

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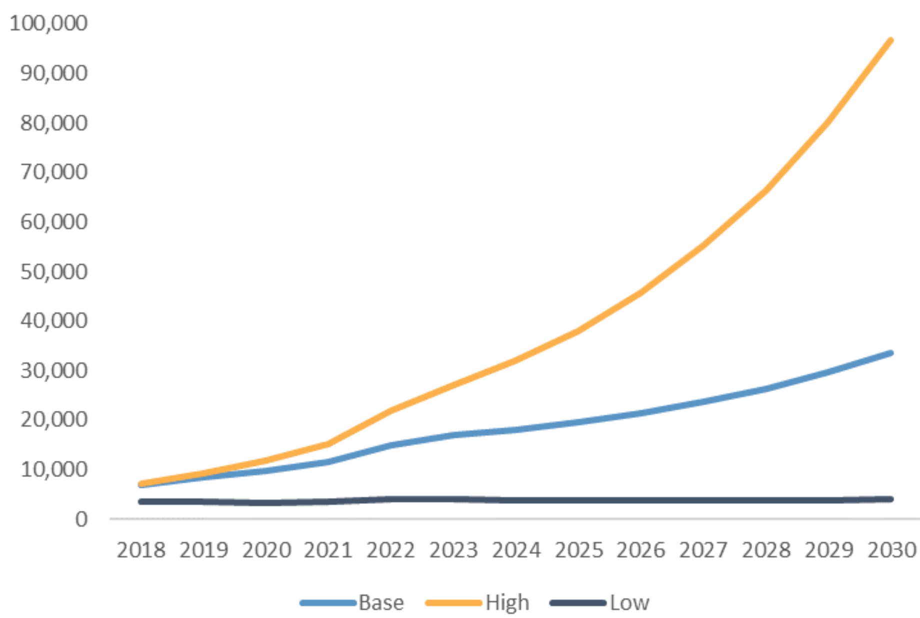
38 https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions
39 http://santaclaraca.gov/home/showdocument?id=62433
40 metric tons (tonnes) of CO_2 equivalent

Based upon the three PEV adoption scenarios developed, The City quantified the net GHG savings that PEVs can contribute. First, the net tailpipe GHG emissions savings from PEVs versus standard internal combustion engine (ICE) vehicles were evaluated. Then, using the electric demand required by the PEVs, evaluated in the following section with data from SVP's IRP, the net GHG emissions caused by PEVs was calculated.[41] The aggregate GHG emissions savings combined with GHG emissions caused by PEVs provided an accurate estimate of the net transportation emissions savings from each PEV adoption scenario. Projections are illustrated in Figure 27.

Figure 27: Net GHG Emissions Savings from PEV Adoption, MT CO_2



Source: EV Blueprint Team

With current levels of PEV adoption, the Low Case assumes GHG emissions savings of 3,985 MT CO_2 as the emissions rate from electric generation declines over time. In the Base Case, PEV adoption is expected to lead to a reduction of 33,456 MT CO_2 by 2030, reducing The City's transportation emissions by 14% from 2008 levels and by 7% from 2016 levels. Meanwhile in the High Case, there is potential to reduce emissions 26% from 2008 levels and 19% from 2016 levels by 2030 totaling to 96,700 MT CO_2. The difference between the Low Case (current adoption) and High Case is over 91,000 MT CO_2 by 2030, highlighting a potential solution to meet The City's CAP goals through increased PEV adoption.

Note that these estimates do not account for the following Santa Clara city programs that may impact estimates and should be evaluated further with the CAP 2.0.

41 Note that the electric intensity (MT CO_2e per MWh) data from the IRP does not account for CAISO market sales that determine a portion of electricity provided to SVP's customers.

100% Green Offering

In response to customer interest, SVP is now supplying its voluntary Green Power program. About 9.1 percent of SVP's residential and business customers subscribe to SVP's voluntary Green Power program. Residential and small business customers who sign up for the Green Power program pay an extra 1.5 cents per kilowatt-hour compared with SVP's regular rates and most of this power is supplied by California solar generation. Medium commercial and industrial customers pay an extra $15 per 1,000 kWh blocks and most of this power is supplied by out-of-state wind power.[42] Many of the large use customers are able to get Green Power contracts based on their individual company goals. EVSE owners will have the option to supply electricity through this 100% green offering, thus the assumed emissions rate for the electric generation may decline even further over time for this evaluation. In this case, emissions savings from PEV adoption would be greater than estimated.

Transportation Demand Management Program

As a part of the CAP, The City is requiring developments in certain transportation districts to adopt and implement their own Transportation Demand Management (TDM) Plan. Under this measure, developments were required to achieve a minimum of 5% to 10% reductions in Vehicle Miles Traveled (VMT) resulting from TDM Plans, contributing to an overall 1% reduction in VMT citywide. Since the CAP's adoption, 26 new developments have been required to have a TDM Plan, and from those, three have been constructed and one has implemented a TDM Plan.

A TDM program for The City would not only reduce City-generated single occupancy vehicle (SOV) use and VMT but would also act as an example for other developments in Santa Clara to create and maintain programs. A TDM program would help reduce the amount of VMT taken by City employees on a daily basis. The collected information expressed that 85% of City employees drive alone to work, resulting in approximately 102 MT CO_2 emissions from City employee commutes. Now that The City has collected baseline data for their employee commute patterns, a TDM program for The City can be expected in the near future.

With The City's effort to reduce total VMT, the overall reduction of GHG emissions from transportation should increase; however, the net GHG emissions savings benefit of PEV adoption (savings from GHG emissions that would have been emitted by ICE vehicles) would be lower than estimated in this Blueprint.

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42 https://www.publicpower.org/periodical/article/silicon-valley-power-offers-100-percent-solar-program

Grid Impacts

SVP's primary responsibility is to provide safe, reliable power, while limiting future cost increases and complying with city core values. PEV adoption poses both risks and opportunities to utilities as summarized in Figure 28.

Figure 28: Utility Risks and Opportunities from PEV Adoption

Increased Planning Cost and Decreased Effectiveness	Waiting to plan for inevitable Plug-in Electric Vehicle (PEV) growth will result in reactive uncoordinated efforts to study and upgrade systems to meet system/circuit stresses caused by local charging. Such ad hoc efforts will prove more costly and less effective than a planned systemic business approach to prepare the grid for PEVs.
Scramble to Keep Pace with Other Agendas	The current reactive approach to transport electrification allows interveners and new market entrants to drive the public debate and steer political responses resulting in utilities trying to catch-up with state regulators.
Missed Load and Business Opportunities	The PEV market will grow and affect utilities whether they want it to or not. Active engagement provides opportunities to counter declining load, test new business models, and reduce negative grid impacts. However, without a strategy, utilities have been ceding these opportunities to new market entrants, which are taking the low hanging fruit.
Precedents and Funding Available	While the PEV market is new, the risk that growth will slow or stop is lower than many think. With state policymakers funding charging infrastructure and another $2.4 billion in Volkswagen settlement funds available, the lack of available charging infrastructure will cease being a barrier to consumers considering PEVs.

Source: Siemens43

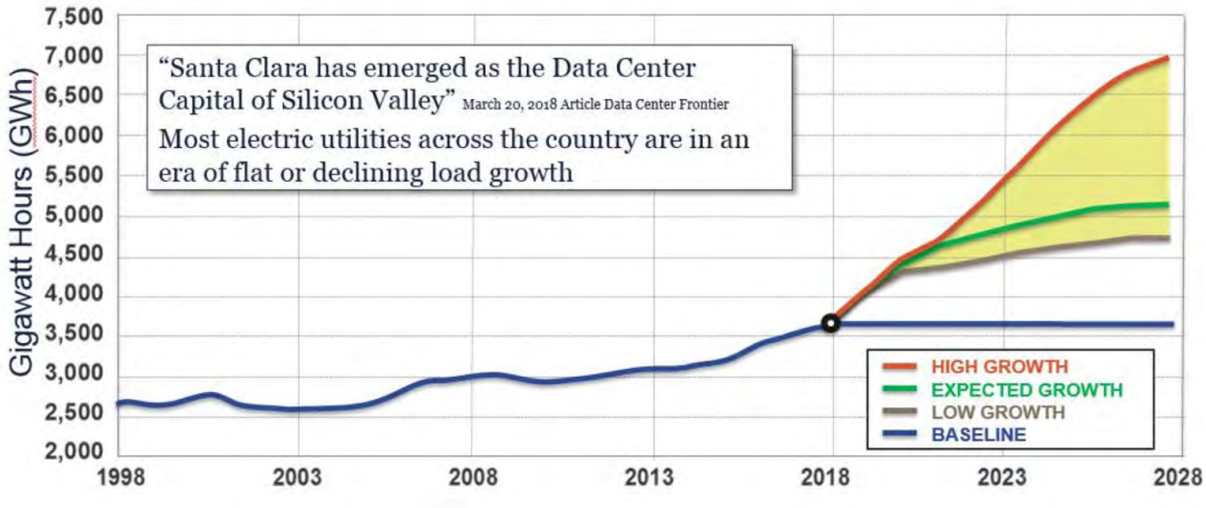
Utilities have the opening to approach electrification of the transportation sector not just as a business opportunity, but an entry point for grid modernization. Therefore, whether a city-owned or investor-owned utility, their understanding of the electrical infrastructure within a city and data to evaluate impacts of PEV adoption on the grid are a crucial part of any EV Blueprint.

Since SVP's electricity sales are primarily commercial/industrial, its energy use and peak demand profile is relatively flat monthly. However, SVP has historically experienced sudden increases in electricity demand at times, as customers move into new facilities. Data center loading can cause SVP's load growth profile to be "lumpy," due to new connections of substantial blocks of power-consuming facilities or equipment by industrial customers. This profile is reflective of the high intensity of industrial energy use in SVP's service area, which is heavily weighted toward high-technology manufacturing and data management facilities.

To accurately plan impacts of PEV adoption on the grid, the EV Blueprint Team first gathered data on The City forecasted energy demand for electricity. Figure 29 illustrates the load forecast for The City over the Blueprint planning phase.

43http://www.paceglobal.com/wp-content/uploads/2017/12/Electrification_Transportation_Sector_Flyer_FINAL.pdf

Figure 29: SVP 2018 IRP Load Forecast, GWh



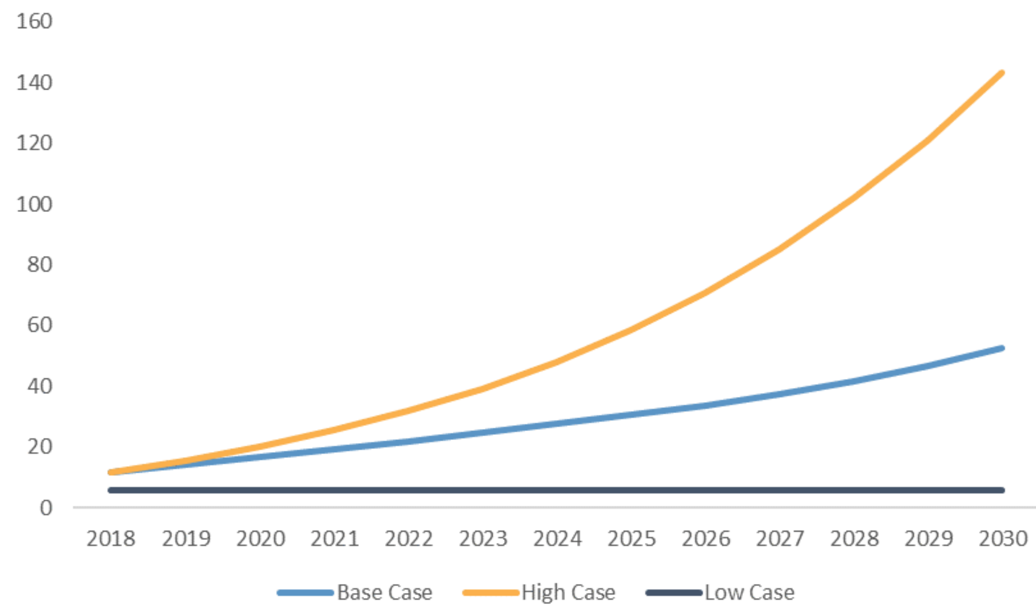
Source: SVP 2018 IRP

Unlike many cities, which experience lower than expected load growth due to energy efficiency programs, and distributed energy resources (DER), The City is experiencing consistent growth in energy and peak demand. Both energy and peak demand have been consistently increasing over the years and this trend is forecasted to continue going forward. SVP recorded a new record peak demand on September 1, 2017 at 586 MW. From 2013-2017, energy sales increased with a 4.44% CAGR, significantly higher than CAISOs declining energy sales rate with a -0.4% CAGR from 2013-2017.[44] From 2018-2030, The City forecasts a 2.13% CAGR in energy (GWh) and 2.14% CAGR in peak demand (MW).[45] Load factor is expected to remain relatively flat growing from 73% to 75% from 2018 to 2030. For similar reasons of expected data center growth, The City's load factor is higher than most other cities and utilities.

Along with this unusually large growth in load from data centers, PEV adoption is expected to increase load growth in The City. Figure 30 illustrates the expected electric energy demand increase within The City due to the PEV adoption scenarios.

44 http://www.caiso.com/Documents/2017AnnualReportonMarketIssuesandPerformance.pdf
45 Note that these growth rates have been updated after the release of the IRP with actual data for 2018

Figure 30: Expected Energy Impacts from PEV Adoption, GWh



Source: EV Blueprint Team

The Base Case scenario forecasts PEV energy impacts to reach 52 GWh of demand by 2030. To put this in perspective, SVP predicts total energy demand in 2030 without PEV penetration to reach 5,281 GWh; thus, PEV adoption is only 0.70% of the total energy demand in the Base Case.[46] However, the High Case scenario estimates PEV energy impacts to reach 143 GWh, a 138 GWh increase from the current PEV adoption energy demand shown in the Low Case. However, as The City has an unusually large load growth compared to other cities, the PEV electricity consumption from the High Case only equates to 2.61% of The City's total electricity demand (MWh). The Grid Impact Analysis section later in the EV Blueprint includes detailed study of these impacts.

It is important to note here that the energy impacts from commercial vehicle adoption are much more significant than their total percentage of the PEVs within The City. For example, in the Base Case, commercial vehicles account for 3% of the PEV adoption, but commercial vehicles account for 37% of the PEV energy demand impact. This results from the relatively high commercial vehicle VMT, increased weight, and decreased vehicle fuel efficiencies.

Electric Vehicle Supply Equipment (EVSE)

- As a leader of Transportation Electrification (TE), California passed Executive Order B-48-18 in January 2018 which calls for 5 million ZEVs by 2030. Although nearly 90% of light duty vehicle charging in California is currently completed at PEV owner homes, achieving the state's goal is also highly dependent on the public charging infrastructure. The CPUC approved $738 million

46 Supporting data will be provided to the CEC in the final report to the CEC.

worth of projects through 2023 for the IOUs to install charging infrastructure at over 1,500 locations in California.[47] Public infrastructure is especially vital to the growth in commercial PEVs where vehicles are more likely to be traveling between cities and longer distances. Thus, each city must develop a plan for locating, funding, and designing public chargers for sustainable PEV adoption.

There are three types of PEV chargers that were considered for The City in the Blueprint.

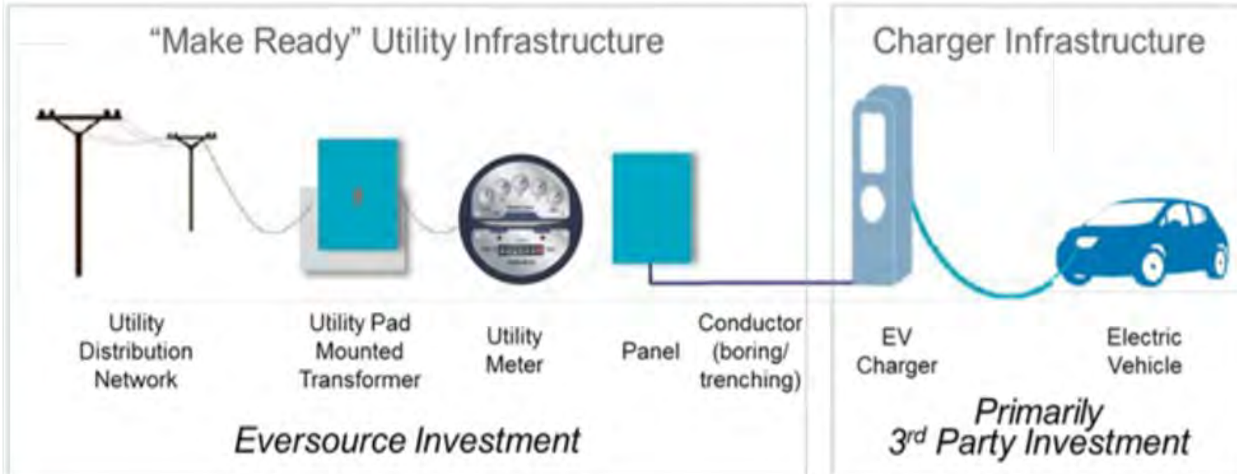
- A Level 1 (L1) charge connector uses single-phase AC 120V power. L1 chargers use standard electric outlets that can be connected to the vehicle with a simple cord. A PEV connected to a L1 charger takes roughly 12 hours to charge a fully depleted 50-mile battery which roughly equates to 4 miles of electric range per hour of charging.[48] L1 chargers are well suited for PHEVs but not for BEVs. L1 chargers have a peak demand of around 1 kW. Therefore, they impose essentially no additional strain on the grid.
- A Level 2 (L2) charger uses single-phase AC 240V power. Typically, L2 chargers are mounted on a wall or pedestal. A PEV connected to a L2 charger takes 3 to 5 hours to charge a fully depleted 50-mile battery which equates to roughly 10 to 20 miles of electric range per hour of charging, or 10 to 20 hours to charge a fully depleted 200-mile BEV such as the Chevrolet Bolt. L2 chargers typically have a peak demand of about 7 kW, which would double the demand of a home that already has a central A/C and electric oven in use. Therefore, L2 chargers in quantity, if not operated off-peak, do impose a significant strain on the grid.
- A Level 3 (L3) charger, otherwise known as DC Fast Charger (DCFC) uses three-phase SC 480V power. The equipment converts AC electricity to direct current and delivers 50 kW or greater. A PEV connected to a DCFC takes approximately 30 minutes to charge a fully depleted 200-mile battery to 80 percent. However, not all PEV models are designed to accept DCFC.

L1 chargers are typically used for home charging and are not suitable for public charging due to the long charging times; however, in some instances with major cost constraints and limited space, such as multi-unit dwellings (MUDs), L1 chargers should be evaluated. Most public chargers will be L2 and L3 (DCFC) chargers. For these chargers with larger power requirements, cities need to assess additional infrastructure when planning development. Eversource Energy provides an overview of the charging infrastructure ecosystem, as shown in Figure 31.

47 https://www.theverge.com/2018/6/1/17416778/california-new-york-electric-charging-investment-stations

48 http://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20PEV%20Sales%20and%20Infrastructure%20thru%202025_FINAL%20%282%29.pdf

Figure 31: Charging Infrastructure Ecosystem



Source: Commonwealth of Massachusetts Department of Public Utilities; Eversource

The PEV charger is only one part of the charging infrastructure ecosystem to be assessed when planning development. In business-as-usual, a utility is usually responsible for updating the distribution network, pad-mounted transformers, and meters while a customer/developer is responsible for panels, conductors, and chargers. Thus, depending on the grid impacts and required power output from the chargers, the charger itself may be a very small percentage of the total costs. As an example, the EV Blueprint Team shows a breakdown of DCFC cost estimates by power output size in Table 7.

Table 7: Estimated Costs of DC Fast Chargers

Size	Charger	Installation	Operation and Maintenance
25 kW – 90 kW (500 V)	$10,000-40,000	$4,000-51,000	$0-4,000
Up to 350 kW (1,000 V)	$70,000-120,000	$4,000-210,000	$0-4,000

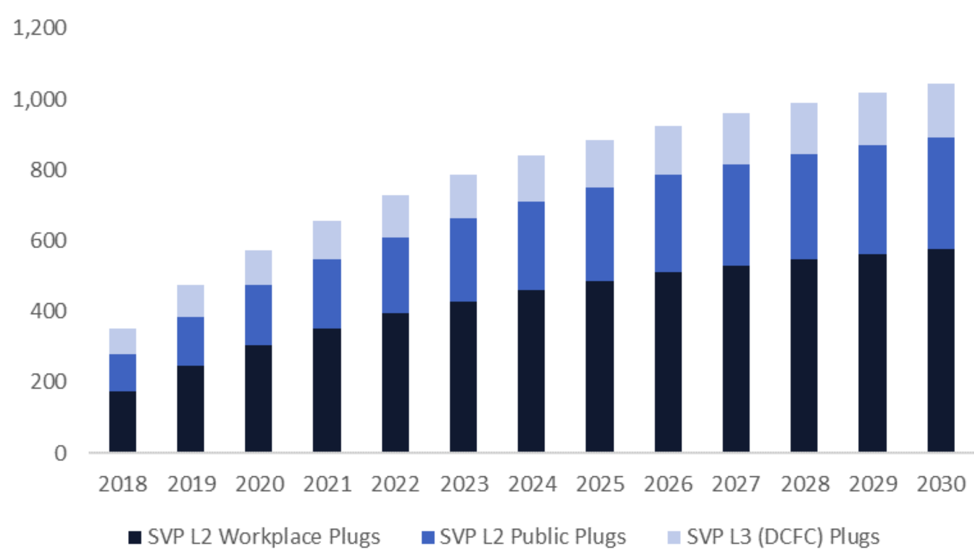
Source: Alternative Fuels Data Center (AFDC); EV Blueprint Team

A city must work with the utility – whether an IOU, Municipality, or Cooperative, to ensure a coordinated effort in public charger siting, thus mitigating the installation expenses. Utilities must analyze feeder level impacts in combination with the city's analysis on transportation flows to strategically locate chargers in areas with reduced installation costs (for Santa Clara, this will be discussed further in Task 3). In addition, a city should consider accelerating the buildout of charging infrastructure in workplaces and multi-unit dwellings. Providing a critical backbone of reliable, public utility-owned chargers is the launching point from which the broader electric transportation and 3rd party charging market in the city can expand and solidify. Identifying and providing make-readies in gap areas creates opportunities for 3rd party charging providers as well that can help optimize grid and customer locations to meet driver needs.

The CEC conducted a recent study with National Renewable Energy Laboratory (NREL)[49] that analyzes plug-in electric vehicle (PEV) infrastructure needs in California from 2017 to 2025 in a scenario where the state's zero-emission vehicle (ZEV) deployment goals are achieved. The statewide infrastructure needs were evaluated using the Electric Vehicle Infrastructure Projection (EVI-Pro) tool, developed by NREL. Each city may use this publicly available study as a baseline to forecast EVSE infrastructure requirements.

For the state of California, the study results show a need for 99,000 to 133,000 destination L2 chargers at workplaces and public locations, and 9,000 to 25,000 DCFCs at public locations by 2025. The results also show a need for home charging solutions at multi-family dwellings, which are expected to host about 121,000 PEVs by 2025. The analysis is conducted at a metropolitan granularity, and thus cannot be used directly for The City's planning. For example, the study forecasts charging requirements for San Jose. The City needs a more granular forecast since The City has less than 7% of the San Jose population. A similar customized detailed study for an individual city may be too expensive. Therefore, the EV Blueprint Team used the publicly available EVI-Pro Lite tool from NREL to conduct analysis for long-term EVSE requirements. Figure 32, Figure 33, and Figure 34 illustrate The City's prorated public EVSE requirements based on the Base Case, High Case, and Low Case PEV adoption scenarios respectively.

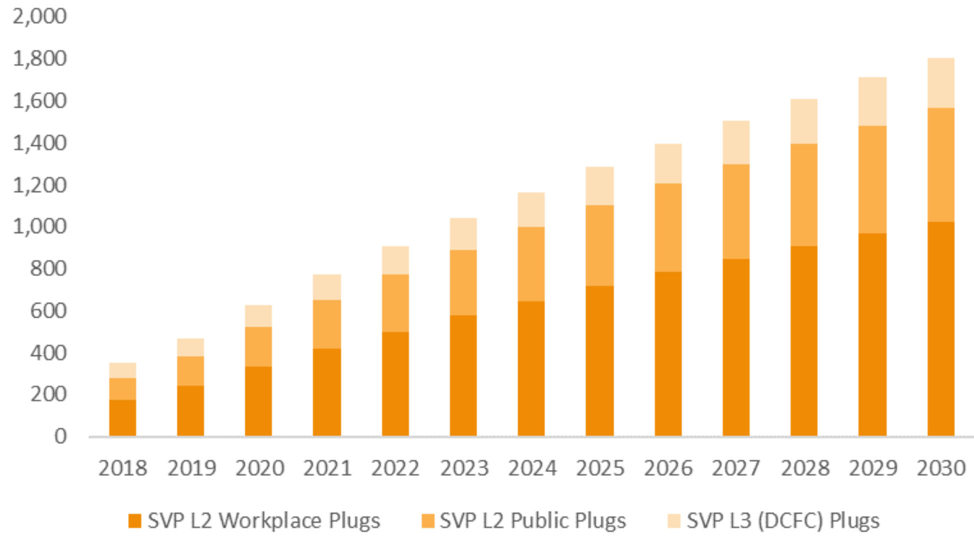
Figure 32: Base Case Required PEV Chargers by Type, # of Plugs



Source: EV Blueprint Team; NREL

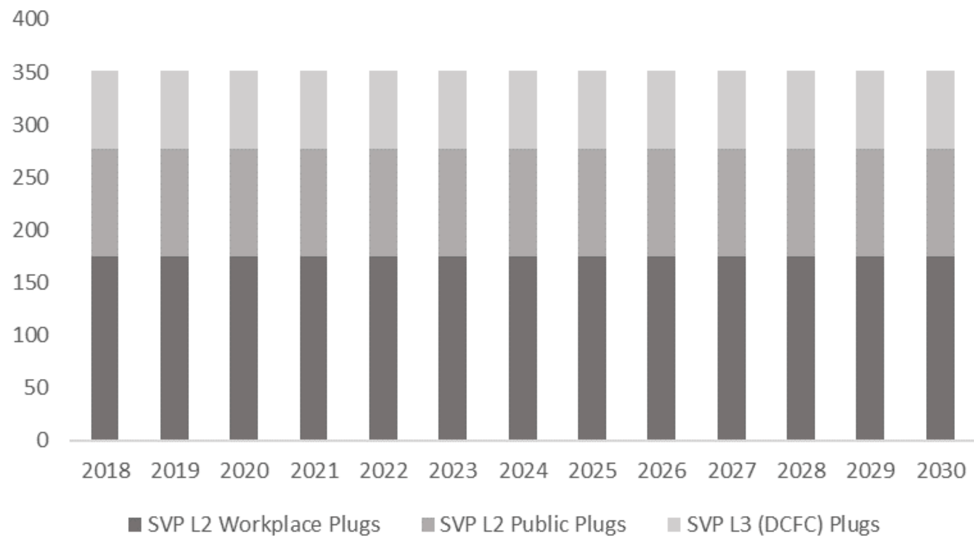
49 https://efiling.energy.ca.gov/getdocument.aspx?tn=223279

Figure 33: High Case Required PEV Chargers by Type, # of Plugs



Source: EV Blueprint Team; NREL

Figure 34: Low Case Required PEV Chargers by Type, # of Plugs



Source: EV Blueprint Team; NREL

Note that this forecast does not include EVSE for MUDs. The City has approximately 59,000 residents living in MUDs[50] (~46% of The City population) and predicts an additional 752 L2 charge connectors are required by 2025 at these MUD locations. Currently, The City is planning

50 2010 Census data

to update the Santa Clara Municipal Code to require new non-residential and residential developments to include PEV chargers.

Societal Co-benefits

While many societal co-benefits could be considered for the Blueprint, the most obvious and potentially valuable is GHG emissions. CARB's Cap & Trade program can be used to fund PEV adoption programs. In California, there is a CO_2 settlement price available from the Cap & Trade program, which for reference was $15.33 per MT CO_2(e).[51] in November 2018.

The Cap & Trade program does not consider the social cost of long-term climate impacts in this settlement price, such as:

- Agricultural losses
- Health benefits
- Sea level rise
- Air conditioning growth

To estimate a true socio-ecological cost of carbon, advanced simulation modeling needs to be conducted. The EPA has invested in three separate models to estimate the social cost of carbon (SCC), as described below.

Climate Framework for Uncertainty, Negotiation and Distribution (FUND)

The FUND model is an integrated assessment model of climate change using Visual Studio Express and is recommended by the EPA to study effects of environmental policies. It differs from other models as it provides a more detailed representation of 16 sectoral/regional economic impacts with their own respective trends, parameters, and outputs with a time-step of one year ranging from 1950 to 3000.

Dynamic Integrated Climate-Economy (DICE)

The DICE model is a computer-based model that integrates economic, climatic and geophysical data to model the effect of human activities and climate policies and project it into the future. The DICE model is based on the Ramsey model, a model of economic theory according to which society invests in capital good, thereby reducing consumption today, in order to increase consumption in the future. The DICE model modifies the Ramsey model to include "climate investments," such as reductions of greenhouse gas emissions. The estimation and projection in the future of climate-related damages remains a controversial issue. However, this estimation is crucial for the model, as policy decisions are based on the balance between cost of damages and benefit from policies.

Policy Analysis of the Greenhouse Effect (PAGE)

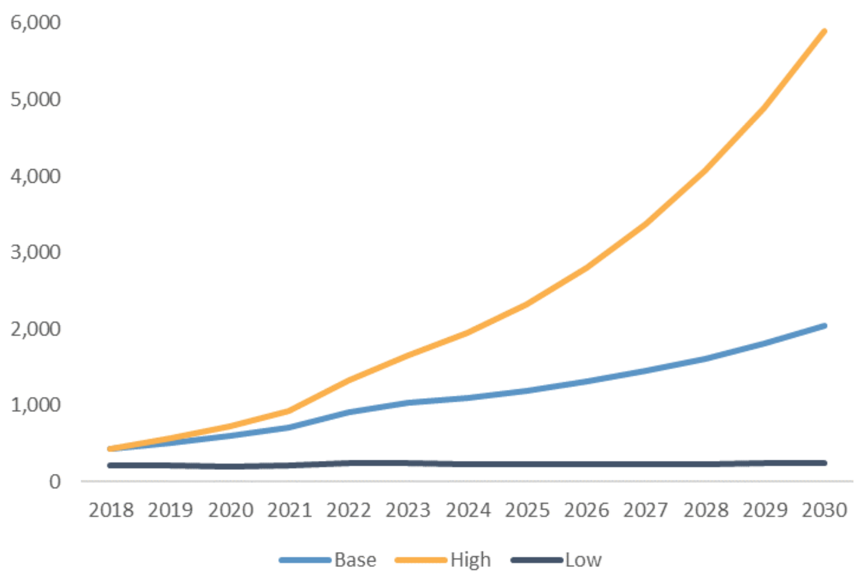
The PAGE model is a Microsoft Excel spreadsheet tool. Unlike other models simulating the effects of climate change, PAGE does not incorporate detailed economic or climate modeling. Instead, simple parameterizations are used to calculate emissions, temperature changes, and economic

51 https://www.arb.ca.gov/cc/capandtrade/auction/results_summary.pdf

impacts. The advantage of the PAGE model is its Monte Carlo sampling approach to quantify the uncertainty in the SCC resulting from uncertainties in the assumed input parameters of the model.

Each of these models can provide a wide range of estimates for the SCC ranging from $25 to $530 per MT CO_2(e).[52] In general, each city should review the methodology of each model and the input assumptions to see which model best captures their social benefits of reduced GHG emissions the best. The City has decided to base its estimates of the SCC from a Caltech Sustainability study "Assessing the Social Cost of Carbon" that reviewed each EPA model in depth. Ultimately, The City uses the study's recommendation that "the FUND model differs from the other models as it provides a more detailed representation of 16 sectoral/regional economic impacts with their own respective trends, parameters, and outputs – such as energy use, GDP, population, intensity, and policy – with a time-step of one year ranging from 1950 to 3000." Based on Caltech's assumptions and sensitivity analysis, the SCC is estimated to be within a range of $44 to $74 per MT CO_2(e).[53] Using the average between the low and high SCC, Figure 35 shows the SCC for each of The City's PEV adoption scenarios.

Figure 35: PEV Adoption Social Cost of Carbon Savings, $000



Source: EV Blueprint Team; Caltech

PEV adoption in The City has led to GHG emissions reductions that can be quantified by the SCC as a net savings of $420,000 in 2018. In the Low Case, as electricity generation produces less GHG, this net savings will decline relative to the High Case, where the growth in PEV adoption can result in a net savings of $5.9 million in 2030.

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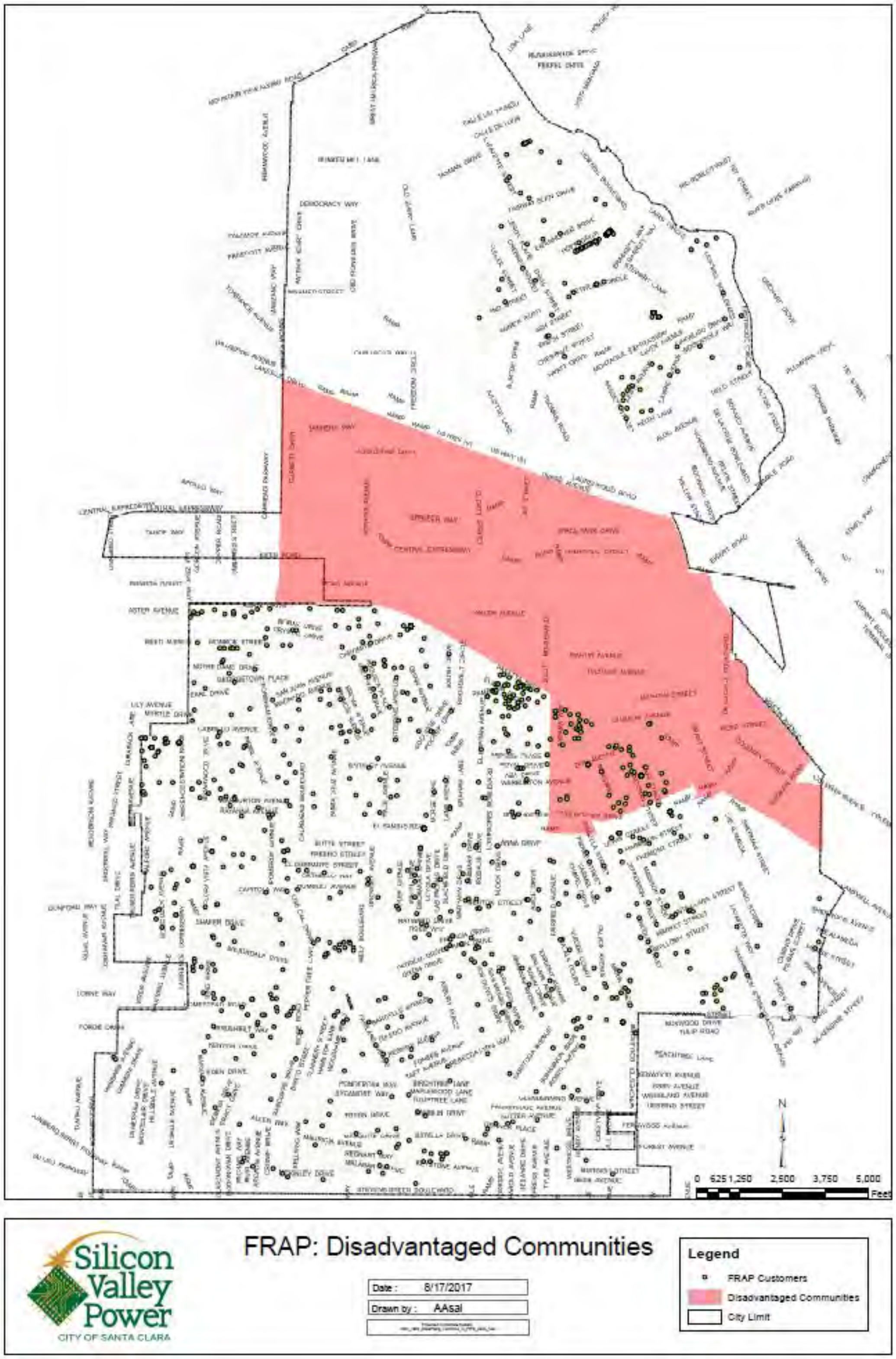
52 This SCC range is in 2016 dollars and based off of scenarios performed by a Caltech Sustainability study "Assessing the Social Cost of Carbon" prepared by Seed Consulting Group.
53 This SCC range is in 2006 real dollars.

Disadvantaged Community (DAC) Growth

Disadvantaged Communities (DACs) often experience above average health effects from vehicle tailpipe emissions as DACs are often located near major roadways. There is only one DAC within The City; it borders Highway 101 and the San Jose Airport. The City has kept this area zoned for heavy industrial and commercial including 24/7 manufacturing, SVP's Donald Von Raesfeld power plant, data centers, high-tech companies and small industrial. The City has kept infill of housing at a minimum except where it makes sense, so that few residential and even fewer lower income Federal Rate Assistance Program (FRAP) residential customers reside within the borders. Figure 36 shows a map of The City with the DAC region and FRAP customers.

Figure 36: Santa Clara Map Identifying DAC & FRAP Customers



Source: SVP

Cities need to consider promoting PEV adoption within DACs, but also ensure the DACs have sufficient low-income residents to target for incentivizing PEV adoption. In 2012, Senate Bill 535 directed that 25% of the proceeds from California's Cap & Trade program go directly to DACs. Utilities have the opportunity to use state funding to support ZEV adoption in DACs. The City recognizes the following types of programs that have targeted ZEV adoption in DACs in Figure 37.

Figure 37: Programs to Increase ZEV Adoption in Disadvantaged Communities

Action	Description	Rationale	Example
State BEV (and PHEV) incentive increases for moderate- and low-income consumers	Increased rebate values for consumers who meet certain income criteria	Support the adoption of zero-emission vehicle technology by low- and moderate-income consumers	California Clean Vehicle Rebate
City outreach events in low-income communities	Outreach and education events, such as ride-and-drives and vehicle showcases	Increase consumer awareness and understanding about the multitude of benefits electric vehicles offer, as well as available incentives, perks, and programs	National Drive Electric Week, Watts, California
City electric buses in public transportation	Electrification of municipal transit buses	Lower total cost of operation, reduce climate and air pollution, and raise awareness of clean transportation	Transit Authority of River City, Louisville, Kentucky
City electric vehicle carsharing programs in low-income communities	Deployment of an electric carsharing fleet and infrastructure	Provide affordable zero-emission transportation options to communities that may otherwise lack equitable access	City of Los Angeles (forthcoming)
Utility public charging infrastructure in low-income communities	A percentage of utility-deployed public charging in low-income communities	Support electric vehicle adoption by expanding access to charging infrastructure in underserved communities	San Diego Gas & Electric
Utility incentive increases for EVSE at multifamily properties	Greater rebates available for charging stations at multifamily properties	Support the adoption of electric vehicles and expand access to charging infrastructure	Austin Energy
Utility EVSE informational materials for multifamily properties	Consumer-oriented information that details the process for installing EVSE	Overcome unique challenges and complications related to installing EVSE at multifamily properties	Seattle City Light

Source: The International Council on Clean Transportation[54]

The EV Blueprint Team prioritized areas associated with low-income residents and MUDs to further promote PEV adoption. Funding available for DAC-specific incentives will be focused on the southeastern corner of the DAC with a high density of FRAP customers, as shown in Figure 36. The remainder of the DAC has been specifically zoned by The City to contain industrial processes away from residential areas and this area is therefore not a high priority for promoting PEV adoption.

54 https://www.theicct.org/sites/default/files/publications/US-Cities-EVs_ICCT-White-Paper_25072017_vF.pdf

Interoperability

With the continued growth of PEV adoption, there arises a requirement for creation of standards. Standards are needed to drive down development costs and prices to consumers, by enabling manufacturers to compete to deliver products to the same specification. Standards will define minimum functionality; manufacturers can add more features as desired. Standards are also needed to decrease the stranded asset risk by ensuring that different electric vehicle service providers can interface to EVSE manufactured by different vendors, especially in the case where a service provider exits the business.

Key assumptions to successful interoperability include:

- The electric vehicle supply equipment (EVSE)-cloud link, such as the communications from a utility application such as Distributed Energy Resource Management System (DERMS) or Advanced Distribution Management System (ADMS), to the EVSE is foundational to grid integration and therefore, the first priority.
- The EVSE acts as the main circuit protection and safety device between a PEV and the grid, providing the function of detecting, reporting, and repairing fault conditions necessary to maintain uptime for EVSEs. Therefore, EVSE manufacturers must comply with the National Electric Code and Underwriters Laboratories requirements.
- The PEV-EVSE-utility data link is not needed for grid integration; rather, it helps primarily via enabling the provision of state of charge (SOC)55, but smart-charging management can occur without it.
- Standards are driven by the procurer of the equipment. Utilities are the procurers of EVSEs in quantity (either directly or via rebates) and therefore can drive EVSE standards.
- EVSE manufacturers will tailor their products for local markets (utilities and public utility commissions via their regulation of utilities) and are thus responsive to standards demands from utilities.
- EVSE manufacturers have also made major headway in replacing the need for secondary utility meters equipment to be installed alongside an EVSE by installing a revenue-grade meter inside the EVSE.
- Utilities have the ability to adopt standards developed by open and transparent standards development organizations for ratepayer-funded projects, including rebates.

The City is expected to complete an Advanced Metering Initiative (AMI) by mid-2019: installing 55,000 "smart-meters" throughout The City to convert energy consumption tracking from monthly recordings to real-time 15-minute recordings. This initiative will allow SVP to record net metered generation as a total to meet CA's requirements, but these smart meters are not able to record local consumption separate from other usage. The City's metering infrastructure is not set up to be able to separate PEV charging from home energy consumption, thus PEV-specific TOU

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55 State of Charge (SOC) is the level of capacity remaining in the vehicle battery pack.

rates require a second meter or use of the sub-meter built into an EVSE. San Diego Gas & Electric (SDG&E) is using such sub-meters in its dynamic pricing pilot for PEV-only tariffs. Further review of PEV-specific rates is discussed in Task 4 program initiatives section.

Autonomous Vehicles

The impacts of autonomous vehicles are not included in the long-term forecasting analysis and program initiatives discussed in later sections of the EV Blueprint. However, pending technological breakthroughs and enabling government policies, autonomous vehicles may disrupt the transportation industry and thus The City's EV Blueprint. It is important for The City to track the advancement of autonomous vehicles, specifically by the level of driving automation, as defined by SAE International[56] as follows:

Level 1: Some driver assistance. These cars may have one or more systems that can control speed or steering – but not both simultaneously. Many new cars have available adaptive cruise control and automatic emergency braking, which are examples of Level 1 features.

Level 2: Even more driver assistance. Many luxury automakers are now making available Level 2 cars that can control steering and speed simultaneously, without driver interaction, for short periods of time (under 1 minute, and in some cases seconds). Level 2 cars cannot control a car in all situations, including merging onto a highway or in stop-and-go traffic.

Level 3: Conditional autonomy. Many automakers such as Ford and Volvo have indicated that they will skip this step – and for good reason. Unlike Level 2 cars, Level 3 autonomy can control a car in all situations with the car constantly monitoring the road, but unlike higher levels on the SAE scale, Level 3 cars will return to human control if the system cannot function correctly.

Level 4: Nearly autonomous. No driver interaction is needed with the Level 4 car; the vehicle will stop itself if the systems fail, which is an important distinction from Level 3.

Level 5: Completely autonomous. Level 5 autonomy takes the driver completely out of the equation. While the presence of a steering wheel, gas and brake pedals don't preclude a car from being Level 5, they would be useless: These cars are not supposed to be driven by people. No automaker has laid out a firm timeline for Level 5 cars to hit the road, but many have said that it is at least a decade or longer away.

Blueprint Goal Development and Selection

The first three steps within the first stage of the Siemens EV-IF process included (1) identifying and understanding the interests and perspectives of impacted and interested internal and external stakeholders; (2) determining the current state of Transportation Electrification (TE);

56 https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles

and (3) forecasting long-term Plug-in Electric Vehicle (PEV) adoption scenarios for The City and additional qualitative planning considerations.

To design an effective EV Blueprint, the EV Blueprint Team needed to identify, evaluate, and agree on a set of goals/targets that would guide the implementation of the EV Blueprint – step four. In general, program goals should be "SMART," that is to say "specific," "measurable," "achievable," "relevant," and "time-bound." A summary of the quantitative forecast scenarios is shown in Table 8.

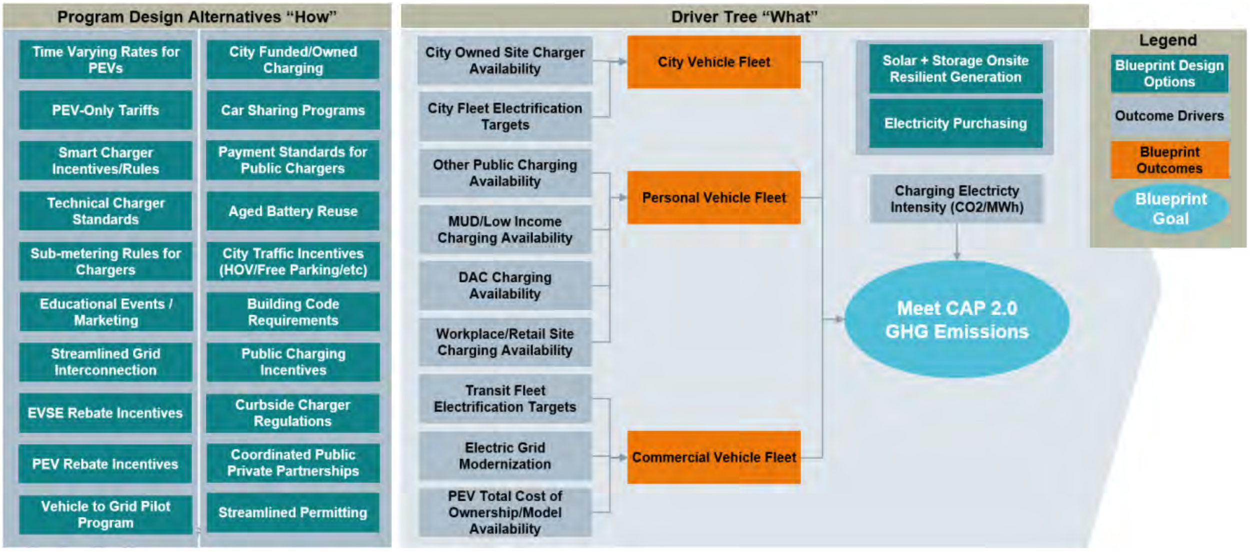
Table 8: EV Blueprint Forecast Scenarios Summary

Forecast	Scenario	Near-Term (2021)	Mid-Term (2025)	Long-Term (2030)
PEV Adoption (Cumulative # of Vehicles)	Low Case	2,369	2,369	2,369
	Base Case	8,369	11,959	15,267
	High Case	10,039	22,161	50,030
GHG Savings (MMT CO_2)	Low Case	3,428	3,762	3,985
	Base Case	9,775	19,562	33,456
	High Case	15,209	38,062	96,700
Social Cost of Carbon (2018$)	Low Case	52,546	57,676	61,089
	Base Case	176,678	299,885	512,887
	High Case	233,149	583,492	1,482,409
Load Impacts (GWh)	Low Case	5.72	5.72	5.72
	Base Case	19.35	30.51	52.38
	High Case	25.49	58.63	143.11
Charging Requirements (# of charge connectors)	Low Case	473	473	473
	Base Case	656	886	1,043
	High Case	773	1,283	1,807

Source: EV Blueprint Team

Internal stakeholders, as shown previously in Figure 7, gathered together in several meetings to review the findings in steps 1-3 of the first stage in the Siemens EV-IF process. After educational sessions were provided, the EV Blueprint Team developed a driver tree as illustrated in Figure 38.

Figure 38: EV Blueprint Driver Tree



Source: EV Blueprint Team

Ultimately, The City's goal for increasing Transportation Electrification (TE) – therefore the EV Blueprint Goal – is to help meet GHG emissions reduction targets from the Climate Action Plan (CAP). While the CAP 2.0 is currently in development, the CAP 1.0 has goals to reduce GHG emissions 55% below 2008 baseline levels by the recommended target year of 2035. The Driver Tree breaks down the outcomes of increasing TE, illustrated as orange boxes, that can lead to GHG reduction: City Vehicle Fleet, Personal Vehicle Fleet, and Commercial Vehicle Fleet. Each of these outcomes has a variety of drivers, illustrated in gray boxes, that the EV Blueprint can prioritize to influence the adoption of PEV fleets. Lastly, the Driver Tree contains program design options, illustrated in turquoise boxes, that present potential programs the EV Blueprint Team can choose to include in the Blueprint to meet near-term, mid-term, and long-term goals.

After several meetings among internal stakeholders, the EV Blueprint drivers – illustrated as gray boxes in Figure 38 above – have been prioritized as listed in Table 9.

Table 9: EV Blueprint Prioritized Drivers

EV Blueprint Drivers	Priority Level
MUD/Low-Income Charging Availability	1
City Fleet Electrification Targets	1
DAC Charging Availability	1
Electric Grid Modernization	2
City Owned Site Charger Availability	2
Other Public Charging Availability	2
Retail Site Charging Availability	2
Workplace Site Charging Availability	3
Transit Fleet Electrification Targets	3
PEV Total Cost of Ownership	3
PEV Model Availability	3

Source: EV Blueprint Team

EV Blueprint Drivers were ranked by priority level, with 1 being the highest priority and 3 being the lowest priority. Considerations for priority level weighed both The City's PEV adoption needs and The City's viable means of influence. For example, though PEV model availability is necessary for increased adoption of PEVs, The City does not have viable means of influence to supply new PEV model selections. Based on stakeholder survey input, there is a clear desire for increased charging availability in multi-unit dwellings (MUDs). Similarly, low-income charging, DAC charging, and city fleet electrification are all viable drivers for the EV Blueprint Team to implement.

The remaining Tasks of Phase I of the EV Ready Communities Challenge provide the analysis, opportunities, and risks to help the EV Blueprint Team choose near-term (2019-2022), mid-term (2022-2025), and long-term (2026-2030) plans to meet The City's TE goals.

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CHAPTER 4:
Task 3: Analyzing Blueprint Target Areas

This section describes the second stage of the Siemens EV-IF which identifies PEV charging target areas within The City. The analytical process for identifying the target areas included four steps. The first step analyzed vehicle usage and traffic patterns within The City to identify where charging infrastructure is expected to be utilized the most. The second step analyzed the impact of PEV adoption on The City's electric grid to identify where charging infrastructure can be expected to require substation equipment upgrades. The third step recommended technology and system combinations specific to EV Blueprint goals that were prioritized in the first stage. In the fourth step the EV Blueprint Team identified and defined the ownership and operating models that owners of Electric Vehicle Supply Equipment (EVSE) employ and evaluated the economics as they pertain to each of the prioritized goals of The City.

To establish the charging infrastructure required to meet expected demand, the EV Blueprint Team applied several tools to couple current traffic and congestion, travel patterns, electric vehicle infrastructure, and demographical data with expected city development and future traffic. To establish the charging infrastructure constraints, the EV Blueprint Team forecasted hourly load profiles and peak load constraints and compared these against feeder capacity limitations. Together, the demand and constraint analysis provided The City a clear understanding of where charging infrastructure will be needed and where SVP equipment upgrades will be required. From this basis, the EV Blueprint Team identified optimal areas within The City for charging infrastructure that offer high utilization and low installation costs.

To establish a plan which targets The City's prioritized EV Blueprint goals, the EV Blueprint Team recommended implementation guidelines for each goal. These recommendations provided SVP with a clear understanding of the technical and economical requirements to promote PEV adoption specific to The City's ecosystem.

The target areas are discussed below in four sub-sections: *Vehicle Usage and Driving Patterns, Grid Impact Analysis, Technology and Systems Considerations, and Business Model Recommendations.*

Vehicle Usage and Driving Patterns

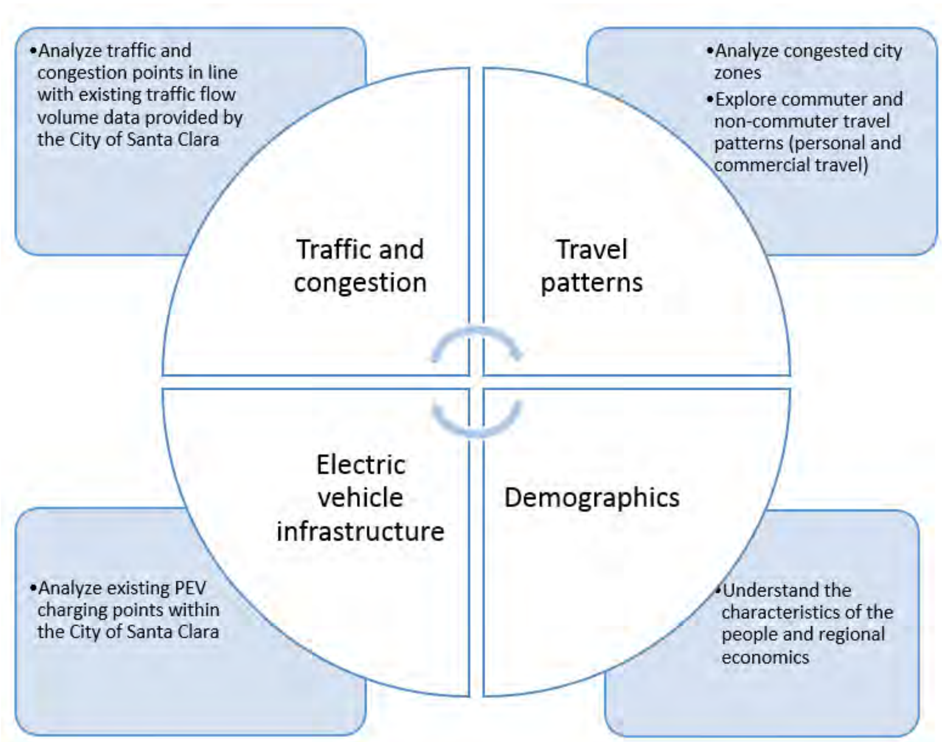
The EV Blueprint Team analyzed current traffic patterns within The City to establish the charging requirements. The methodology, tools, and results of the study helped to identify target areas within The City that are expected to require public charging. Since the study relies upon current traffic data, The City's development plans were evaluated to determine target areas based on future demand. Areas with high charging requirements were determined and were specified by Traffic Analysis Zones (TAZs).

Methods

At the core of the project, the EV Blueprint Team combined its in-depth traffic knowledge with travel and traffic pattern information about the City of Santa Clara to propose a set of potential areas for future plug-in electric vehicles (PEV) infrastructure deployment.

The study makes use of several data sources shown in Figure 39 to analyze the current situation in The City, coupling traffic and congestion, travel patterns, electric vehicle infrastructure and demographical data as a powerful data set that can be used to assist with decision-making.

Figure 39: Data Analyzed



Source: EV Blueprint Team

Additionally, the EV Blueprint Team has utilized desk research and its expertise in electric vehicle charging infrastructure development to provide a set of suggestions for The City going forward.

Tools

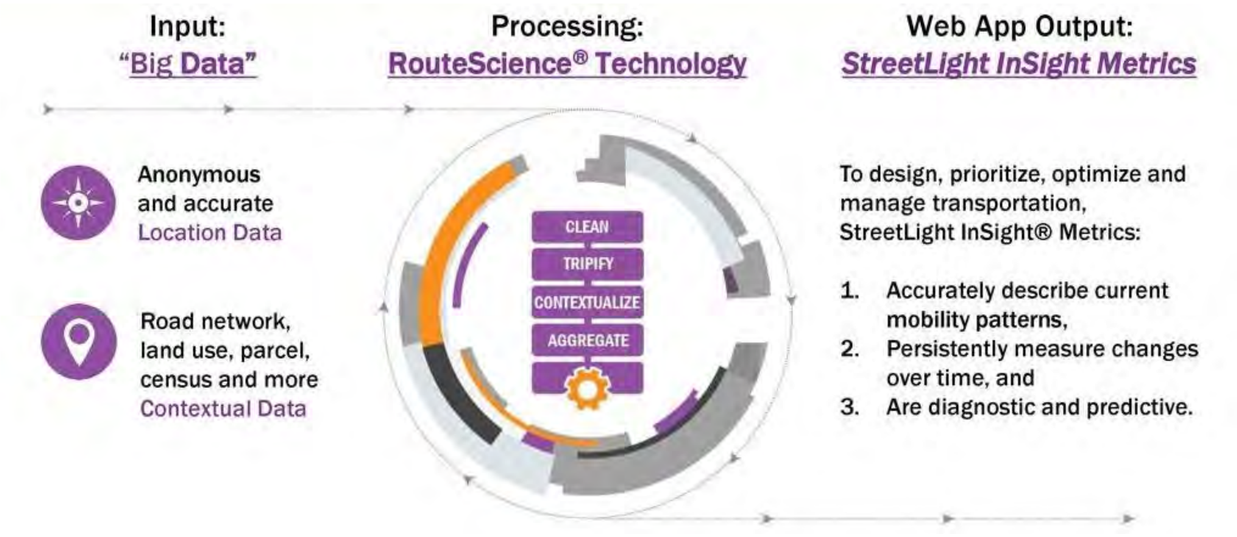
This section describes the tools and data sets utilized for this traffic analysis study.

StreetLight InSight

The main tool utilized for the project is named StreetLight InSight – an online, cloud-based software platform provided by StreetLight Data[57] that has enabled the EV Blueprint Team to generate aggregated travel pattern analytics from anonymized mobile device data.

The application illustrated in Figure 40 is powered by StreetLight Data's analytic processing engine (RouteScience®) that algorithmically integrates trillions of spatial data points from over 65 million mobile data devices, including cell phones, connected cars, fleet management systems, smart phone applications and many more. The output results translate into trips and location-based behavior that can be reported against spatial and statistical datasets.

Figure 40: StreetLight Data's Platform



Source: Streetlights Data

The data within the system is anonymized, with metrics describing groups only and never individuals to protect privacy. The data is also cleaned by the platform with false signals from inbound data being removed.

Other features of RouteScience® include patternization (a method where data is organized into trips and series of activities), contextualization, and metric creation to allow the EV Blueprint Team to produce reports in line with the purpose of this project.

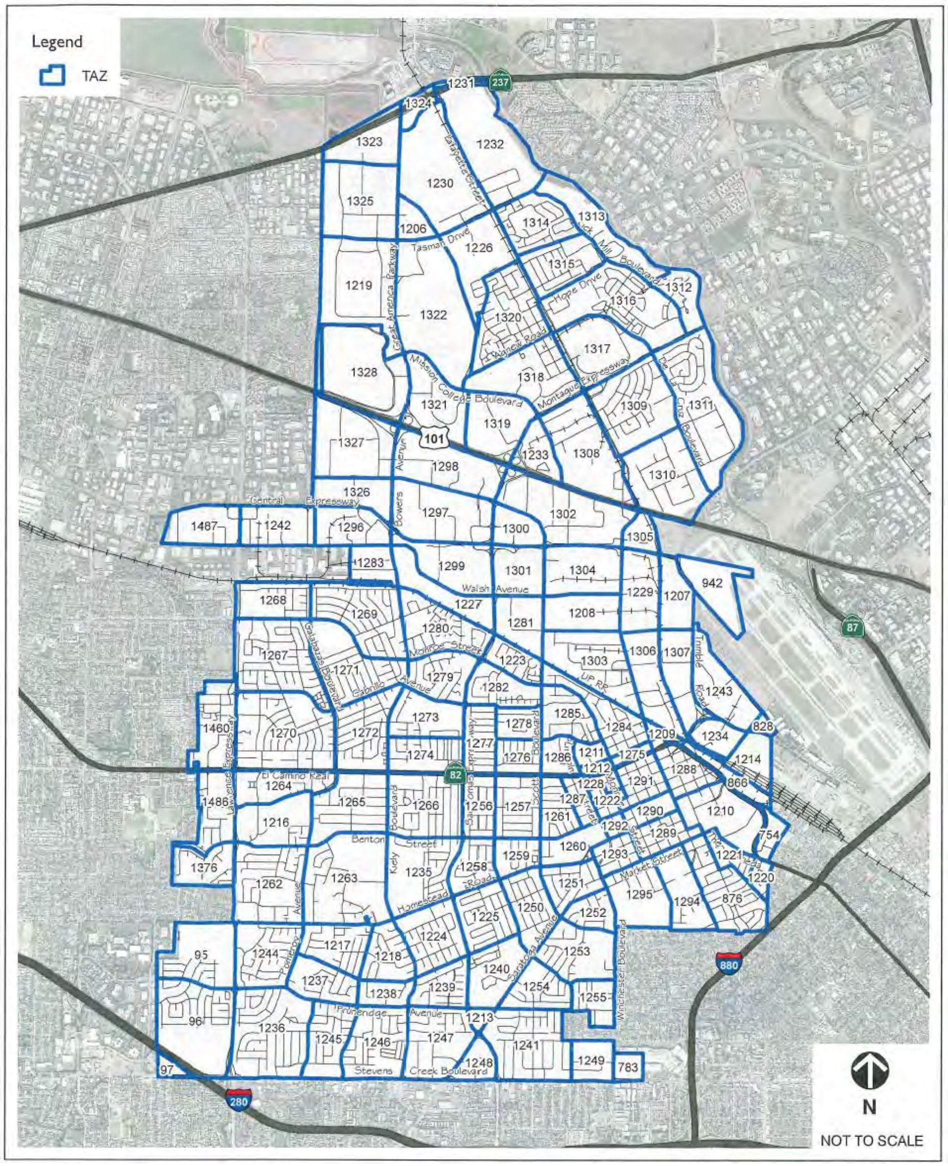
Traffic Analysis Zones

To ensure a common nomenclature and region definition that may be used throughout the study in alignment with The City, this study has adopted The City's Traffic Analysis Zone (TAZ)

57 http://www.streetlightdata.com

definition. The shapefile data for The City's TAZs as shown in Figure 41 was provided to the EV Blueprint Team and incorporated as a layer within the StreetLight InSight platform for this project.

Figure 41: Traffic Analysis Zones for The City



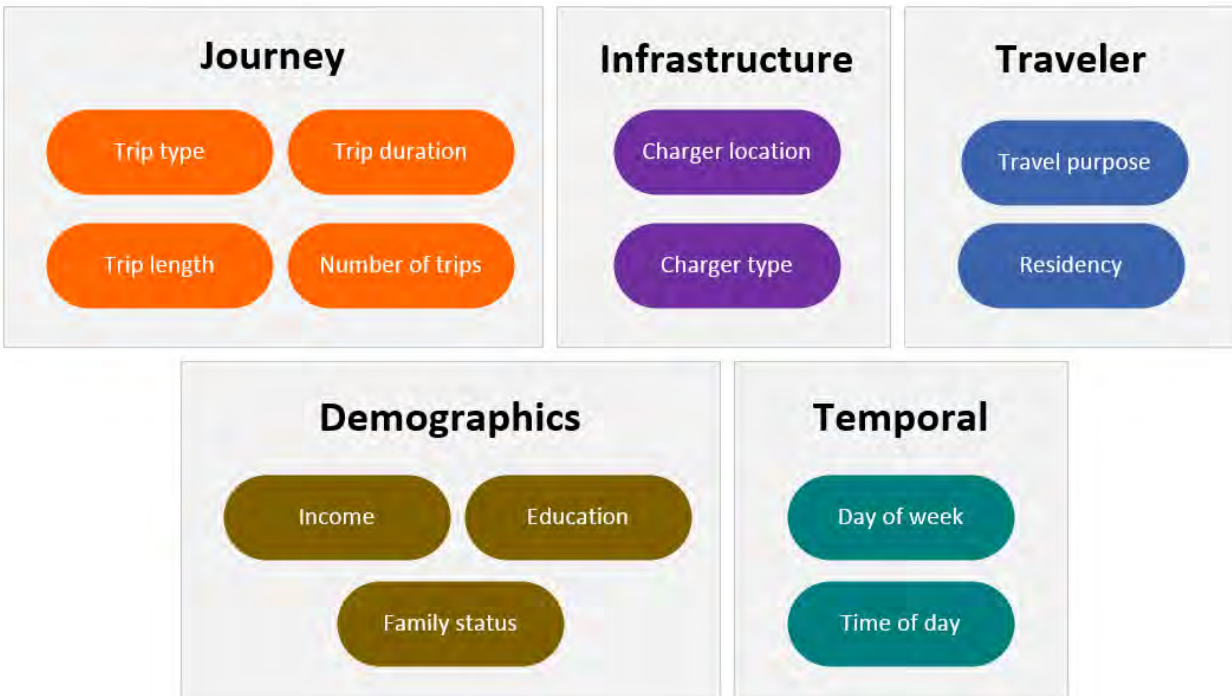
Source: Silicon Valley Power

This report focuses on TAZs that are either fully or partially within The City's jurisdiction, with the distinct city boundaries highlighted in map views presented throughout this report.

Data Fusion

As part of this project, the EV Blueprint Team also utilized demographics and infrastructure information relating to The City to help with the decision-making process to select a limited number of candidate areas for new plug-in electric vehicle charging infrastructure. This data in combination with the StreetLight InSight platform is illustrated in Figure 42 and further defined in Table 10.

Figure 42: Data Types Utilized



Source: EV Blueprint Team

Table 10: Data Types Defined

Type	Metric	Description
Journey	Trip type	*Personal or commercial trip, where a trip refers to a journey starting from or ending in each zone*
	Trip duration	*The trip time in seconds for a full trip*
	Trip length	*The trip length in miles for a full trip*
	Number of trips	*Total number of trips*
Infrastructure	Charger location	*Location of a PEV charging point*
	Charger type	*Type of a PEV charging point (Level 2 or DCFC)*
Demographics	Income	*General citizen income information (ranging from less than $20K to more than $200K)*
	Education	*General education information (no high school diploma, high school, some college, bachelor's degree or graduate degree)*
	Family status	*Describes whether a family does or does not have children*
Temporal	Day of week	*Average based on day of the week (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday). Can be aggregated or selected individually*
	Time of day	*Average based on time of day, hourly. Can be aggregated or selected in hourly time bands (e.g., 1 pm-2 pm)*
Traveler	Travel purpose	*Percentage based on trip types, namely:* • *HBW: home-based work, i.e., home-to-work or work-to-home* • *HBO: home-based other, i.e., from or to home, but not home-based work* • *NHB: not home-based, i.e., not from or to home*
	Residency	*Percentage based on residency of visitors who spend at least a few minutes in a zone, which could be of type:* • *Living in local metro area: visitors who reside in metropolitan areas (i.e., a densely populated urban core) within 45 miles of a zone* • *Living in other metro area: visitors who reside in metro areas beyond 45 miles of a zone* • *Living in non-metro areas: visitors who reside in non-metro areas (e.g., less populated areas such as a suburbs)*

Source: EV Blueprint Team

Notes:

- The information about demographics is based on the 2010 U.S. Census[58].
- Metrics such as homeownership and age were not adopted due to these not being available within the system.

By fusing this anonymized data, the EV Blueprint Team was able to develop recommendations that can target not simply areas with high traffic density, but also based on other human-centered aspects such as commuter traffic, journey lengths, population income, and multi-family environments.

58 https://www.census.gov/programs-surveys/decennial-census/decade.2010.html

Results

The EV Blueprint Team utilized travel pattern data for both personal and commercial trips. The results for each of those journey types are presented separately in the sections to follow. It should be noted that these results focus only on TAZs that lie either fully or partially within The City boundaries.

Personal Journeys

When it comes to personal journeys, attention was primarily given to journey information and demographics, targeting education level, family status, and income as points which could help The City with the overall decision-making process when selecting zones for new infrastructure.

Candidate Zones Based on All Trips

The heatmap in Figure 43 demonstrates the average number of trips for all days of a week (i.e., Monday to Sunday) for all times of those days using the data recorded in the system for the many Santa Clara TAZs. The TAZs marked in red indicate the highest average number of trips (between 27.79k and 36.98k) for all days of a week and the TAZs marked in green indicate the lowest average number of trips (between 243 and 9.43k). Figure 43 also shows the locations of currently operating L2 and DCFC public electric vehicle charging stations[59] in each zone.

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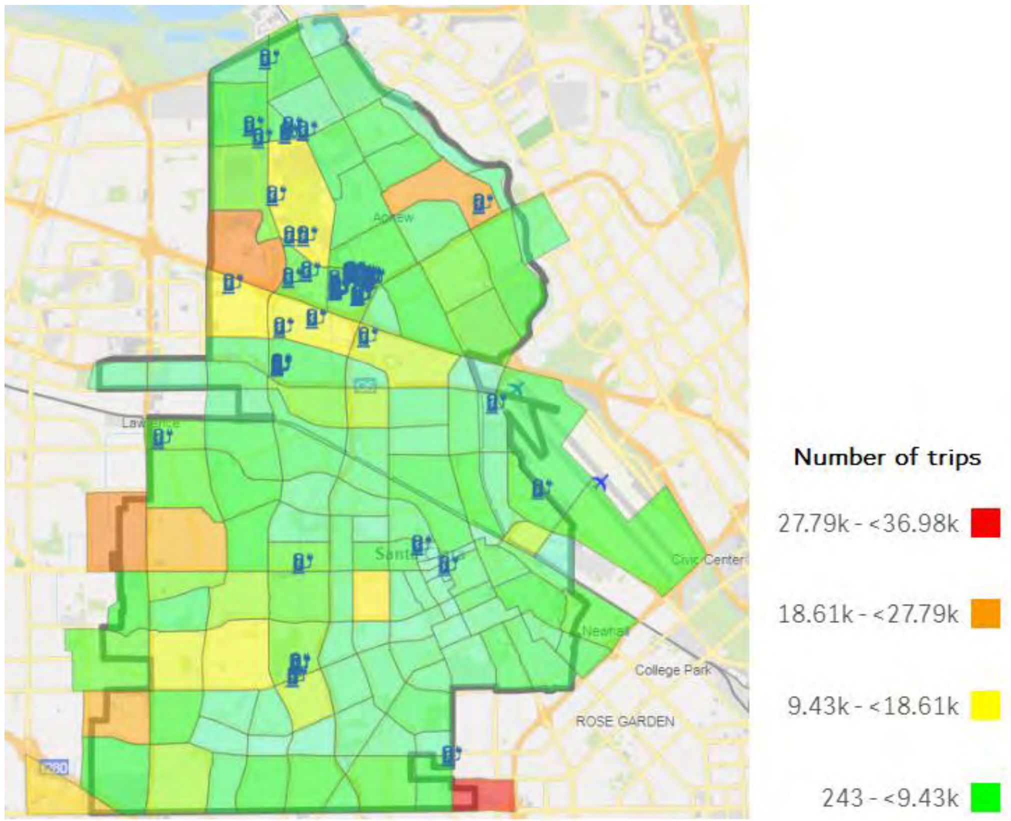
59 Retrieved from https://afdc.energy.gov/fuels/electricity_locations.html#/analyze

Figure 43: Heatmap[60] of Personal Trips in Santa Clara TAZs (all days of week, all times)



Source: StreetLights Data

From Figure 43, one clear candidate zone for PEV infrastructure is identified: TAZ 783 (marked in red), which is the TAZ with the highest average number of personal trips. It is important to note that only part of TAZ 783 lies within The City, while the TAZ is under the City of San Jose jurisdiction.

Additionally, four TAZs scoring high in the number of trips (marked in orange) do not have any charging infrastructure at present: 95, 1270, 1328, and 1460.[61] Three of these TAZs belong to The City, all but TAZ 1460, which is under Sunnyvale's jurisdiction. Details are shown in Table 11.

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60 Presented with a continuous color scale format.

61 Please refer to Figure 41 for a map of TAZ locations.

Table 11: Candidate Zones Based on Personal Trips

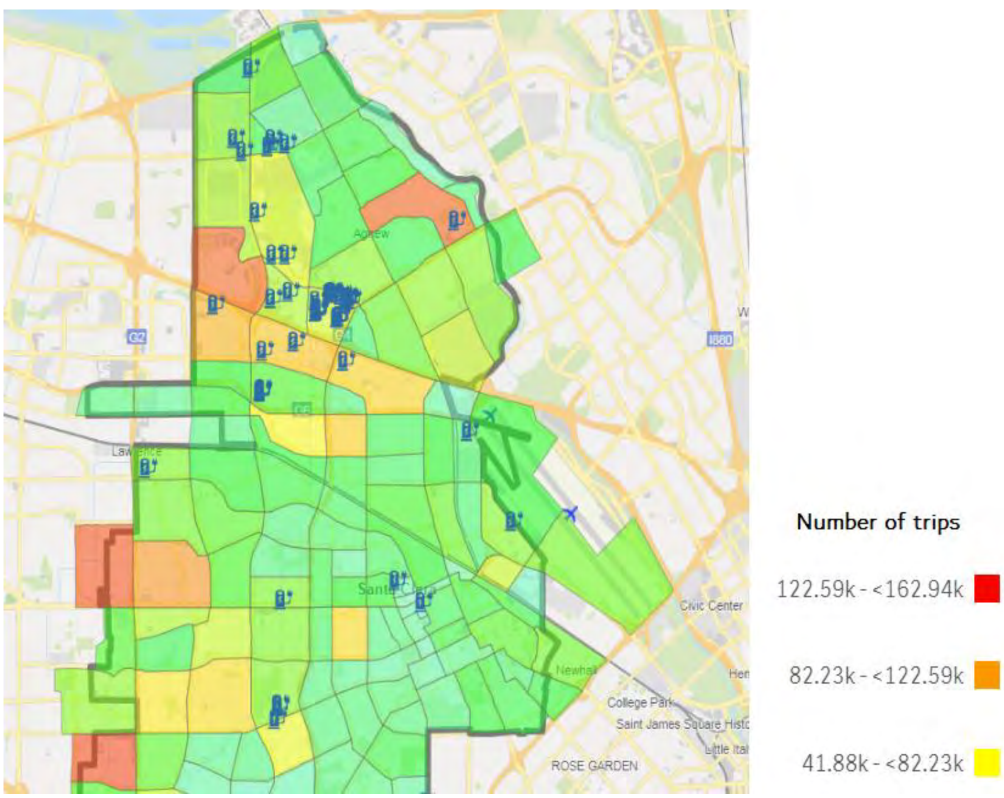
TAZ	Jurisdiction	Number of trips	Number of public chargers
95	Santa Clara	25,983	0
783	San Jose	29,975	40[62]
1270	Santa Clara	25,549	0
1328	Santa Clara	29,897	0
1460	Sunnyvale	29,897	0

Source: StreetLights Data; AFDC

Candidate Zones Based on Weekday, Commuter Trips

Figure 44 depicts the average number of trips for weekdays only (i.e., Monday to Friday) for all times within the data recorded in the system for the many Santa Clara TAZs. The exhibit also includes the location of electric vehicle charging infrastructure in each of the zones, with the TAZs marked in red indicating the highest average number of trips (between 122.59k and 162.94k) for weekdays and green indicating the lowest average (between 1.52k and 41.88k).

Figure 44: Heatmap[63] of Trips in Santa Clara TAZs (weekdays only, all times)



62 All chargers located in TAZ 783 are in San Jose and not within the borders of The City.
63 Presented with a continuous color scale format.

Source: StreetLights Data

It is important to note that Figure 44 displays the average number of weekday trips across twenty-four-hour days. The number of trips in a given hour will vary substantially from early-morning hours to rush hour times. Further, the results of the analysis depicted in Figure 43 and Figure 44 were compared, and in each analysis the same zones were determined to contain high average trip counts.

Focused analysis of the five top zones identified in Table 12 (95, 783, 1270, 1328 and 1460) revealed that most weekday trips within those TAZs were less than 30 miles. This relatively short distance (i.e., 60 miles per round trip) is well-suited to range constrained PEVs.

Table 12: Statistics for Candidate Zones Discussed

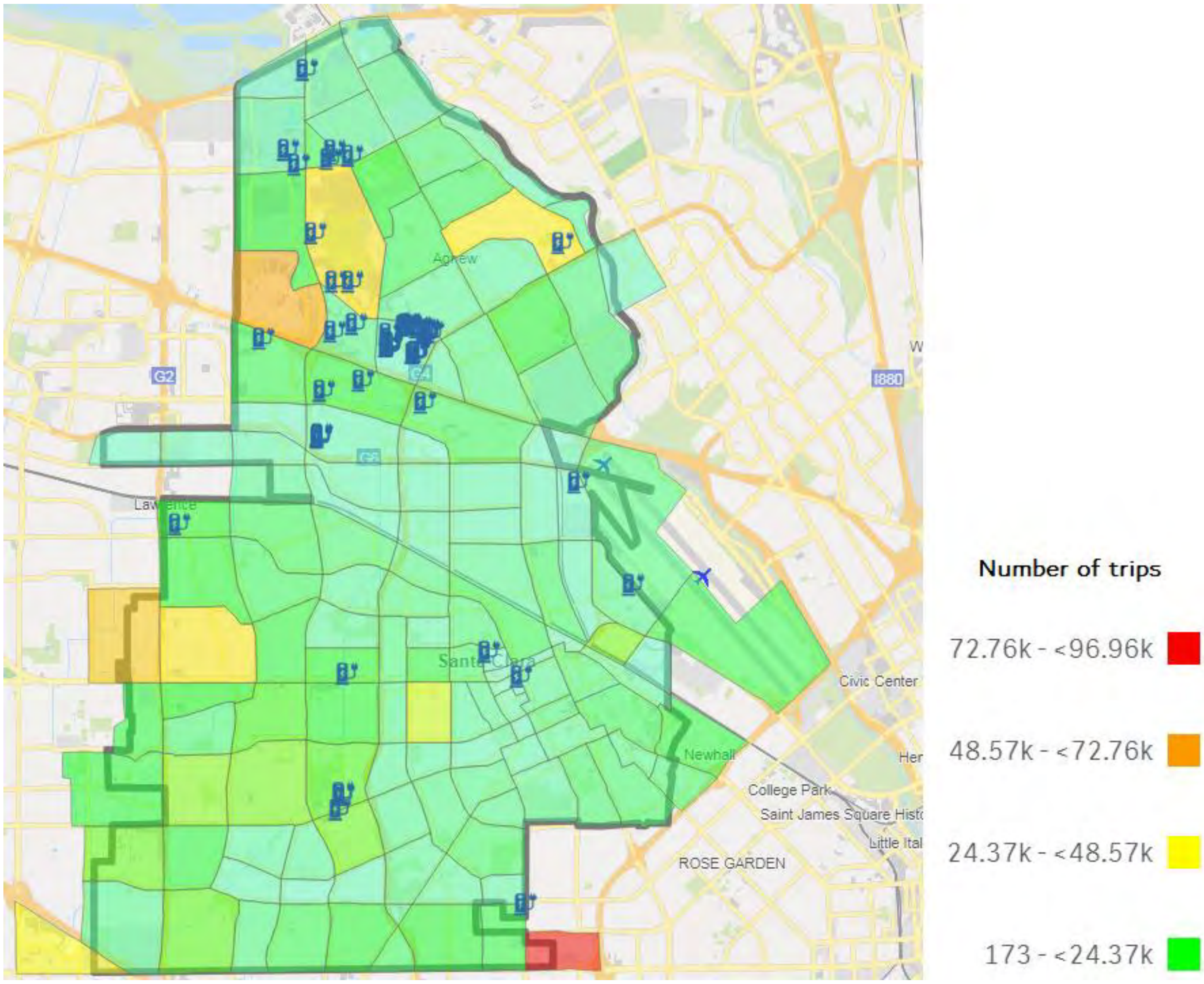
TAZ	Trips <10 mi	Trips 10-40 mi	Trips 40-100 mi	Trips by Drivers <$75k	% HBW	% NHB	% Live in Metro Area	% Live in Other Metro Area	% Live in Non-Metro Area
95	202,599	87,488	8,231	131,194	23%	36%	94.14%	5.70%	0.15%
783	236,306	78,718	9,986	153,407	14%	49%	91.62%	8.19%	0.19%
1270	205,476	42,164	4,230	117,699	24%	31%	93.73%	6.16%	0.11%
1328	213,455	61,586	5,866	127,205	13%	50%	86.32%	13.43%	0.25%
1460	239,445	47,785	6,344	134,524	23%	26%	93.59%	6.30%	0.11%

Source: EV Blueprint Team

Candidate Zones Based on Weekend Trips

Figure 45 portrays the average number of trips for weekends only (i.e., Saturday and Sunday) within each TAZ, and the location of currently operating electric vehicle charging infrastructure in each of the zones. TAZs marked in red indicate the highest average number of trips (between 72.76k and 96.96k) for weekends and those in green indicate the lowest average (between 173 and 24.37k).

Figure 45: Heatmap of Trips in Santa Clara TAZs (weekends, all times)



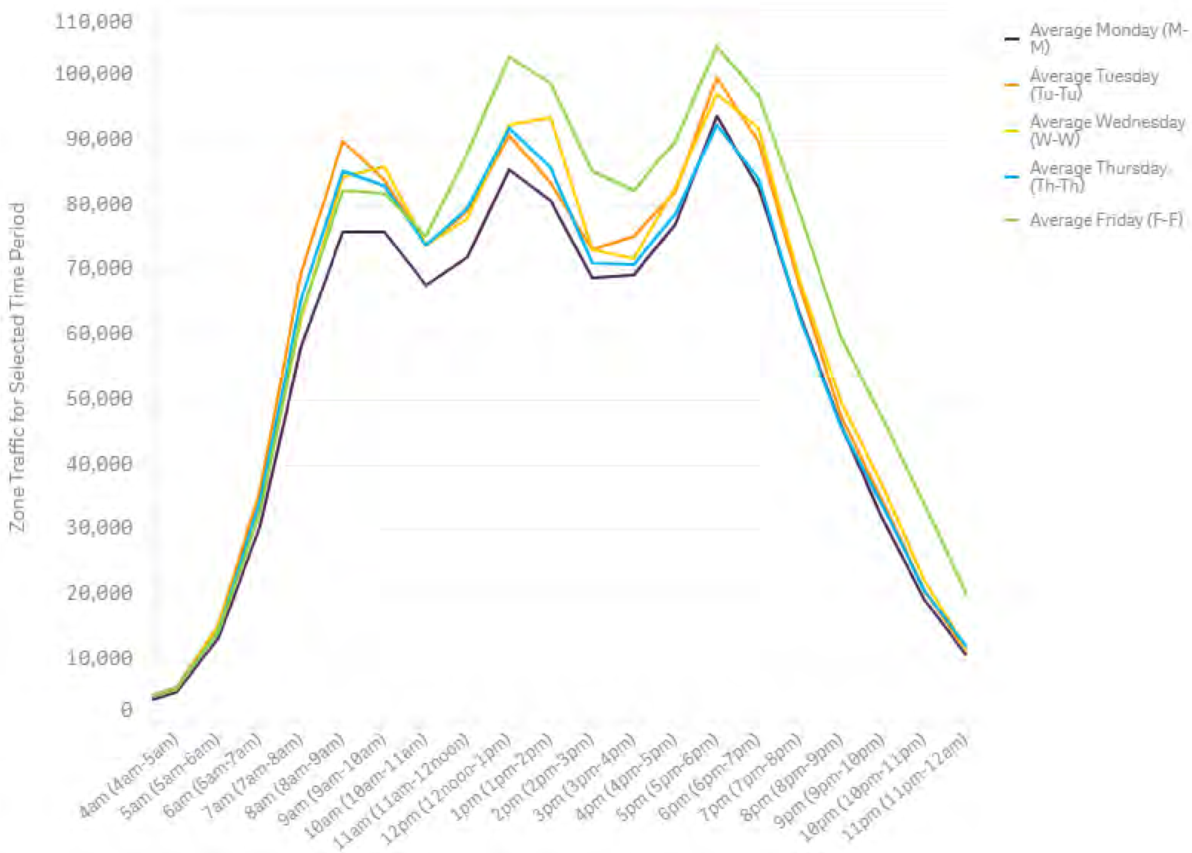
Source: StreetLights Data

A comparison of the weekend and weekday trips indicates that in general, traffic patterns remain the same regardless of the day of week. Further, the same TAZs are expected to have high traffic and therefore high demand for PEV charging.

Personal Travel Peak Times and Demographics

Figure 46 shows that the peak travel times in the City of Santa Clara overall are similar for all weekdays, with traffic typically worsening on Friday.

Figure 46: Peak Times in Santa Clara for Personal Travel, number of trips

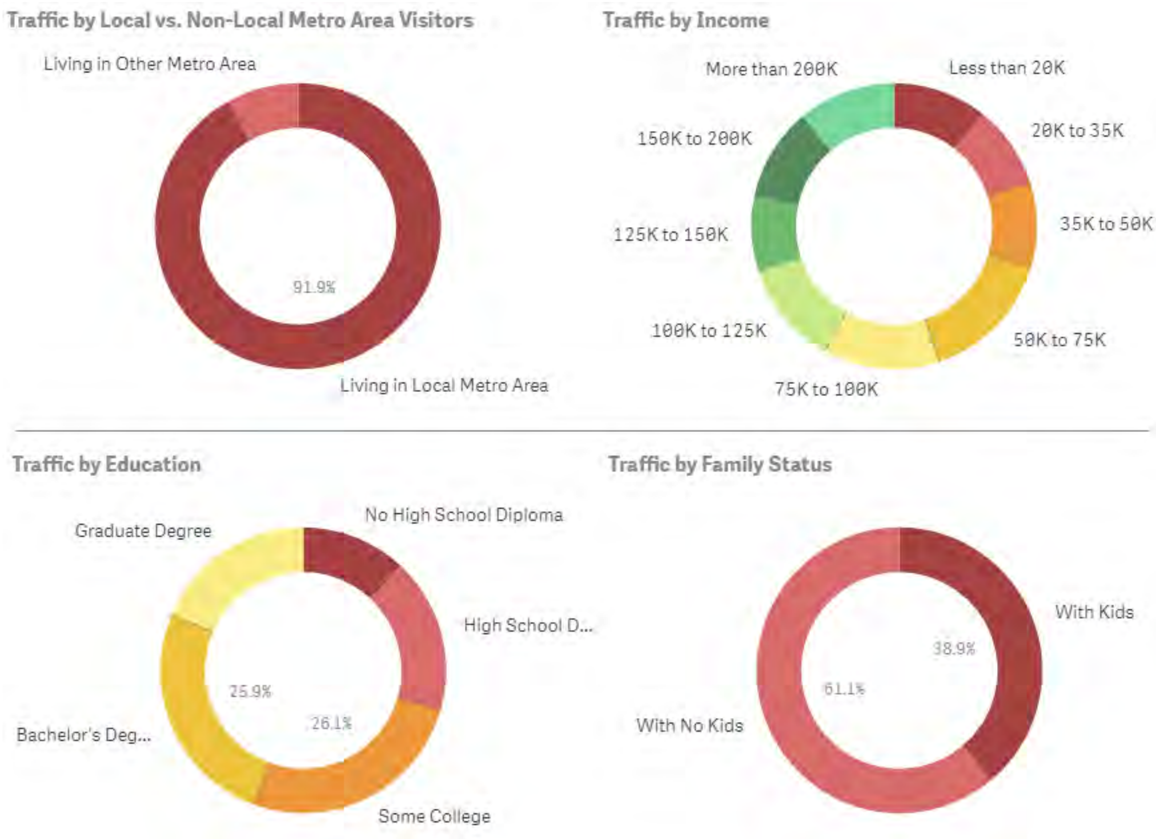


Source: StreetLights Data

Rush hours range from 7:00 am-9:00 am, 11:00 am-2:00 pm and 4:00 pm-7:00 pm. Figure 47 shows that most trips come from people who live in local metro areas (91.9%) and who have income greater than $75,000 per annum (55.1%), with the median for the region being $108,609.[64]

64 https://www.census.gov/quickfacts/fact/table/santaclaracitycalifornia/RHI125217

Figure 47: Commuter Demographics in Santa Clara (all zones)

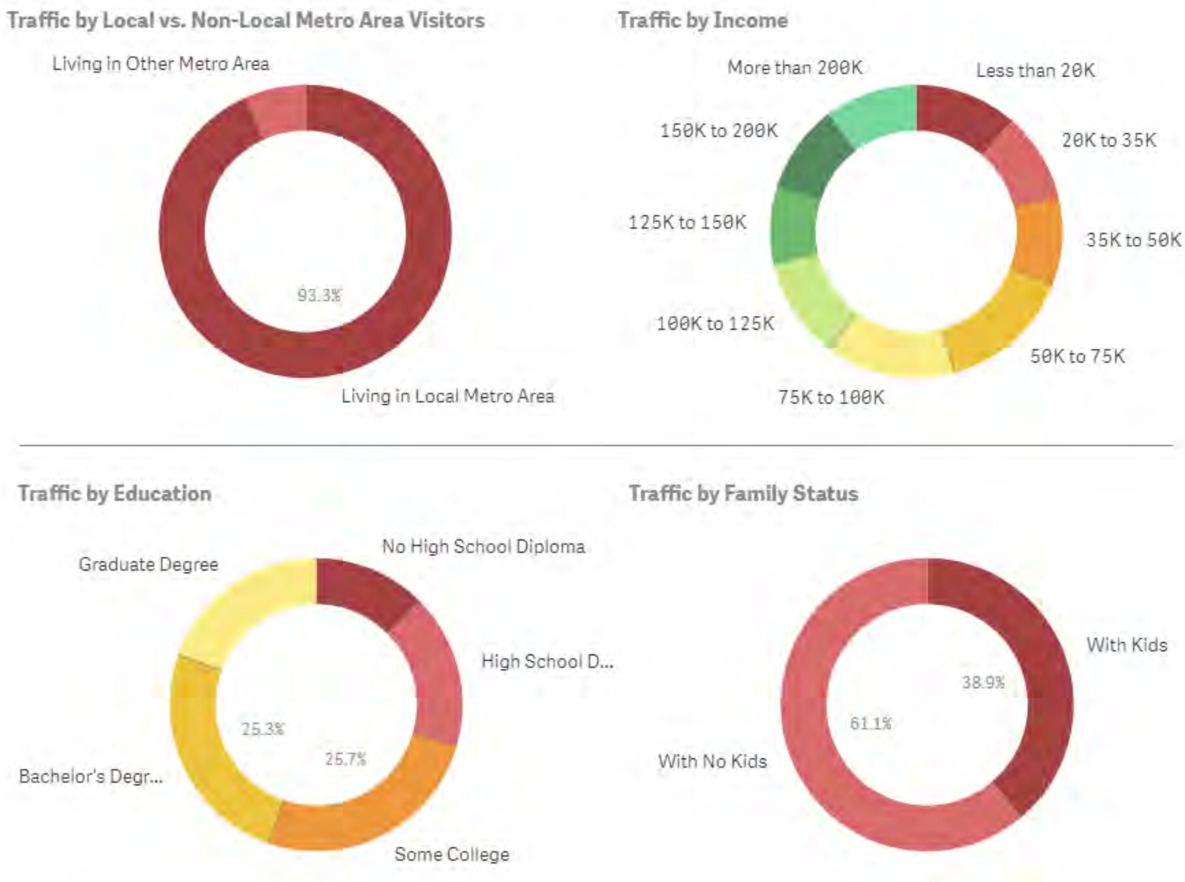


Source: StreetLights Data

With regards to other commuter characteristics, most travelers have at least some college education (70.6%) whereas most people do not have children (61.1%).

By observing the commuter demographics for candidate zones discussed (783, 1460, 1270 and 95), the picture is also very similar to the overall city in terms of origin, income, education and family status as demonstrated in Figure 48.

Figure 48: Commuter Demographics for TAZs 783, 460, 1270, and 95



Source: Streetlights Data

Another key consideration is the purpose of the driver trips. As described in Table 12, on weekdays, except for zone 783, all others have most trips done for work commuting purposes. Zone 783, however, has a larger proportion (59.2%) of non-home-based trips, which relate to people going to or from work to other locations (i.e., errands).

The difference in trip purpose between zone 783 and others results from the presence of a large shopping mall in this district (Westfield Valley Fair). This shopping mall is mostly located in San Jose's portion of TAZ 783; however, there is a small part of the mall within The City's boundaries. In addition to commuters, this shopping mall attracts visitors going from/to work or from/to other locations which could relate to shops, restaurants and other outlets in this region.

Figure 49: Shopping Facilities in TAZ 783

Sources: Google Maps, Visit San Jose

Zones with High Demand and Limited PEV Infrastructure

The analysis highlighted two zones with a high number of trips and limited PEV charging infrastructure as shown in Table 13.

Table 13: TAZs with High Demand and Limited PEV Charge Ports

TAZ	Jurisdiction	Number of public PEV chargers available	PEV charger type available
1316	Santa Clara	4	Level 2
1327	Santa Clara	2	Level 2

Source: EV Blueprint Team

TAZs 1316 and 1327 have a limited number of PEV charging points while also having high traffic demand, thus making those zones potential areas for increased demand in future.

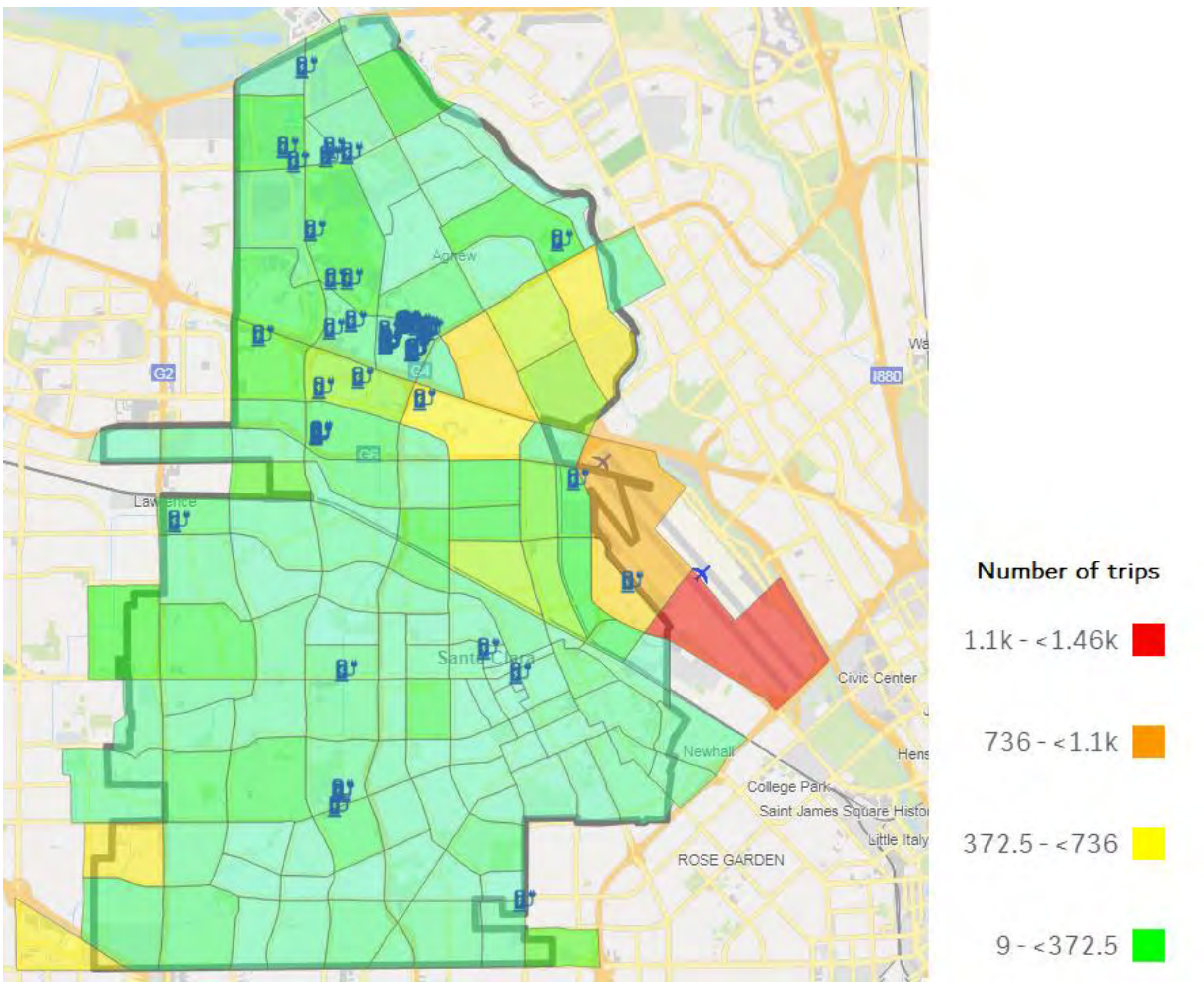
Commercial Journeys

The commercial traffic analysis focused only on journey information, since demographics were not available for trips of this type.

Candidate Zones Based on Commercial Trips

Figure 50 demonstrates the average number of commercial trips for all days of the week (i.e., Monday to Sunday) within the data recorded in the system for the various Santa Clara Traffic Analysis Zones. The TAZs marked in red indicate the highest average number of trips (between 1.1k and 1.46k) for all days of the week and green indicates the lowest average (between 9 and 372.5). This exhibit also includes the location of electric vehicle charging infrastructure in each zone.

Figure 50: Heatmap[65] of Commercial Trips in Santa Clara TAZs (all days of week, all times)



Source: StreetLights Data

Figure 50 clearly indicates that zone 828 (marked in red), has by far the largest number of commercial trips in the zones. Additionally, zones 1243 and 1308 also scored high in the number

65 Presented with a continuous color scale format.

of trips (marked in orange) and do not have PEV infrastructure at present. Further, as indicated in Figure 51, these high traffic zones provide no charging infrastructure.

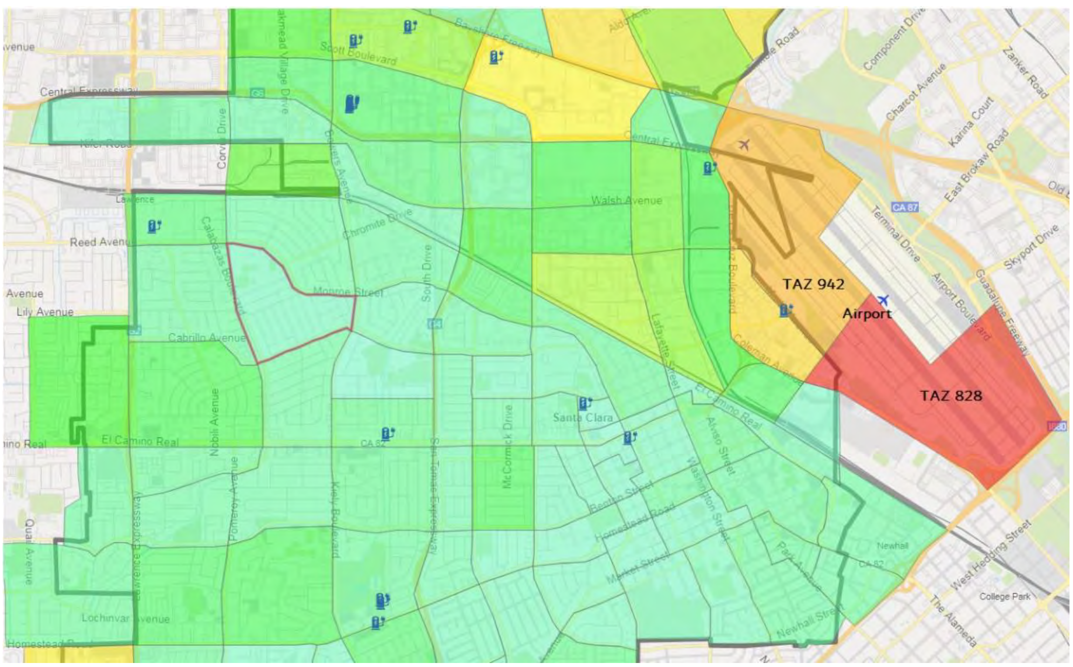
Figure 51: Candidate Zones Based on Commercial Trips

TAZ	Jurisdiction	Number of trips	Number of chargers in Santa Clara
828	San Jose	1,463	0[66]
1243	Santa Clara	878	0
1308	Santa Clara	828	0

Source: EV Blueprint Team

As seen in Figure 52, it is no surprise that the number of commercial trips in zones 828 and 942 are high given that the Norman Y. Mineta San Jose International Airport lies within these zones, thus the expected number of cargo vehicles is significant in this region. Additionally, Santa Clara University, major cross-county transportation stops, a number of private sector companies, and retail outlets are located in this area – all of which would likely contribute to an increase in the number of commercial vehicles comparatively.

Figure 52: Area Surrounding Santa Clara's TAZs 828 and 942 (near San Jose Airport)



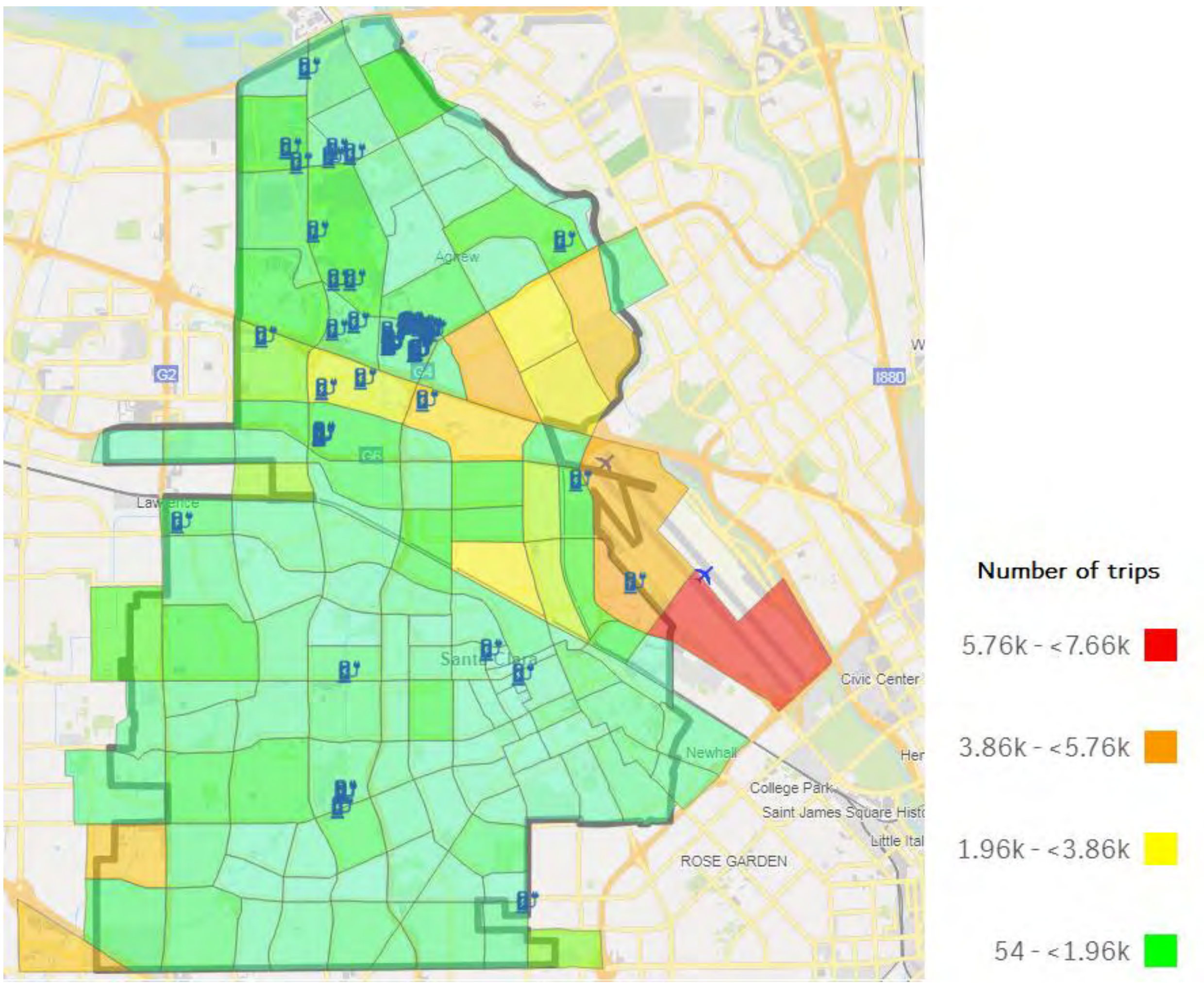
Source: StreetLights Data

66 Chargers in TAZ 828 are located in San Jose, not The City.

Candidate Zones Based on Weekday Trips

The heatmap in Figure 53 provides the average number of trips for weekdays only (i.e., Monday to Friday) within the data recorded in the system for various Santa Clara Traffic Analysis Zones. This exhibit also includes the location of electric vehicle charging infrastructure in each zone, with the TAZs marked in red indicating the highest average number of trips (between 5.76k and 7.66k) for weekdays and green indicating the lowest average (between 54 and 1.96k).

Figure 53: Heatmap[67] of Commercial Trips in Santa Clara TAZs (weekdays only, all times)



Source: StreetLights Data

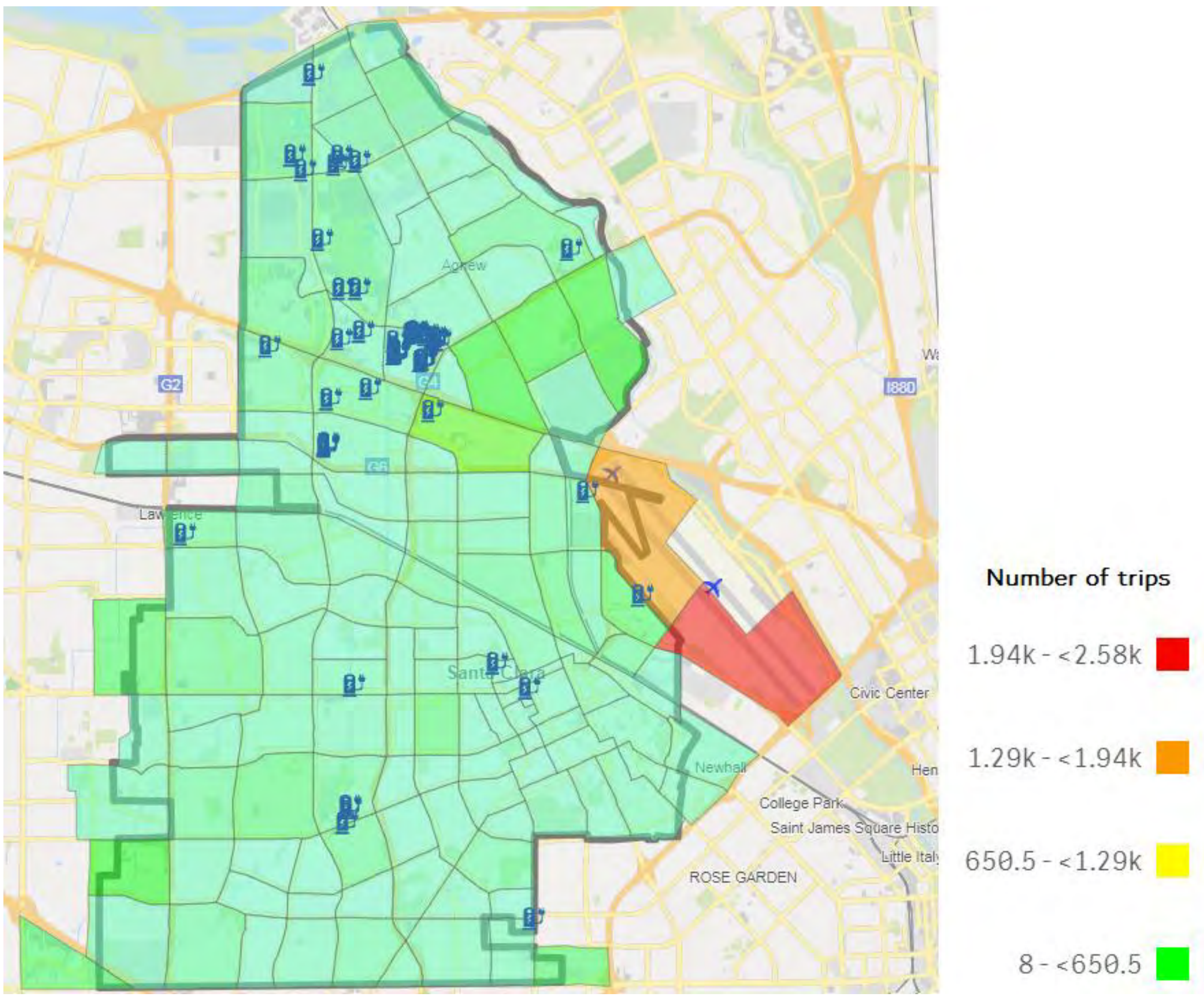
When filtering the data to provide information for weekdays only, the resulting picture is similar to that for all TAZs for commercial vehicles on average. Given that no new TAZs are highlighted with high traffic on weekdays for commercial journeys when compared to the average number of trips for all days, there is no need to drill down further into the data set at this point as the results, by and large, match the average set for commercial trips as shown in Figure 50.

67 Presented with a continuous color scale format.

Candidate Zones Based on Weekend Trips

The weekend traffic analysis is presented in Figure 54 and includes the location of electric vehicle charging infrastructure in each zone, with the TAZs marked in red indicating the highest average number of trips (between 1.94k and 2.58k) for weekends and green indicating the lowest average (between 8 and 650.5).

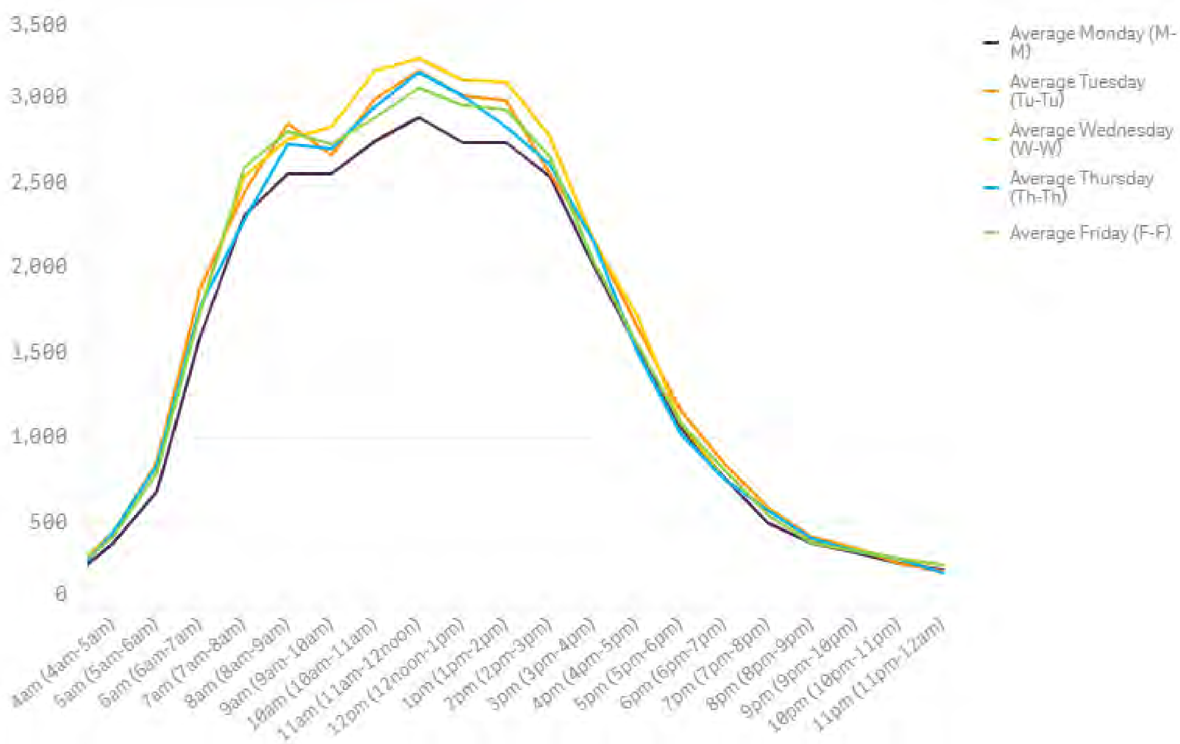
Figure 54: Heatmap of Commercial Trips in Santa Clara TAZs (weekends only, all times)



Source: StreetLights Data

The number of trips is greatly reduced over weekends when compared to weekdays, as expected, but the general traffic patterns remain essentially the same regardless of the day of the week. Figure 55 shows peak times in The City for commercial traffic.

Figure 55: Peak Times in Santa Clara for Commercial Traffic, number of trips



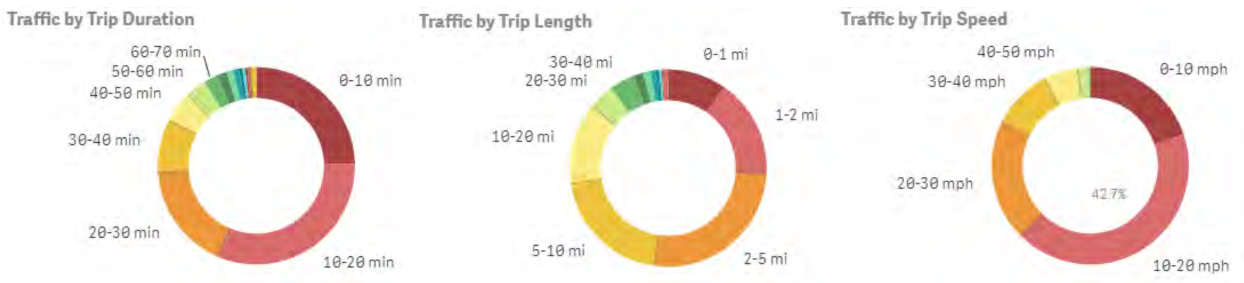
Source: StreetLights Data

The peak times for commercial trips in The City overall are similar for all weekdays, with constant increase in traffic from 6 am until 1 pm and a reduction thereafter. This is also expected due to the nature of commercial vehicles and the hours that these typically operate (i.e., mornings and afternoons).

When it comes to trip characteristics, looking at weekdays, most of the commercial trips within The City are completed in less than 20 minutes (56.5%), are shorter than 10 miles (72.5%), and involve an average speed of under 20 mph (62.6%). See Figure 56 for more detail.

Such short trips could be accommodated with commercial electric vehicles, allowing those to complete several trips within a single charge. For example, an electric truck with 200-mile range could, in theory, run 16 trips averaging 10 miles or less – which would help reduce emissions significantly.

Figure 56: Commercial Trip Characteristics for Weekdays



Source: StreetLights Data

Zones with High Demand and Limited PEV Infrastructure

The commercial trip analysis also revealed that some zones with a high number of trips have limited charging infrastructure. This is the case for zones 942 and 1302 (i.e., highlighted in orange and yellow respectively in Figure 53).

TAZ 942 is within the San Jose jurisdiction and has four PEV Level 2 charging points – all of which are designated for Tesla vehicles and located at a private club location where only members can make use of them. The limited infrastructure coupled with high demand means that zone 942 could be suitable for further PEV charging points to allow usage by the wider public, thus not restricting to club owners only in this area.

On the other hand, TAZ 1302 has four PEV Level 2 charging points. Although this zone has less demand than 942, the limited PEV infrastructure would suggest this to be another potential location for future PEV growth within the Santa Clara jurisdiction. Table 14 summarizes these findings.

Table 14: Candidate Zones Based on Demand and Infrastructure

TAZ	Jurisdiction	Number of trips	Number of public chargers
942	San Jose	1,037	0
1302	Santa Clara	746	4

Source: EV Blueprint Team

Future Developments

This study investigated potential areas for charging infrastructure deployment considering recent traffic patterns as provided by the StreetLight InSight platform. However, The City has also performed several traffic modeling and simulation activities which consider new developments and construction projects planned over the next 10 years.

While a large number of developments are approved and planned[68], two specific large initiatives are highlighted and investigated by this analysis: the CityPlace project and the Kylli Mixed Use Development project.

CityPlace is a multi-phased, mixed-use development of up to 9.16 million gross square feet of office buildings, retail and entertainment facilities, residential units, hotel rooms, surface and structured parking facilities, new open space and roads, landscaping and tree replacement, and new/upgraded/expanded infrastructure and utilities.[69] With a lot size of 240 acres, this project will span across two TAZs: 1230 and 1232. As a result, it is expected that this development will result in additional traffic demand and, subsequently, would likely benefit from charging infrastructure.

The Kylli Mixed Use Development project[70] is smaller than the CityPlace development, with 46 acres that would see 3,500,000 square feet dedicated to offices, 400,000 square feet for hotels and amenities as well as an addition of 6,000 housing units, all within TAZ 1219. While this project is currently pending review, given its size, this TAZ should also be considered as a potential area for traffic growth in future which could result in further need of PEV infrastructure as well.

As such, TAZs 1230, 1232, and 1219 would be potential candidates for added PEV charging points given major development projects planned or being reviewed by The City.

Recommendations

This study analyzed the traffic congestion, citizen and commercial travel patterns, charging infrastructure, demographics and future developments in different Traffic Analysis Zones in the city of Santa Clara and surroundings.

The recommendations from the EV Blueprint Team prioritized first areas that do not have existing electric vehicle infrastructure, yet that have high potential for PEV charging usage, and second areas with high demand where only a limited number of charging points exist. Prioritized areas also include major developments that may be suitable candidates for infrastructure in 5-10 years.

By coupling the location and availability of existing PEV infrastructure with other traffic and traveler aspects, the following tiers of recommendations are proposed, as shown in Table 15. Each tier includes one or more TAZs. Please note that only zones that are within the Santa Clara

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68 http://santaclaraca.gov/government/departments/community-development/planning-division/development-projects-list
69 http://santaclaraca.gov/Home/Components/BusinessDirectory/BusinessDirectory/216/2571?alpha=C
70 http://santaclaraca.gov/Home/Components/BusinessDirectory/BusinessDirectory/245/2495?alpha=K

jurisdiction have been included, i.e., TAZs that are partially in Santa Clara, but under the jurisdiction of another city such as Sunnyvale or San Jose have been deliberately excluded.

Table 15: Tier-Based Recommendations with Rationale

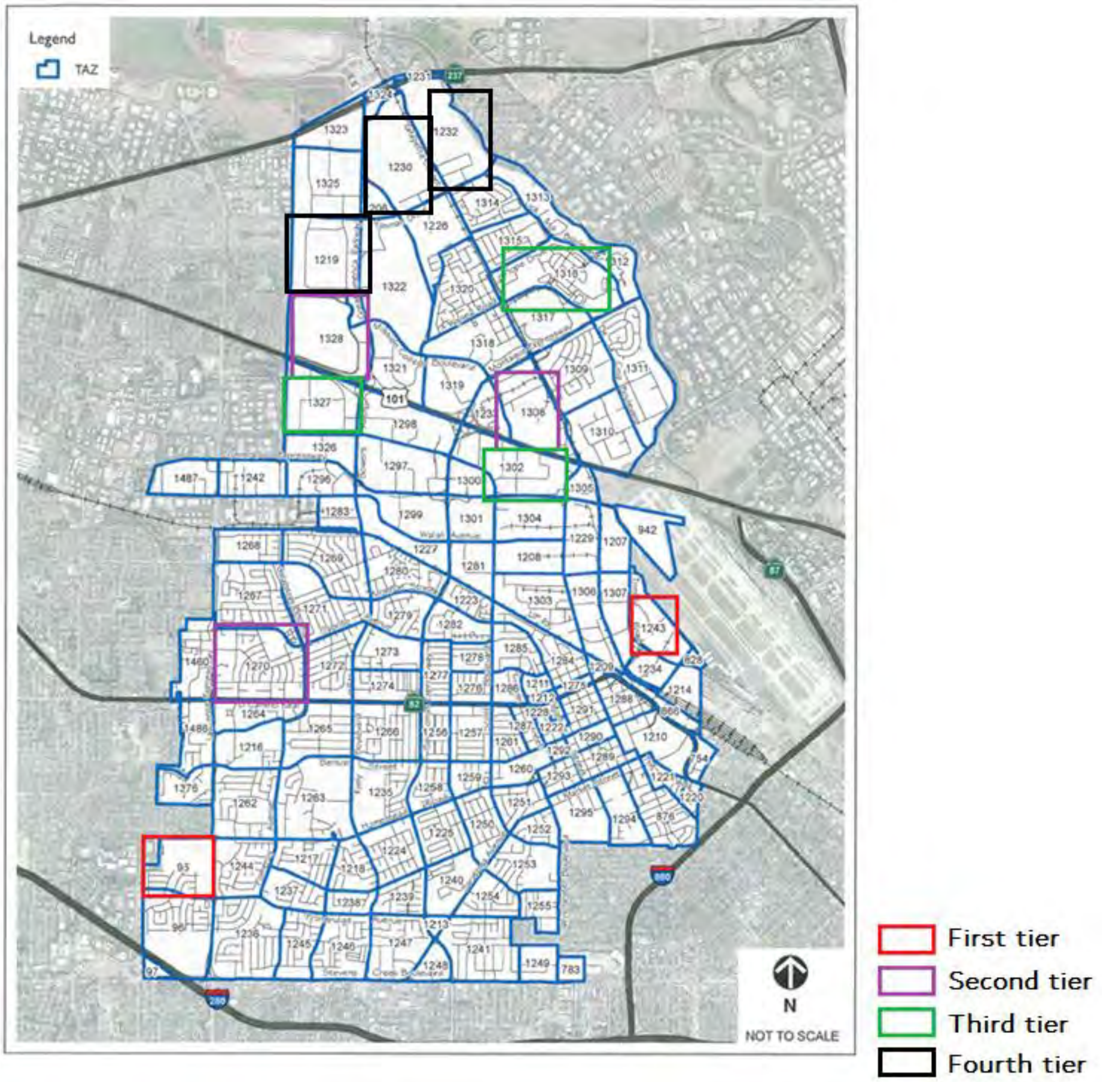
Tier	Type	TAZ	Rationale
First	Personal	95	Zone with highest demand in its category and no PEV charging infrastructure. In proximity with a large retail center, deployment will allow shoppers to utilize the infrastructure while shopping
	Commercial	1243	Zone with highest demand in its category and no PEV charging infrastructure. Proximity to the airport could open opportunities for PEV of different types, including passenger transport and cargo
Second	Personal	1270 1328	Zones with high demand for personal travel and currently without PEV charging infrastructure
	Commercial	1308	Zone with high demand for commercial vehicles and currently without PEV charging infrastructure
Third	Personal	1327 1316	Zones with high demand and limited existing PEV charging infrastructure
	Commercial	1302	Zone with high demand with limited and restricted PEV charging infrastructure
Fourth	Future Development	1219 1230 1232	Zones with major developments planned or under review

Source: EV Blueprint Team

For personal trips, the TAZs indicated above carry a large proportion of commuter traffic during weekdays composed of 50 miles or less per trip, making them ideal for electric vehicle adoption as the majority of currently available PEVs have a range of over 100 miles.[71] For commercial trips, the TAZs selected present obvious candidates – with TAZ 1243 and 1308 having heavy demand and no PEV infrastructure at present. Additionally, to ensure future developments are also considered, TAZs which contain major construction projects approved or being reviewed by The City have been included, although not specific to personal or commercial journeys. Figure 57 illustrates these prioritized locations on a map of The City TAZs.

71 https://www.fueleconomy.gov/feg/evtech.shtml

Figure 57: Tier-Based Approach Plotted on Santa Clara TAZ Map



Source: EV Blueprint Team

Grid Impact Analysis

After conducting the traffic analysis to identify zones with expected high charging station utilization, the EV Blueprint Team evaluated the grid impacts of increased charging based on the PEV adoption scenarios in Task 2. First, the EV Blueprint Team developed the hourly charging profiles and peak load impact for each year based on the PEV energy demand forecasts, and traffic analysis, by traffic analysis zone (TAZ). Next, the Team evaluated feeders based on available capacity for anticipated PEV peak demand, vehicle to grid integration (VGI) applications were considered for future utility programs, and eMobility Stress Testing was outlined for evaluating individual feeders with SVP approved distribution software modeling. From this analysis, recommendations for implementation of charging infrastructure within The City were provided.

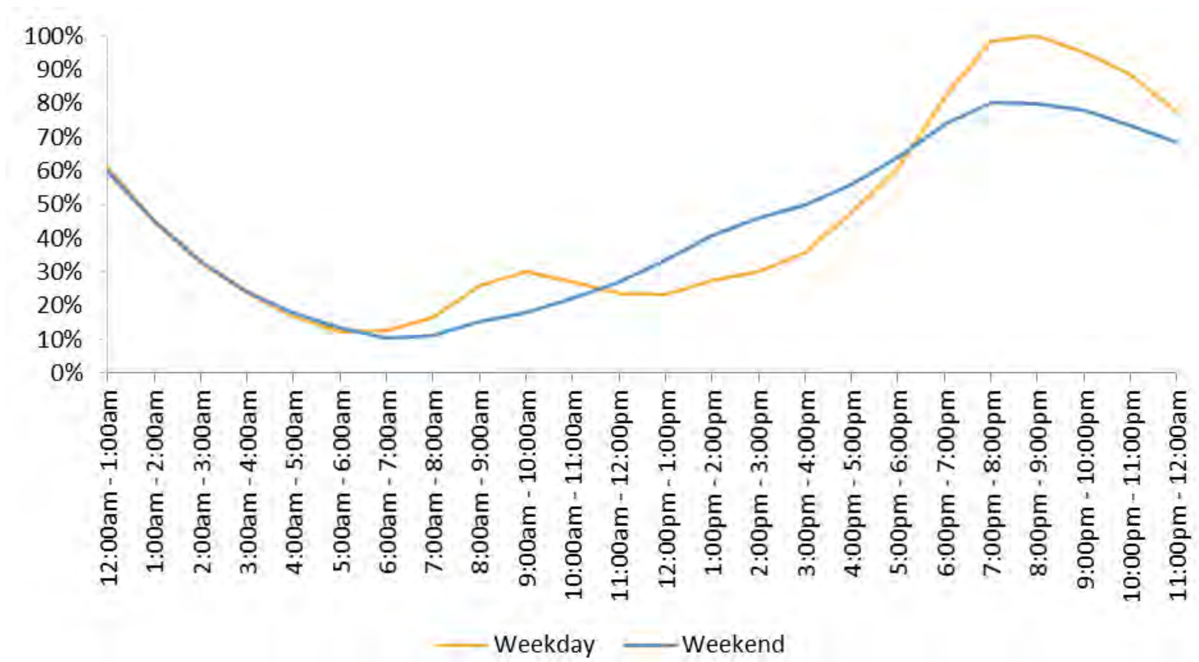
Detailed Load Impact Analysis

In Task 2, the EV Blueprint Team forecasted average annual electric demand to The City from charging PEVs – also shown Figure 30. However, the impact of the total demand on maintaining a safe and reliable electric grid can range widely based on the time of day when charging is occurring. Thus, understanding the hourly charge profile and determining the capacity during The City's peak demand helped the EV Blueprint Team to better analyze the grid readiness to accept greater PEV charging.

Hourly Charging Profile & Peak Charging Impacts

For weekdays, The City should prepare for two charging peaks to account for vehicles arriving at work during the morning and returning home during the evening. The first peak will result from workplace and public L2 chargers; whereas the second, significantly larger peak will be driven by residential charging. For weekends, The City should prepare for one gradually increasing charging peak in the evening mainly driven by residential charging. The demand from L3 chargers (DCFC) sub-hourly rapid charging will cause additional volatility in the load profiles. All types of charging loads should be integrated efficiently to prevent additional ramping generator requirements and stress on distribution infrastructure. Figure 58 indicates the charging profiles that the EV Blueprint Team referenced to model the hourly charging impact to The City.

Figure 58: PEV Charging Profiles, % of peak hour

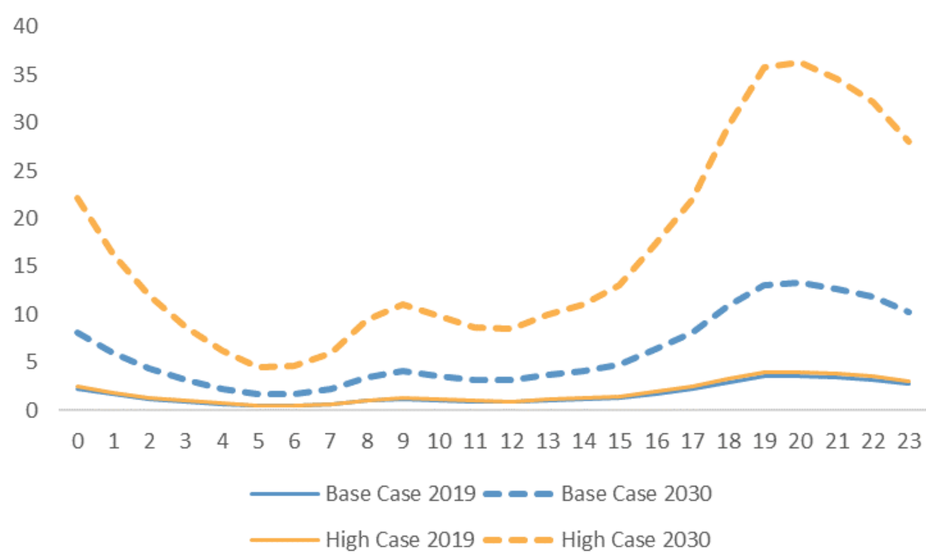


Source: CEC; NREL[72]

72 http://docketpublic.energy.ca.gov/PublicDocuments/17-ALT-01/TN222986_20180316T143039_Staff_Report__California_PlugIn_Electric_Vehicle_Infrastructure.pdf

Generally, the charging demand for PEVs in The City varies significantly based on time of day. The City expects maximum charging demand to occur during weekdays as residents charge PEVs after work hours, and charging demand is forecasted to be greatest from 7:00 pm to 9:00 pm. The average hourly charging demand is expected to be 45% of the maximum hourly charging demand. With this data, the EV Blueprint Team was able to convert forecasted average annual electric demand from PEV charging to forecasted hourly electric demand from PEV charging as shown in Figure 59.

Figure 59: Santa Clara PEV Hourly Load Demand, MW



Source: EV Blueprint Team

Charging demand is expected to peak from 8:00 pm to 9:00 pm and by 2030, this peak may exceed 35 MW. However, the peak demand from PEV charging does not occur during the same hour that SVP experiences peak system demand. This is important to differentiate for any city evaluating the impacts of PEV charging to grid infrastructure.

Since SVP's electricity sales are primarily commercial/industrial, its energy use and peak demand profile is relatively flat. Using SVP's metered system load data from 2017 and 2018, the EV Blueprint Team determined that The City's peak demand typically occurs on weekdays between the months of June and October referred to as "Peak Months". Figure 60 indicates The City's system hourly demand as a percentage of the peak demand hour.

Figure 60: SVP Hourly Demand During Peak Months, % of Peak Hour

Source: EV Blueprint Team

Consistently across the 2017 and 2018 load data, The City experienced peak demand between 3:00 pm and 4:00 pm. Yet, the expected charging demand from 3:00 pm to 4:00 pm is lower than the average charging demand experienced throughout a day. From a grid infrastructure planning perspective, this is a unique optimal situation.

However, SVP's relatively flat load profile shows that The City experienced *nearly* peak demand between 1:00 pm and 6:00 pm. The EV Blueprint Team recommends evaluating the PEV charging demand from 5:00 pm to 6:00 pm when charging demand is expected to be greater than average and The City's electric system load is still likely to reach peak demand. Table 16 summarizes the peak charging demand for the low, base, and high cases for each of the timeframes discussed.

Table 16: Forecasted PEV Charging Demand in The City

Forecast	Scenario	Near-Term (2021)	Mid-Term (2025)	Long-Term (2030)
Average PEV Demand (MW)	Low Case	0.7	0.7	0.7
	Base Case	2.2	3.5	6.0
	High Case	2.9	6.7	16.3
Peak PEV Demand 8:00 pm – 9:00 pm (MW)	Low Case	1.5	1.5	1.5
	Base Case	4.9	7.7	13.3
	High Case	6.5	14.9	36.3
System Peak PEV Demand 3:00 pm – 4:00 pm (MW)	Low Case	0.5	0.5	0.5
	Base Case	1.8	2.8	4.8
	High Case	2.3	5.3	13.0
PEV Demand 5:00 pm – 6:00 pm (MW)	Low Case	0.9	0.9	0.9
	Base Case	3.0	4.7	8.1
	High Case	3.9	9.0	22.0

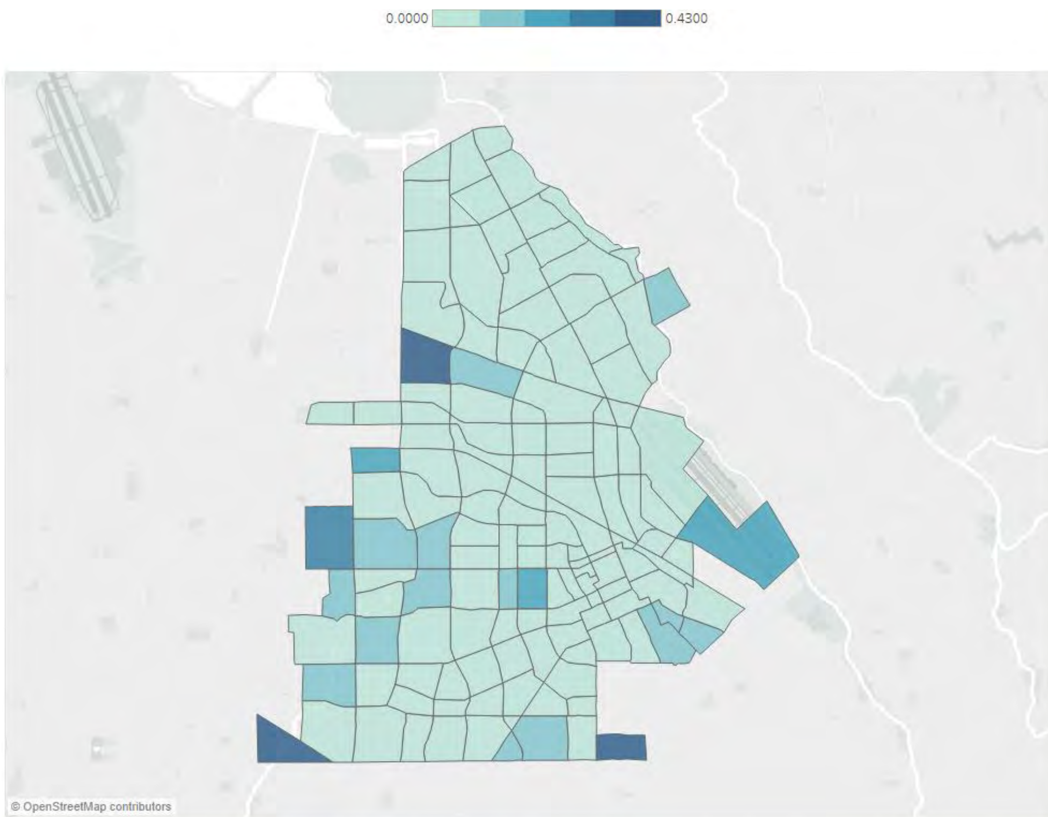
Source: EV Blueprint Team

The EV Blueprint Team expects charging demand to be as much as 22 MW in 2030 occurring from 5:00 pm to 6:00 pm, which could represent 3.1% of the total peak demand (716 MW) forecasted for The City in 2030. The EV Blueprint Team combined the load and traffic analysis to forecast to what degree charging demand is expected throughout The City.

Traffic Analysis Zone Load Impacts

The EV Blueprint Team used the PEV Demand, 5:00 pm - 6:00 pm, High Case forecast to plan for peak load impacts across The City's TAZs. The total peak charging demand was divided among the TAZ regions based on a percentage of traffic as derived in the traffic analysis. Figure 61 portrays this analysis in a heatmap of The City, for 2030.

Figure 61: Heatmap of Forecasted 2030 PEV Demand, 5:00 pm - 6:00 pm, High Case (MW)



Source: EV Blueprint Team

Available feeder capacity within a TAZ will dictate to what degree the local network can support the incremental PEV load without upgrades, or if further grid infrastructure requirements should be considered. Generally, SVP practice is to design each feeder to normally operate 50% of the available thermal capacity. This practice improves reliability, so feeders can absorb additional load when nearby feeders are undergoing maintenance. However, SVP practice is to review the "available capacity" excluding this additional 50% redundancy design for planning purposes.

When a feeder has 0% available capacity – equivalent to 50% of designed thermal capacity – system upgrades must be considered before adding load.

Note that the City only has partial zoning in some of the TAZs illustrated by Figure 61 near the Westfield Mall, San Jose International Airport, Apple Inc., and Main Street. This report focuses on TAZs that are either fully or partially within The City's jurisdiction, with the distinct city boundaries highlighted in Figure 41.

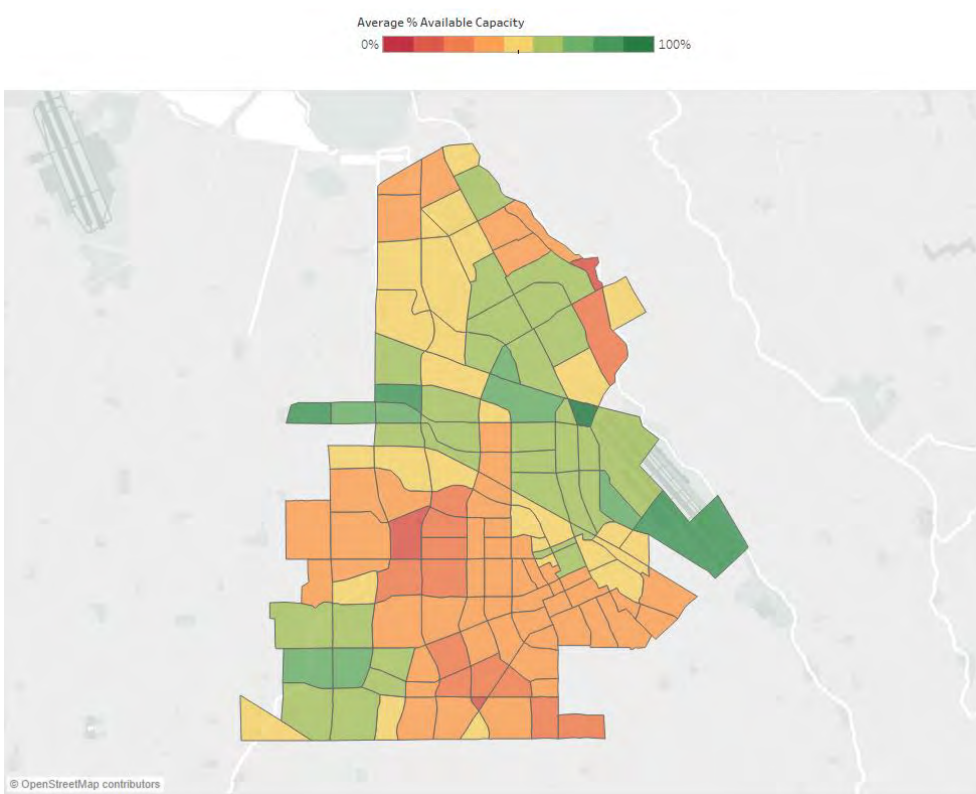
Recommendations

The Grid Impact Analysis provided the first analytical step in determining which, if any, feeders might require upgrades to support increasing charging demand. The analysis identified TAZs with feeders that could approach engineering design limits. Additional engineering analysis will be required for marginal feeders. This analysis is called eMobility Stress Testing and is outlined in the following section.

SVP Feeder Capacity Analysis

To protect secure critical infrastructure data, the EV Blueprint does not provide any information on specific feeders. Rather, feeder capacity is discussed based on averages of feeders within each TAZ as depicted in Figure 62.

Figure 62: Available Capacity of Feeders by TAZ, % of Total Capacity

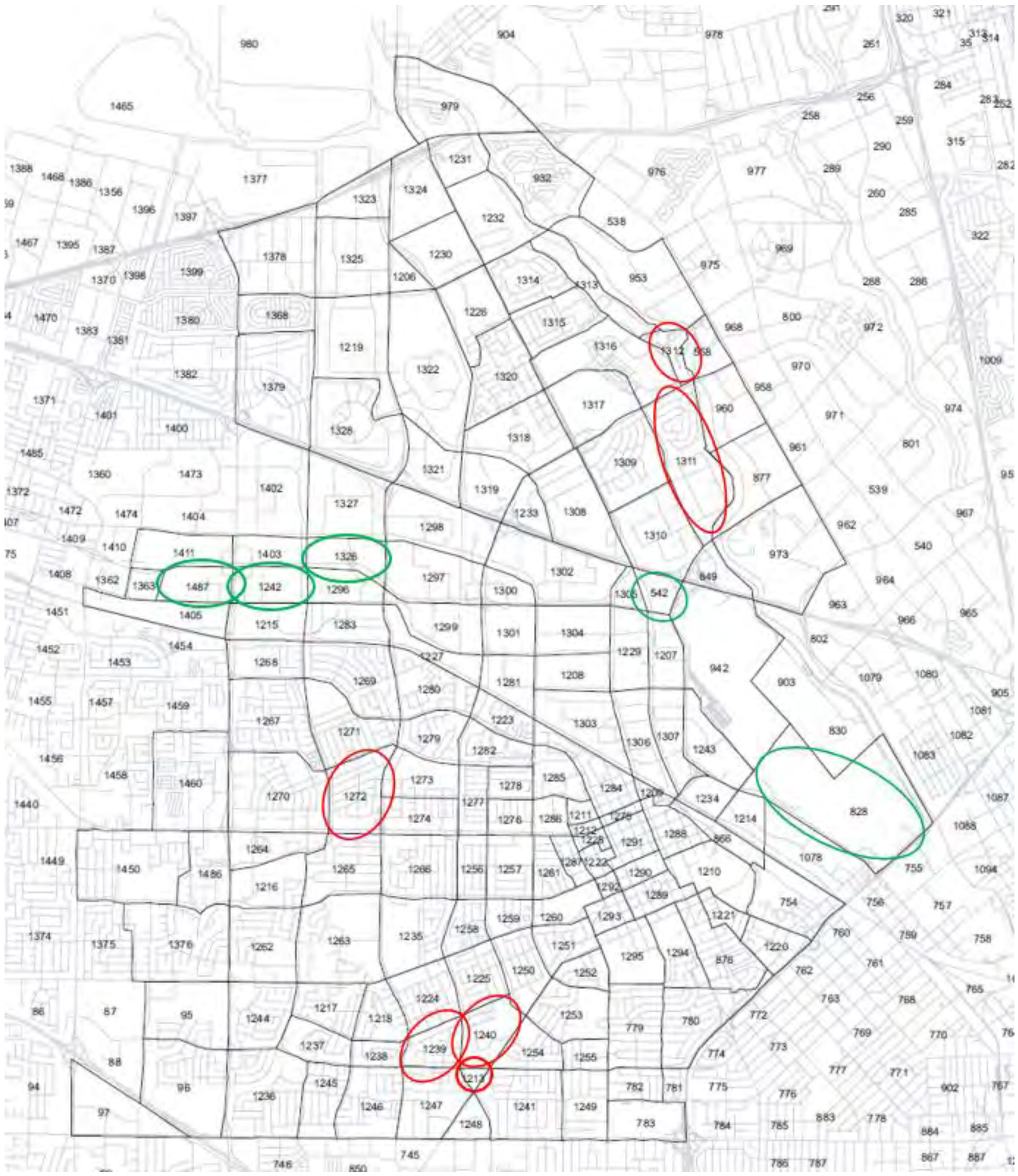


Source: EV Blueprint Team

Note that the City only has partial zoning in some of the TAZs illustrated by Figure 62 near the Westfield Mall, San Jose International Airport, Apple Inc., and Main Street. This report focuses on TAZs that are either fully or partially within The City's jurisdiction, with the distinct city boundaries highlighted in Figure 41.

Rather than conducting an expensive and time-consuming analysis of each feeder to assess its ability to accept incremental charging demand, the EV Blueprint Team applied experience and engineering judgement to determine which feeders might require detailed engineering analysis. SVPs distribution engineers indicated that in their experience, once a feeder's available capacity reached 0%, equivalent to 50% of its thermal capacity design limits, further stress testing was advised. On this basis, the EV Blueprint Team determined that feeders in TAZs 1213, 1272, 1311, 1312, 1239, and 1240 will likely be first to require additional analysis and potential upgrades. The team also determined that TAZs with the most available feeder capacity, and therefore the lowest need for additional analysis and upgrades included 1242, 1326, 1487, 828, and 542. Please reference the traffic analysis for further detail on city borders as The City is only partially in TAZ 828. Figure 63 illustrates these recommended TAZs for new PEV infrastructure (green) and feeder capacity upgrades (red).

Figure 63: Target Areas Based on Grid Analysis



Source: EV Blueprint Team

Vehicle to Grid Integration

Without careful planning, Transportation Electrification within The City could create additional ramping generator requirements and stress on the distribution system. One way to lessen or reverse this potential impact is for SVP to manage load control and demand response through Vehicle to Grid Integration (VGI).

VGI is a broad term that encompasses the many ways in which a PEV can provide benefits or services to the grid and bring benefit to society or drivers by optimizing PEV interaction with the grid. Of the four key means to manage the impacts of charging defined below, the first three describe methods to manage vehicle charging and the fourth is an approach by which PEVs could provide electricity storage to support electric grid operations. These means generally include:

1. Charging level incentives (foundational): Tools include rebates for lower level charging, modifications for current allowance policy, demand charge design, etc.
2. Time of Use (TOU) rate design and adoption policy (foundational): Tools include TOU rate design and policies to require or encourage TOU rate adoption for PEVs.
3. V1G (or managed or controlled charging): Unidirectional power flow under central or customer control enabling vehicles to charge and provide ISO wholesale market services or DER market services. Includes varying the charge rate at the charging station, PEV management system, parking lot PEV energy management system, or building management system in order to provide demand response, ancillary services or other market services.
4. V2G: Similar to V1G but bidirectional power flow to the grid.[73]

To manage the potential charging impact on peak demand, it is important that SVP evaluate the impact and potentially enact some combination of the first three means described above. While these means have little to no impact on the PEV itself, the fourth item, V2G, does.

While application of V2G technologies could significantly help a utility's management of the grid, there are severe battery pack degradation concerns with V2G. Research from the Hawaii Natural Energy Institute predicts the use of a PEV with V2G could reduce the working lifespan of the battery pack to less than 5 years' time. Specifically, the research concluded that V2G discharge to the grid twice a day increased the battery capacity degradation by 75% and that V2G discharge to the grid once a day increased the capacity degradation by 33%.[74] However, intelligent use of V2G may be able to optimize a battery's condition thereby limiting battery pack degradation. For example, a PEV parked for the day at a high state of charge (SOC)[75] will degrade faster than a PEV parked at a lower SOC. V2G can enable the usage of the battery pack at a lower SOC. However, at this time this is an unproven theory that needs to be reviewed in more detail before being considered in the EV Blueprint.[76]

The EV Blueprint Team forecasted the potential PEV battery-based storage capacity (MWh) and power (MW) that could be in SVP's network. By combining expected increases in battery capacity and increased PEV adoption in personal and commercial fleets, the EV Blueprint Team calculated that by 2030, the total capacity of all PEV batteries in The City could reach 3,750 MWh.[77] Figure 64 depicts the potential battery storage capacity from personal and commercial PEVs within The City through 2030. Note that these forecasts assume all PEVs in The City are plugged into the grid

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73 V2G may be possible in the next few years for The City; however, at this point a lot of engineering analysis and retrofits would be required by The City.

74 https://cleantechnica.com/2017/05/16/vehicle-grid-discharge-even-constant-power-detrimental-ev-battery-performance-study-finds/

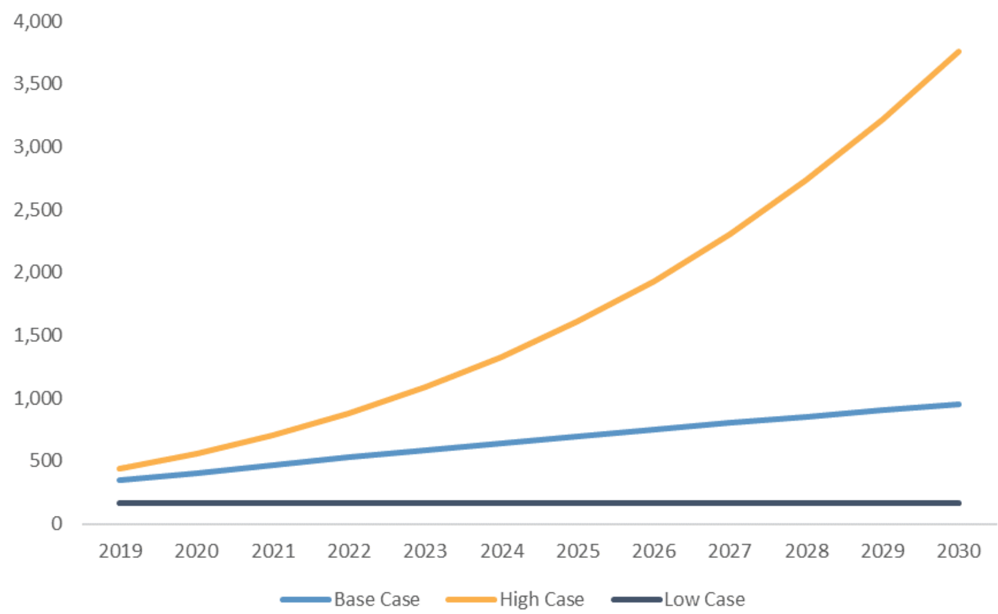
75 State of Charge (SOC) is the level of capacity remaining in the vehicle battery pack.

76 https://www.current-news.co.uk/news/v2g-found-to-improve-the-lifetime-of-electric-vehicle-batteries

77 Energy storage technology measures capacity in megawatt-hours since there is a limited amount of electricity capable of supply unlike traditional generation technologies, where energy is unlimited as long as fuel is available, that measure capacity in megawatts.

and readily available – a theoretical assumption that indicates the maximum capabilities based on the PEV adoption forecasts.

Figure 64: PEV Battery Storage Capacity, MWh



Source: EV Blueprint Team

eMobility Stress Testing

The EV Blueprint Team did not use distribution system modeling software to evaluate the impact of PEVs on individual feeders. Currently, SVP requires a system impact study only for additional loads greater than 1 MW – potentially fleet depots or large DCFC stations – these studies help determine design and costs for any system upgrade requirements. For implementation of charging infrastructure and future VGI applications, the EV Blueprint Team suggests an independent study to evaluate load shifting, congestion, frequency control, and voltage support requirements and capabilities for SVP's individual feeders.

Technology and Systems Considerations

Introduction

The objective of the Technology and Systems Considerations section is to highlight technical specifications for development of PEV chargers. The key technologies discussed are the PEV charger requirements and the Information Technologies (IT) architecture that interfaces the charger with backend systems. The technology discussion is structured to align with the prioritized drivers of the EV Blueprint including:

- MUD Charging availability
- City Fleet Electrification

- DAC Charging availability
- Public Charging stations
- Retail Site Charging

Based on the technology and systems considerations, the EV Blueprint team identified guidance for The City and/or Silicon Valley Power (SVP) to further encourage the EVSE infrastructure build out in cases where the lack of infrastructure may severely hinder PEV adoption in the concerned community. Furthermore, The EV Blueprint team highlighted technology and systems combinations to needed to potentially acquire SVP residential customer charging data to support PEV program funding through LCFS credits.

Charging Technology Overview

As discussed earlier in this report, there are generally three levels of charging: Level 1, Level 2, and DC Fast charging. Each type of charger charges batteries at different speeds, requires different levels of power supply, and therefore is offered at differing costs. While from a technology perspective, each can be applied to any application, some are more appropriate for meeting customer needs. Typical charger technologies and specifications for each ownership/ operating model are discussed in Table 17 below.

Table 17: Technology Selection by Application

Application	Technology Selection
MUD/Low Income Chargers	For MUD applications, AC charging technologies (Level 2) such as wall-boxes with 11 kW charging power are often employed. This means the AC converter within the PEV (e.g. 7.4 kW) is the maximum limitation factor for charging load during a charging session at MUD location. For the planning of the charging load, the driving patterns and charging demand state of charge (SOC) need to be considered.
City Fleets Chargers	For City fleet charging applications, AC charging technologies (e.g. wall-boxes/ AC charging-stations with 11 kW charging power, Level 1,2) for the longtime charging-sessions greater than 1 hour and DC charging technologies (e.g. Multicharger 50 kW DC with CHAdeMO and CCS outlet, Level 3) for charging sessions less than 1 hour are appropriate. This means the AC converter within the PEV (e.g. 7.4 kW) is the maximum limitation factor for charging load during a charging session at location. For the short-term charging session, the limitation will be the charging capability of the Charging station and DC connector of the PEV. For the planning of the charging load, the driving patterns and charging demand state of charge (SOC) need to be considered.
Disadvantaged Community (DAC) Chargers	The City has positioned all industrial activities in one zone away from most residents, which is considered a Disadvantaged Community (DAC). Indeed, this is a DAC by California standards, but most of the zone has industrial-use vehicles. There is a small portion of the DAC, that is more residential shown previously in Figure 36. The DAC may be a good area for commercial vehicle charging and ride sharing vehicle charging. Additional charging capabilities for medium and heavy-duty electric vehicles should be considered in these areas as well. The EV Blueprint team recommends AC charging-stations with 11 kW charging power (Level 1 and 2) for the longtime charging-session greater than one hour and DC charging technologies – Multicharger 50 to 350 kW DC with CHAdeMO and CCS outlet – for medium and heavy-duty electric vehicle fleets.
Public Chargers	Typical public area PEV charging applications include curbside parking, parking public transport stops, stadiums, etc. For this application, the charging duration is expected between 1 hour and 10 hours (overnight parking). Chargers for these applications should cover the hardware requirements for outdoor-use. Also new and innovative charging station systems like streetlamp-station or “Satellite” solutions for curbside parking and charging should be considered. For public charging the both PEVs from private owners and PEV fleets should be considered in the relevant parking-charging location. Regarding the charging stations for public charging, we recommend AC chargers with 11 to 22 kW charging power for the charging sessions greater than 1 hour and DCFC Multichargers, 50 to 350 kW DC with CHAdeMO and CCS outlet, for short parking/charging duration or high demand of charging power.

Application	Technology Selection
Retail Site Chargers	For retail charging, the typical user is a light duty privately owned PEV. The motivation for retail charging, including restaurants and hotels, is typically for: • *Primary business model: Offering charging service as primary business* • *Secondary business model: Attracting customers to buy within the retail shop* For the retail charging service as primary business, DC charging technologies – Multicharger 50 to 350 kW DC with CHAdeMO and CCS outlet – are recommended. For the retail charging service as a secondary business, AC chargers with 3 and 7 to 11 kW charging power should be the preferred option.

Source: EV Blueprint team

As mentioned in the Grid Impacts Analysis section, it is important to understand the potential impacts of PEV charging on the electric network and one means to reduce a possible impact on the energy network, a smart-charging capability should be considered. With this functionality an exchange or retrofit of existing substations and utility distribution network could be avoided. Furthermore, a power quality meter should be connected to substations within areas with high penetration of PEVs. The power quality meter should be connected to an Energy management control center (e.g. SCADA) in order to monitor the load at this specific substation and area. In the CPO-Backend the dynamically load-management functionality will reduce the load-capacity in the relevant charging station. The load-management functionality should consider the following parameters:

- PEV charging transactions of relevant PEV owners (from MSP backend)
- Individual charging patterns of PEV owners (from MSP backend)
- Grid-connection capability (static information within the CPO backend-system)
- Charging capability of connected charging station (charging capabilities in kWh, temperature)
- Charging capability of connected PEV based on IEC/EN 61851
- Distribution operator request for relevant load-areas to decrease the charging power

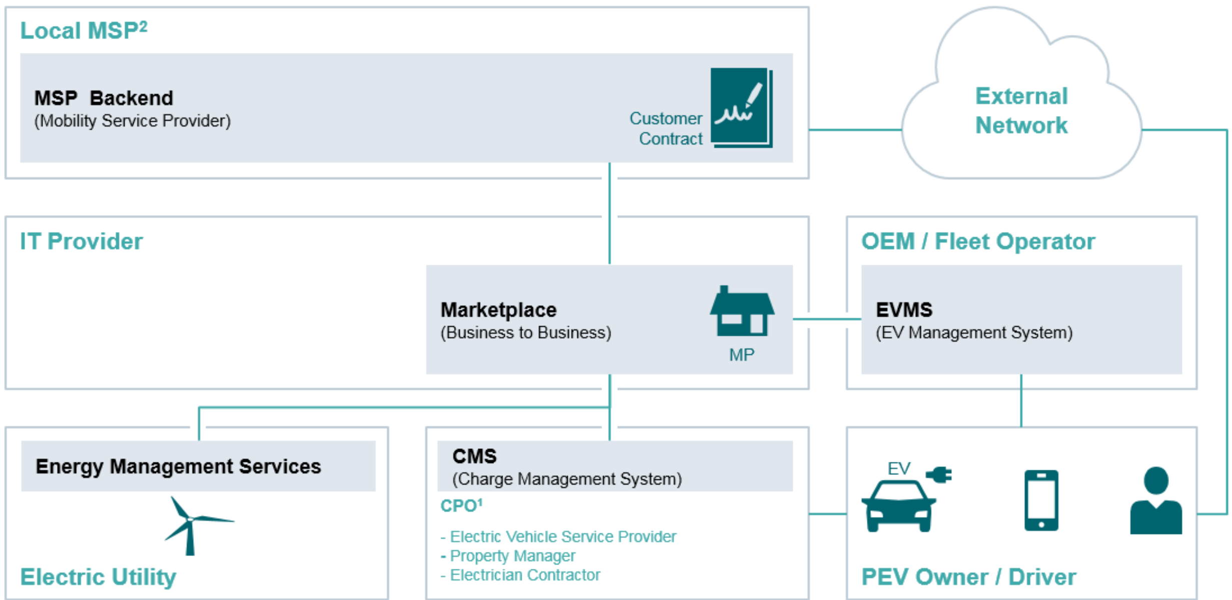
Charger Equipment Standards

As mentioned above, charger selection should be based on the application and expected usage of a charging station. For each charger, the authentication and authorization should be done by RFID-cards (RFID /NFC –Multireader ISO 14443 A/B, Mifare, ISO 18092 (NFC) DesFire) or a charging app from the owner of the charger. The interface from the charging station to the CPO backend-system should be based on OCPP V1.6 (or higher versions). For mid to long-term EV Blueprint considerations, communication based on ISO/IEC 15118) and updating the firmware of the charging stations for remote connection should be considered.

Information Technology Architecture

Information Technology (IT) architecture for chargers are important to the success of a well-integrated charging station. Figure 65 maps typical stakeholders and roles involved in the e-Mobility ecosystem charger IT architecture.

Figure 65: IT Architecture e-Mobility Infrastructure



1 Charge Point Operator | 2 Mobility Service Provider

Source: EV Blueprint Team

The most important stakeholders (roles) in this ecosystem are the electric utility (SVP), the charge-point operator (CPO) and the mobility service Provider (MSP). In many instances the CPO and MSP role are both provided by an EVSP. We keep the roles separate in this section for potential cases where the EVSP does not provide both services.

The PEV owner will have the B2C business transaction (e-Mobility contract) with the MSP. The transaction could be a "direct payment" transaction or also membership contract that provides access to charging infrastructure. In the case of a membership contract, the invoicing could be on a monthly or quarterly fee as pre-paid or post-paid based on the charging session.

For the charging service of "home-charging", a long charging time, e.g. during the night time, could be expected. For home charging, a charging technology (EVSE) with relative "low" charging power (Level 1 or 2 charger) is adequate. To support smart charging capabilities to support grid constraints with scheduled charging session, an IT-connection to the backend of the MSP and Energy retailer is necessary. A connection to an interoperability – Roaming platform is in this case not necessary.

For the charging service of "Highway", gas-station-like set up requires a short charging time, between 15 minutes – 1 hour for charging. The charging technology (EVSE) and the grid connection needs to fulfil the charge to the PEVs with 50 kW DC up to 350 kW DC (Level 3 chargers). For this charging technology an online connection with the local CPO backend system is required. With this IT connection, possible operational handlings such as remote charging session starts, firmware updates, and control of charging station temperature could be covered.

The IT connection could be also used to integrate the cash-desk system of the "Highway" charging service.

The chargers will be connected to the Utility Meter and should have a possibility to be connected via LAN/WLAN to the IT-Backend-system of the CPO/MSP. Based on this connection, smart charging capabilities such as shifting the charging start from peak hours to off-peak hours could be possible. This could reduce the expected load / peak for the distribution network in peak hours. The MSP/Energy retailer has to provide an attractive PEV-Charging contract (e.g. tariff-model, non-financial motivation e.g. reservation of charging stations in public areas) to the PEV owners for each driver. The MSP/Energy retailer should provide a charging-app or web-portal where the PEV owner can enter the charging-session details such as charging start and stop times and SOC. The AC charging stations hardware and installation/integration will be offered by the local CPO/MSP. Within the installation the IT-connection to the CPO backend-system has to be tested as well.

The AC and DC charging stations hardware and installation/integration is typically offered by the MSP/CPO. During the installation, the IT-connection to the MSP/CPO backend-system has to be tested. Before installing the AC / DC infrastructure a grid planning assessment for the relevant location is recommended for any capacity greater than 1 MW to plan the necessary stabilization of the grid connection (substation) and grid (cable) on the location of the fleet. Afterwards, additional smart charging capabilities could be considered.

As discussed in various sections of the EV Blueprint, SVP can obtain LCFS credits by filing charging data from customers. It was determined the ability to obtain this charging data from residential customers does not provide enough benefits to justify the costs. However, this section outlines the technology needs if The City decides to develop a program to collect residential charging data in the future.

Residential Charging Data Requirements

To Support the SVP charging program initiative, the PEV owner needs to get a report on daily/monthly/quarterly basis in a file (e.g. xls) or smart-charging app to report the charging session to SVP. The report should contain data in a Charge Detail Record (CDR) covering:

- EVMA-ID (Electro-Mobility Account-ID)
- EVSE-ID (Electric-Vehicle Supplier Equipment-ID)
- Charging-Duration (Start – End)
- Charged kWh
- Charging Technology (AC / DC)

From the CPO Backend, the local CPO/MSP need to send the Charging data based on the CDR (file-information above) to the SVP Incentive program in a daily/monthly or quarterly report / file. The SVP incentive program will check the reports from the PEV-Driver (based on MSP/Energy Retailer backend) and the reports/files from the local report initiate the payment to the PEV-Driver.

Business Model Evaluation

Introduction

The objective of the Business Model Evaluation section is to define the ownership and operating models for Electric Vehicle Supply Equipment (EVSE) and evaluate the economics as pertains to the key stakeholders of each model. Given the prioritized EV Blueprint drivers identified (those with a priority level of 1 or 2) during the course of this engagement, we focused on the following ownership/operating models:

- Multi-Unit Dwellings (MUDs)
  - Parking spot shared among residents (one-to-many relationship)
  - Parking spot owned by individual resident (one-to-one relationship)
- City owned charging stations in Disadvantaged Community (DAC)
- Privately owned charging stations
  - Electric Vehicle Service Provider (EVSP) ownership model
- City owned charging stations for City vehicle fleets
  - Public-Private Partnerships (e.g., privately funded and operated stations on public property through a lease-lease-back arrangement)

Specifically, in this section, for each model listed above we:

- Identified the key stakeholders or parties involved
- Documented the transactions occurring among all the parties involved
- Described and quantified the transactions by estimating the financial payments for each transaction
- Built a financial model including:
  - Identification of the most effective party to own and operate the EVSE
  - Estimates of capital, make-ready, variable & fixed operating and maintenance (O&M) costs, billing, overheads, etc.
  - Estimates of variable and fixed revenues from sources including, but not limited to, charging fees (fixed, variable, time based, etc.), demand response, incentive payments, tax credits, etc.
  - Calculation of the economic value over the life-cycle of the EVSE occurring to the owner

Based on the economic analysis, the EV Blueprint Team identified opportunities for The City and/or SVP to further encourage the EVSE infrastructure build out in cases where the lack of infrastructure may severely hinder PEV adoption in the concerned community. The EV Blueprint Team also conducted primary research into the available financing options from lending institutions and described the most common financing options available to EVSE owners. Furthermore, The EV Blueprint Team listed and described innovative products being considered as the EVSE financing markets develop further.

Multi-Unit Dwellings

Today's PEV drivers charge at convenient locations where they park throughout the day, for example, at their workplaces. However, research has shown that more than 80% of the charging still happens at home. In the same way that people choose to charge their cell phones overnight at home, drivers prefer to charge their PEVs overnight. Having charging stations on site at multi-unit dwellings like apartment or condominium complexes makes this possible and convenient. For that reason, it is important for apartment Property Managers to consider charging stations for their residents.

In the context of multi-unit dwellings (MUDs), the most convenient charging station locations are the parking spots used by residents. For the purposes of describing the business model for PEV charging infrastructures, it helps to consider two common ownership scenarios for the parking spots:

- Individual Resident Ownership
- Property Manager Ownership

In the first instance, the individual resident controls the decision of installing the charging station. The resident commonly works with the Homeowners Association (HOA) to put the common equipment such as electrical panels in place. Such "easy-to-install" equipment is a necessary precursor to the installation of charging stations at the parking spot owned by the resident.

In the second instance the Property Manager typically owns the parking spots and assigns them to the residents and may or may not charge them a monthly parking fee. Alternatively, the parking spots maybe in common areas and may be shared by multiple residents on a first-come, first-served basis. In either case, the individual resident using the parking spot does not own it and the installation of the charging station is typically initiated by the Property Manager.

The framework governing both the scenarios is described further in Table 18.

Table 18: Multi-Unit Dwelling PEV Charging Framework

	Individual Resident Ownership	Property Manager Ownership
Applicable to	Appropriate where residents have assigned parking spots, or they own them outright, as it allows residents to charge right where they park.	Ideal for shared, mixed-use where residents may not own spots, or are not assigned a particular spot, or where parking is limited.
Access Controls	Charging stations can be easily assigned to residents directly and quickly, however, controls need to be in place to ensure that other drivers cannot use the charging station when the owner/assignee is away.	Access to charging stations can be restricted to residents only or extended to guests and the public. To increase utilization and accommodate resident needs, an appropriate PEV charging and pricing policy will need to be setup and administered. Many third-party providers provide such a service.

	Individual Resident Ownership	Property Manager Ownership
Pricing Components	• Utility Component – generation (energy), fuel surcharges, transmission, distribution, taxes • If electricity service is provided through resident's existing meter, demand charges may be avoidable; if the electricity service is billed through a shared HOA or Property Manager level meter, demand charges may be included • Station O&M, 24/7 support costs may be recovered through a monthly service charge	• Utility Component – generation (energy), fuel surcharges, transmission, distribution, taxes • Electricity service is billed through a shared Property Manager level meter, so demand charges are very likely to be included (may depend upon number, type of chargers) • Station O&M, 24/7 support costs may be recovered through a per session and/or length of time-based charge
Billing Frequency	• Monthly	• Per session • Can be monthly if service is restricted to residents and HOA/Property Manager, residents and charging operator all agree and have a billing process in place for aggregating all monthly charging session charges into a single bill per month
Parties Involved in Billing Process	• Individual resident • Charging station operator • HOA/Property Manager can most likely be taken out of the loop, but may be involved if they need to recoup property level "easy-to-install" investments	• Individual resident • Charging station operator • HOA/Property Manager

Source: EV Blueprint Team

Individual Resident Ownership Scenario

Under this scenario, the residents of the multi-unit dwellings in question tend to be owners of the individual units for example, a condominium. In this case, there is likely to be a Homeowners Association (HOA) overseeing the condominium complex and the individual residents are subject to the HOA rules. So, it is likely that the HOA would need to get involved to approve and setup common charging infrastructure that can be leveraged by the individual owner, who can then decide whether to install charging stations in the parking spots that they own. This demographic of condominium owners tends to have the economic resources required to buy an electric vehicle, however, they may not do so if there is a lack of charging infrastructure at their places of residence.

Transaction Framework for Individual Resident Ownership Scenario

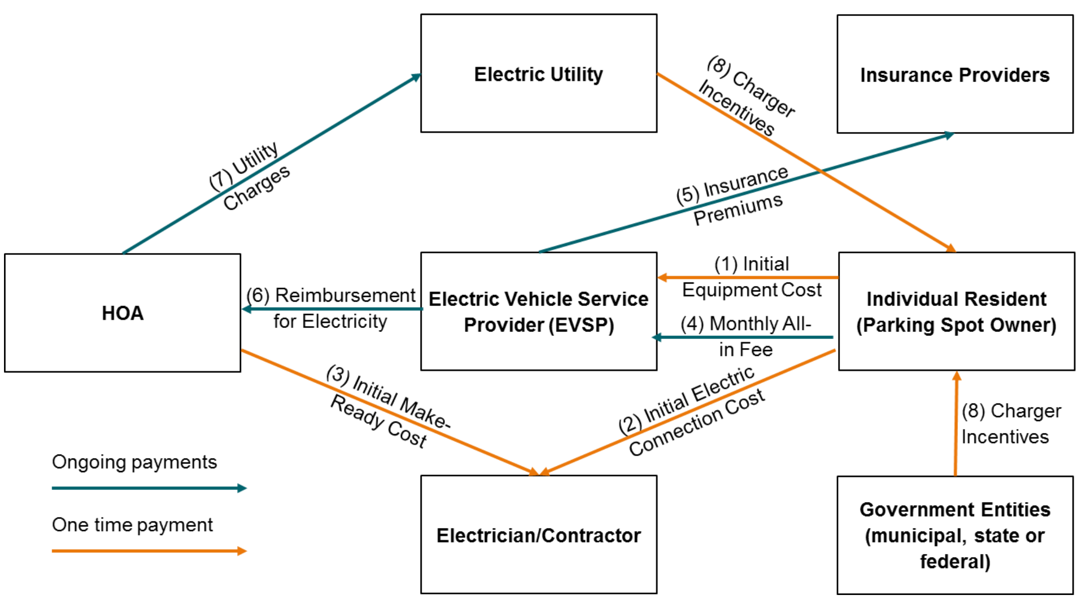
The key parties involved in the PEV charging station business model for the Individual Resident Ownership Scenario are listed as follows:

- Individual Resident (Parking Spot Owner)
- HOA
- Electric Vehicle Service Provider (EVSP)
- Electrician or Contractor
- Electric Utility
- Insurance Providers
- Government Entities

Under this scenario, the business model is set in motion when the individual resident, who also happens to own the parking spot, wishes to buy a PEV. In order to charge her PEV, the resident must approach the HOA in order to get approvals for installing the charging equipment. The HOA is involved because equipment in the common areas such as electric meters, electric panels, etc. is needed to support individual charging stations.

The economic framework for this scenario is described in Figure 66. This is the most common setup that the EV Blueprint Team has observed, especially in the California market.

Figure 66: Economic Transactions for Individual Resident Ownership Scenario for Multi-Unit Dwellings



Source: EV Blueprint Team

The initial cost of the equipment and the "make ready" setup is borne by the residents. The HOA, with the residents' input, typically hires a Electric Vehicle Service Provider (EVSP) to supply the equipment; and, once installed, to perform the ongoing maintenance and provide residents with customer service for the charging stations. A licensed electrician or contractor usually performs the installation and the interconnections and is paid for by the residents. After the charging equipment is installed and residents start using the charging equipment, the ongoing operating expenses are paid to the EVSP who takes care of the monthly billing. The electricity costs are reimbursed to the HOA who then pays the electric utility. Then, once the operations commence, the HOA is taken out of the loop and the residents directly deal with one entity – the EVSP. The EVSP typically holds liability insurance on the equipment installed so that if there are any issues that affect the common areas or equipment, the EVSP is covered and relieved of any financial liability.

The transactions shown in Figure 66 are further described in Table 19.

Table 19: Description of Transactions for Individual Resident Ownership Scenario for Multi-Unit Dwellings

Payment	Frequency	From	To	Description
(1) Initial Equipment Cost	One time	Individual Resident	EVSP	One-time payment for the charging station equipment installed at the parking spot; can be in the $2k+/charger range for Level 2 charging stations.
(2) Initial Electric Connection Cost	One time	Individual Resident	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the electricity connection from the building panel to the parking spot; actual cost is a function of distance of parking spot from electrical panel.
(3) Initial Make-Ready Cost	One time	HOA	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the infrastructure (e.g., panels) to serve multiple charging stations; typically, one panel can serve 30-40 Level 2 chargers and can cost upwards of $20k/panel.
(4) Monthly All-in Fee	Monthly	Individual Resident	EVSP	Ongoing monthly payments comprise the monthly subscription fee (to pay for 24/7 support, insurance) and utility charges (energy, T&D charges, taxes, surcharges) which are levied typically on an on-hour basis for the length of time used.
(5) Insurance Premiums	Annual	EVSP	Insurance Provider	Ongoing liability insurance premiums for the charging equipment. These insurance costs are ultimately recovered from the individual residents in their monthly charge.

(6) Reimbursement for Electricity	Monthly	EVSP	HOA	Ongoing variable payments for electricity used depending upon the tariff rate offered by the utility to the HOA/Property Manager. These payments are aggregated by the EVSP from all the fees collected from individual residents and reimbursed to HOA/Property Manager who pays the utility.
(7) Utility Charges	Monthly	HOA	Electric Utility	HOA/Property Manager pays the utility charges based on the tariff applied to the property for the amount of electricity used by all the individual residents that month.
(8) Charger Incentives	One time	Local Utility or Government Agencies	Individual Resident	Certain utilities offer low-income residents rebates to help with the installation of chargers. Such rebates or tax credits may also be available from government agencies at the municipal, state, or federal level.

Source: EV Blueprint Team

Property Manager Ownership Scenario

Under this scenario, the residents of multi-unit dwellings in question tend to be tenants of the individual units, for example, apartments. In this case, there is a Property Manager overseeing the apartment complex and the individual residents are subject to the rules of the apartment community set by the Property Manager. So, in this case it is the Property Manager's prerogative to setup chargers. The Property Manager may also use the charger infrastructure to attract residents and increase the property value by providing PEV charging to the residents at their residential location, which is the most convenient place to charge their EVs. The important distinction from the *Individual Resident Ownership Scenario* is that individual residents are renters and even if they have assigned parking spots, they do not own the parking spots or the dwelling structure that they live in. In this case, the renters would have little, if any, control over the decisions affecting the overall community including installing charging equipment.

There are many ways to recoup the costs of PEV charger deployment at MUDs, including tax credits, rebates and potential increases in rent. Managers of MUD properties have the option of developing different PEV charging pricing models depending on the property's goals. Common objectives include generating incremental revenues or encouraging drivers to leave their parking space as soon as they are finished charging. Pricing policies can then be structured in a way to encourage sharing of a community charging station by residents, and property managers can pursue the option to provide a larger number of personal chargers without the need for electric upgrades through energy management.

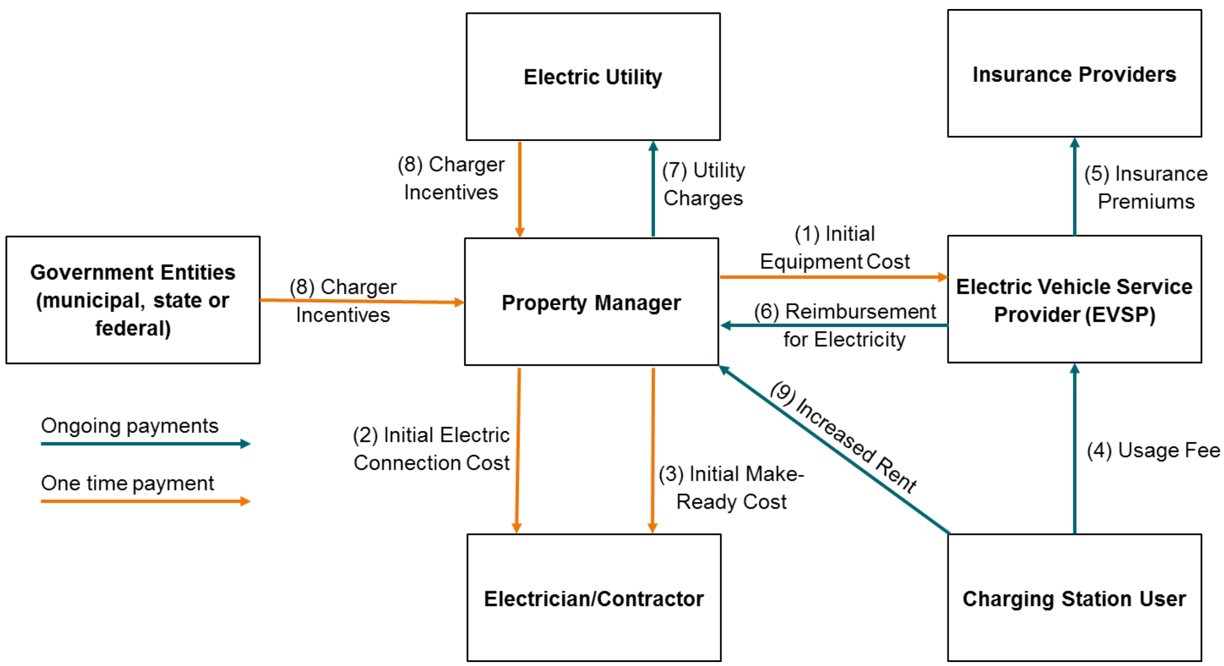
Transaction Framework for Property Manager Ownership Scenario

The key parties involved in the PEV charger business model for the Property Manager Ownership Scenario are listed below:

- Property Manager
- Electric Vehicle Service Provider (EVSP)
- Charger User (apartment resident)
- Electrician or Contractor
- Electric Utility
- Insurance Providers
- Government Entities

The economic transaction framework is fully described in Figure 67.

Figure 67: Economic Transactions for Property Manager Ownership Scenario for Multi-Unit Dwellings



Source: EV Blueprint Team

Under this scenario, the business model is set in motion when the Property Manager decides to install chargers. Since they have full decision-making capability in this case, the initial installation cycle can be smoother, streamlined, and shorter compared to the *Individual Resident Ownership Scenario.* There are several Electric Vehicle Service Providers (EVSPs) to choose from, who provide end-to-end support from installation to ongoing support and maintenance and also take care of billing, so the Property Manager is likely to work with an EVSP. The EVSP is also better equipped to handle charging regulations, permitting, approvals, capacity limitations, and property reimbursements. The EVSP offers ongoing insurance, support, maintenance, and automated billing services, and the cost of these services are typically built into the charging fees, so there is no additional cost to the Property Manager.

The charging stations are installed in common areas of the property and connect to common area power. The residents can subscribe to the charging service. Through the residents' use of access cards, the EVSP is able to monitor electricity consumed by residents. Members are billed monthly for the amount of energy used, and the Property Manager is fully reimbursed for the energy consumed by PEV charging. The Property Manager then pays the utility for the electricity used for charging.

The transactions shown in Figure 67 are further described in Table 20.

Table 20: Description of Transactions for Property Manager Ownership Scenario for MUDs

Payment	Frequency	From	To	Description
(1) Initial Equipment Cost	One time	Property Manager	EVSP	One-time payment for the charging station equipment installed at the parking spot; can be in the $2k+/charger range for Level 2 charging stations.
(2) Initial Electric Connection Cost	One time	Property Manager	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the electricity connection from the building panel to the parking spot; actual cost is a function of distance of parking spot from electrical panel.
(3) Initial Make-Ready Cost	One time	Property Manager	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the infrastructure (e.g., panels) to serve multiple chargers; typically, one panel can serve 30-40 Level 2 chargers and can cost upwards of $20k/panel.
(4) Usage Fee	Per use	Charging Station User	EVSP	Per-use payments comprise primarily utility charges (energy, T&D charges, taxes, surcharges) which are levied typically on an on-hour basis for the length of time used, and fixed charges to recover O&M, insurance costs of the station, and utility demand charges, if any.
(5) Insurance Premiums	Annual	EVSP	Insurance Provider	Ongoing liability insurance premiums for the charging equipment. These insurance costs are ultimately recovered from the charging station user in their per-use fee.

Payment	Frequency	From	To	Description
(6) Reimbursement for Electricity	Monthly	EVSP	Property Manager	Ongoing variable payments for electricity used depending upon the tariff rate offered by the utility to the Property Manager. These payments are aggregated by the EVSP from all the fees collected from individual residents, and reimbursed to Property Manager who pays the utility.
(7) Utility Charges	Monthly	Property Manager	Electric Utility	Property Manager pays the utility charges based on the tariff applied to the property for the amount of electricity used by all the charging station users that month.
(8) Charger Incentives	One time	Electric Utility or Government Agencies	Property Manager	Certain utilities offer rebates to help with the installation of charging stations in low-income neighborhoods. Such rebates or tax credits may also be available from government agencies at the municipal, state, or federal level.
(9) Increased Rent	Monthly	All Residents	Property Manager	Property Manager recovers the upfront installation costs through rent increases from all residents of the multi-unit dwelling property.

Source: EV Blueprint Team

Economic Analysis for Property Manager Ownership Scenario for Multi-Unit Dwellings

The Property Manager Ownership Scenario is assigned a priority level 1 (highest priority) by The City and SVP, so we chose this scenario to conduct a detailed analysis using our proprietary pro forma financial model to analyze the full economic impact of installing charging infrastructure to the owner – the Property Manager in this case.

The primary assumptions in this model, in terms of the size of a MUD community and the size and number of chargers considered, are described in Figure 68.

Figure 68: Pro Forma Model Assumptions for the Property Manager Ownership Scenario

MUD Residents	Amount
Charging Subscribers	
Total number of units, #	400
Subscription Rate in Year 1, %	10.0%
Number of subscribers in Year 1	40
Annual growth rate in number of subscribers, %	10.5%
Years to reach full subsciption, #	25

Charging Stations	Amount
DC Fast Chargers	
Total number of sites, #	1
Total number of stations, #	3
Total number of chargers, #	6
Level 2 Chargers	
Total number of sites, #	1
Total number of stations, #	20
Total number of chargers, #	20

Source: EV Blueprint Team

The full set of assumptions used in the model will be included in an Appendix for the final report to the CEC.

The EV Blueprint Team's model estimated the costs and payments from various publicly available sources such as the EVSE websites for the nature and fees charged and Siemens internal sources for the cost of equipment, installation, make-ready costs for Property Managers.

The key observations and inferences from the economic analysis are:

- The Property Manager makes the capital investment needed to buy and install the charging equipment in the MUD community and hires a full-service EVSP, who supplies, installs, maintains, supports the equipment, and bills the resident. The entire model framework is described in Figure 67 and Table 20.
- Currently, the size of investments necessary are not big enough to attract many lending institutions to offer customized financing solutions to the Property Managers. The state of the financing industry and products available are discussed at the end of the Business Model Evaluation section.
- There are city level or state level incentives available to the Property Managers from time to time that will subsidize partially (or fully in some cases for smaller installations) the initial investment needed to setup the EVSE. A full study of available incentives is beyond the scope of the study.[78]

78 The interested reader can refer to the DriveClean.ca.gov, which is a web site of the California Air Resources Board developed as a resource for clean technology vehicles and has a comprehensive list of incentives available for entities interested in installing EVSE.

- The Property Manager may use the charging station infrastructure in their MUD communities to attract residents and increase the property value by providing PEV charging to the residents at their place of residence.
- The model finds that, in the absence of any external sources of funding such as public or private grants, the Property Manager needs to pass approximately 17% of the initial investment to the residents as permanent rent increases in order to break-even on a Net Present Value (NPV) of future cash-flows basis.

Disadvantaged Community (DAC)

Disadvantaged communities are defined by the Office of Environmental Health Hazard Assessment, on behalf of the California Environmental Protection Agency, as the top 25% scoring areas from CalEnviroScreen along with other areas with high amounts of pollution and low populations.[79] A significant portion of The City is designated as a DAC, in part a result of having a heavily-traveled portion of U.S. Highway 101 and the neighboring San Jose International airport. The primary focus of the activities in The City's DAC are industrial in nature, thus involve the use of industrial vehicles. The DAC area of The City is likely to be a good candidate for commercial vehicle (class 3-6) charging. Given this assumption, the EV Blueprint Team has assumed a higher proportion of DC fast chargers in DAC locations as compared to MUD locations.

The DAC zones are likely to lack charging infrastructure, which may significantly limit the PEV adoption in those areas. The Santa Clara DAC zone is primarily an industrial zone, and industrial companies are primarily driven by economics when procuring vehicles. Thus, in order to stimulate PEV adoption in the DAC zones, it is important that The City takes the initiative of funding and installing EVSE infrastructure in these zones. Unless The City can find private partners willing to fund the charging infrastructure installation, The City will need to provide the initial capital needed for the equipment and installation costs. In this case, The City would own the equipment, however, given there are a number of full-service EVSPs operating in the market, The City has several options of for-profit EVSPs to choose from for an EVSP to supply and operate the equipment for The City.

Transaction Framework for City Owned Chargers in DAC Zones Scenario

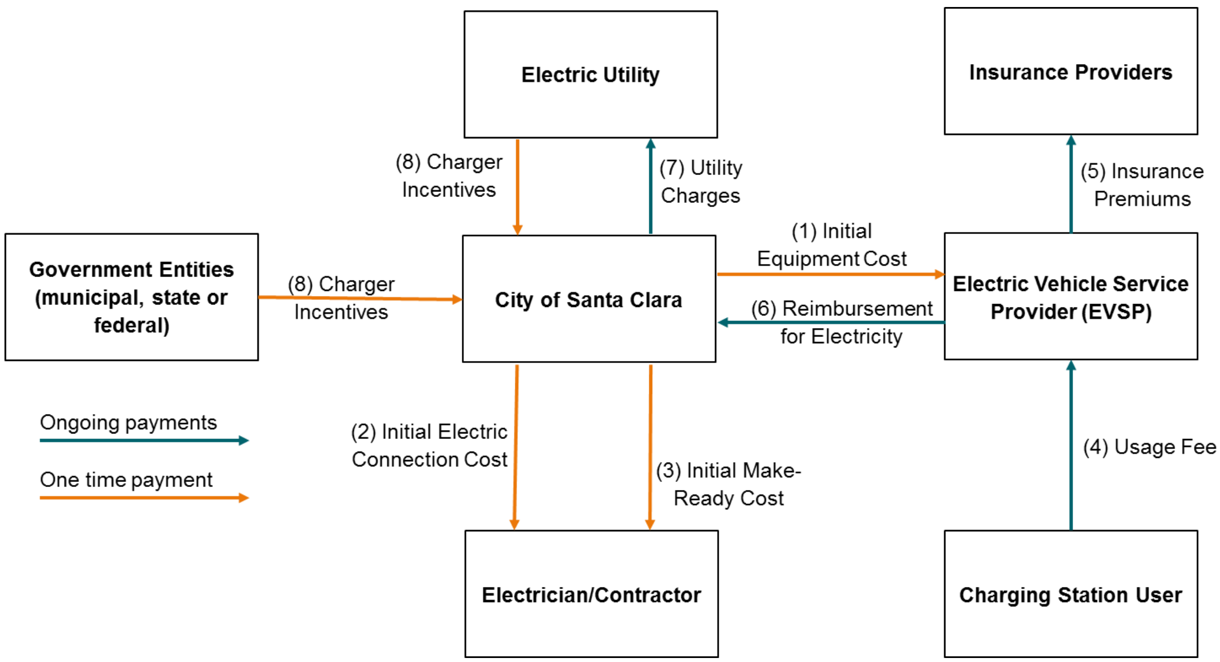
The key parties involved in the PEV charging station business model for the City Owned Chargers in DAC Zones Scenario are listed below:

- City of Santa Clara
- Electric Vehicle Service Provider (EVSP)
- Charging Station User
- Electrician or Contractor
- Electric Utility
- Insurance Providers
- Government Entities

79 https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

The economic transaction framework is fully described in Figure 69.

Figure 69: Economic Transactions for City Owned Chargers in DAC Zones



Source: EV Blueprint Team

Under this scenario, the business model is set in motion when The City decides to install charging stations in the DAC zones. The City has the option to hire an EVSP to install, maintain, and provide customer support for the EVSE installed in DAC zones. The users of the charging stations pay for the service and electricity to the EVSP, who in turn reimburses The City for the electricity costs. The City, being the owner of the charging stations, is responsible for paying the local utility for the electricity used.

The transactions shown in Figure 69 are further described in Table 21.

Table 21: Description of Transactions for City Owned Chargers in DAC Zones

Payment	Frequency	From	To	Description
(1) Initial Equipment Cost	One time	City of Santa Clara	EVSP	One-time payment for the charging station equipment installed at the DAC site.
(2) Initial Electric Connection Cost	One time	City of Santa Clara	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the electricity connection from the main electric panel to the charging spot; actual cost is a function of distance of charging spot from electrical panel.

Payment	Frequency	From	To	Description
(3) Initial Make-Ready Cost	One time	City of Santa Clara	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the infrastructure (e.g., panels) to serve multiple charging stations; typically one panel can serve 30-40 Level 2 chargers.
(4) Usage Fee	Per use	Charging Station User	EVSP	Per-use payments comprise primarily utility charges (energy, T&D charges, taxes, surcharges) which are levied typically on an on-hour basis for the length of time used, and fixed charges to recover O&M, insurance costs of the station and utility demand charges, if any. Usage fee can also be on a $ per kWh basis.
(5) Insurance Premiums	Annual	EVSP	Insurance Provider	Ongoing liability insurance premiums for the charging equipment. These insurance costs are ultimately recovered from the charging station user in the per-use fee.
(6) Reimbursement for Electricity	Monthly	EVSP	City of Santa Clara	Ongoing variable payments for electricity used depending upon the tariff rate offered by the utility. These payments are aggregated by the EVSP from all the fees collected from individual users and reimbursed to City of Santa Clara who pays the utility.
(7) Utility Charges	Monthly	City of Santa Clara	Electric Utility	City of Santa Clara pays the utility charges based on the tariff applied to the DAC site for the amount of electricity used by all the charging station users that month.
(8) Charger Incentives	One time	Electric Utility or Government Agencies	City of Santa Clara	Certain utilities offer rebates to help with the installation of charging stations in low-income neighborhoods. Such rebates or tax credits may also be available from government agencies at the municipal, state, or federal level.

Source: EV Blueprint Team

Economic Analysis for City Owned Chargers in DAC Zones Scenario

The primary assumptions under the City Owned Chargers in DAC Zones Scenario modeled in the EVSE pro forma financial model are described in Figure 70; these include the size and number of charging stations per site, along with the number of potential sites in the DAC zone.

Figure 70: Pro Forma Model Assumptions for the Scenario of City Owned Chargers in DAC Zones

Number of Meters	Amount
Meters per site	1

DAC Site	Amount
Incremental Charging Subscribers	
Number of new subscribers in Year 1	40
Annual growth rate in number of subscribers, %	20.0%

Charging Stations	Amount
DC Fast Chargers	
Total number of sites, #	3
Total number of stations, #	3
Total number of chargers, #	18
Level 2 Chargers	
Total number of sites, #	3
Total number of stations, #	3
Total number of chargers, #	9

Source: EV Blueprint Team

The full set of assumptions used in the model will be included in an Appendix for the final report to the CEC.

The key observations and inferences from the economic analysis are:

- The City of Santa Clara makes the capital investment needed to buy and install the charging equipment in the DAC zone and hires a full-service EVSP, who supplies, installs, maintains, and supports the equipment, and bills the resident.
- Currently, the size of investments necessary are not big enough to attract many lending institutions to offer customized financing solutions to The City. The state of the financing industry and products available are discussed at the end of the Business Model Evaluation section.
- There are a number of incentives available to a municipal entity (e.g., the Department of Energy, California Energy Commission, etc.) however, such incentives are temporary and subject to availability of funds. Hence, in our economic analysis we consider no external sources of funding, and assume the entire capital is raised by The City.

- The model finds that, in the case of DAC zones, The City needs approximately 11% of the initial investment to be recovered through revenue sharing agreements with the EVSPs and/or through municipal tax increases. The revenue shared and/or tax increases would need to be permanent and ongoing over the life of the EVSE for the project to break-even on a Net Present Value (NPV) of future cash-flows basis.

Privately Owned Chargers

All the scenarios considered so far assumed that the owner outsources the equipment procurement, installation, operations, maintenance, and customer support to EVSPs. However, this scenario for Privately Owned Chargers focuses on the turnkey business model, wherein the EVSP owns and operates the PEV charger, undertakes and manages the installation, maintenance and related services, and substantially retains all of the PEV charging revenue.

The EVSP sometimes manufactures the charging equipment (Level 2 as well DC Fast Chargers) itself or has favorable sourcing arrangements with other suppliers. In addition to the equipment, the EVSP also offers an online or cloud-based "Network" that enables the EVSP to offer services such as payment processing, and remote monitoring and troubleshooting of stations. The EVSP's Network is also capable of collecting and sharing data such as real-time station status, detailed charging session information, energy dispensed, greenhouse gases reduced, etc. with partners and PEV drivers. The PEV drivers are able to interact with the EVSP via mobile applications that enable them to locate PEV charging stations, view real-time station status information, pay and initiate PEV charging sessions, and manage billing information.

The EVSP enters into long-term agreements with entities to own and operate charging stations at locations such as airports, car dealers, healthcare/medical facilities, hotels, mixed-use, municipal locations, multi-family residential and condo, parks and recreation areas, parking lots, religious institutions, restaurants, retailers, schools and universities, stadiums, supermarkets, transportation hubs, and workplaces. The EVSP may or may not have negotiated revenue sharing agreements with the hosts.

The noteworthy characteristic of this model is that the EVSP owns the charging stations allowing it complete control and discretion over the structure, features offered, and pricing for the PEV charging services.

Sources of Revenues and Costs

Before we analyze the economics of this scenario, it is helpful to gain an understanding of the sources of revenues and costs that will be included in the pro forma financial model.

The EVSP revenues are derived primarily from fees charged to PEV drivers for PEV charging in public locations. PEV charging fees to PEV drivers are based either on an hourly rate, a per kilowatt-hour (kWh) rate, or by session. A per kWh rate structure is used in the pro forma financial model.

The next source of revenue is through PEV charging hardware sales. PEV charging hardware is sold to the EVSP's partners such as The City, retailers, workplaces, etc. In addition to hardware sales, the EVSP provides product warranties of varying lengths (e.g., 1 or 2 years) and warranty fees paid by the customer serve as an additional source of revenue. Separately, other sources of revenues from PEV charging services are network fees (payments made by the EVSP's partners to get access to charging and billing data online or over the telecommunications network), and also payment processing fees. In the current turnkey scenario, it is assumed that the EVSP owns and operates the equipment, so revenues from hardware sales, warranties, and network fees from the host partners are not considered in the financial model.

Low Carbon Fuel Standard (LCFS) credits are another source of revenue; these are generated as a byproduct from the electricity utilized by the charging stations. The value of the credits depends upon market conditions; however, the EVSP is able to monetize these credits by selling them into the secondary market as conditions permit.

The cost of revenues includes electricity reimbursements, revenue share payments (if any) to the EVSP partner that hosts the charging station, the cost of charging stations sold (including commissions), connectivity charges paid to telecommunication networks, warranty, repairs and maintenance services, and depreciation of the installed charging stations. Other fixed operating expenses include compensation of employees, and general and administrative costs.

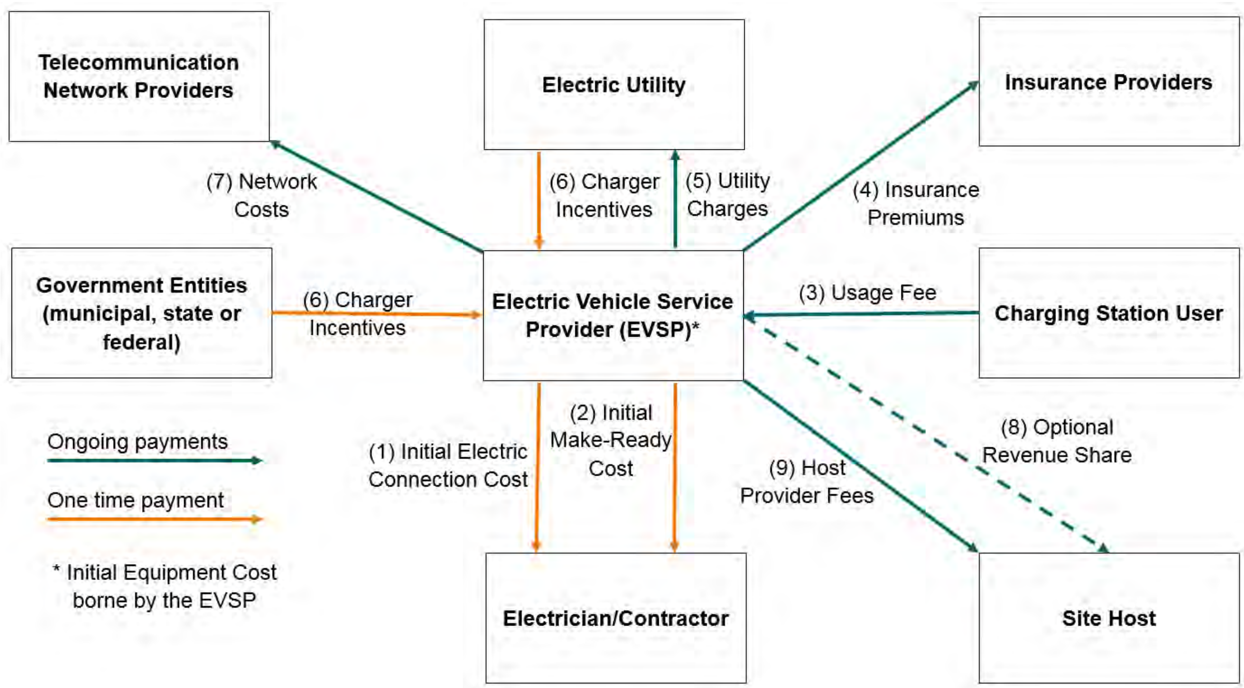
Transaction Framework for Privately Owned Chargers Scenario

The key parties involved in the PEV charging station business model for the Privately Owned Chargers scenario are listed below:

- Electric Vehicle Service Provider (EVSP)
- Charging Station User
- Electrician or Contractor
- Electric Utility
- Insurance Providers
- Government Entities
- Telecommunication Network Providers

The economic transaction framework is fully described in Figure 71.

Figure 71: Economic Transactions for Privately Owned Chargers



Source: EV Blueprint Team

Under this scenario, the business model is completely driven by profit/loss considerations. The EVSP may set the model in motion when it locates an economically attractive site and/or a willing partner host for charging services and decides to invest in the venture. As described in earlier sections, the EVSP is in the business of supplying the equipment and may have hardware manufacturing in-house or may be outsourced to pure-play hardware providers. Similarly, the installation of the equipment may be in-house or may be outsourced to a contractor specializing in charging hardware installation. The EVSP works with the site host and completes the installation of the charging hardware and acquires liability insurance. The EVSP is the owner and the operator of the charging equipment in this case and leases the space for the charging equipment from the host. The EVSP may negotiate a "host provider" fee that is net of the leasing costs, any revenue share agreements, and the benefit that a charging location provides to the host if it is a commercial entity. The EVSP also pays for the electricity consumed by the charging station users directly to the electric utility. The EVSP sets up payment mechanisms and mobile applications for the charging station users to locate and use the charging stations, and to pay for the charging services. The charging service revenue constitutes the primary revenue source for the EVSP. The EVSP also taps into all available sources of external incentives from federal, state, and municipal agencies.

The transactions shown in Figure 71 are further described in Table 22.

Table 22: Description of Transactions for Privately Owned Chargers

Payment	Frequency	From	To	Description
(1) Initial Electric Connection Cost	One time	EVSP	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the electricity connection from the main panel to the charging spot; actual cost is a function of distance of charging spot from electrical panel.
(2) Initial Make-Ready Cost	One time	EVSP	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the infrastructure (e.g., panels) to serve multiple charging stations.
(3) Usage Fee	Per use	Charging Station User	EVSP	Per-use payments comprise primarily utility charges (energy, T&D charges, taxes, surcharges) which are levied typically on an on-hour basis for the length of time used and fixed charges to recover O&M, insurance costs of the station and utility demand charges, if any. Usage fee can also be on a $ per kWh basis.
(4) Insurance Premiums	Annual	EVSP	Insurance Provider	Ongoing liability insurance premiums for the charging equipment. These insurance costs are ultimately recovered from the charging station user in the per-use fee.
(5) Utility Charges	Monthly	EVSP	Electric Utility	EVSP pays the utility charges based on the tariff applied to the charging site for the amount of electricity used by all the charging station users that month.
(6) Charger Incentives	One time	Electric Utility or Government Agencies	EVSP	Certain utilities offer rebates to help with the installation of charging stations in low-income neighborhoods. Such rebates or tax credits may also be available from government agencies at the municipal, state, or federal level.
(7) Optional Revenue Share	Ongoing	EVSP	Site Host	EVSP may pay a negotiated portion of the revenue to the site host to incentivize the host to allow the EVSP to setup charging stations on the host's property.

Payment	Frequency	From	To	Description
(8) Host Provider Fees	Ongoing	EVSP	Site Host	EVSP may pay a negotiated "host provider" fee if the host is a commercial entity (e.g., a retail store) the fee may be the net of the leasing costs, the network fees payable by host, and the economic benefit that a charging location provides to the host.

Source: EV Blueprint Team

Economic Analysis for EVSP Owned Charging Stations Scenario

The primary assumptions under the EVSP Owned Charging Station Scenario modeled in the EVSE pro forma financial model are described in Figure 72; these include the size and number of charging stations per site along with the number of potential sites in The City.

Figure 72: Pro Forma Model Assumptions for the Scenario of EVSP Owned Charging Stations in The City

Charging Stations	Amount
DC Fast Chargers	
Total number of sites, #	10
Total number of stations, #	3
Total number of chargers, #	60
Level 2 Chargers	
Total number of sites, #	10
Total number of stations, #	2
Total number of chargers, #	20

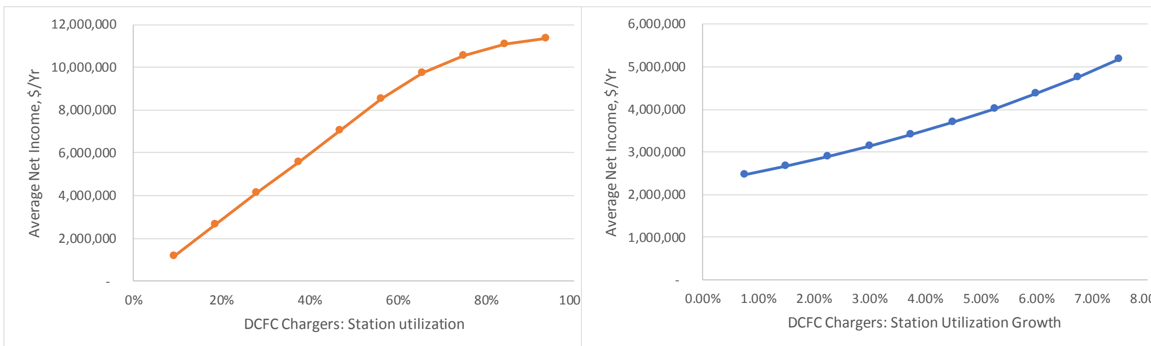
Source: EV Blueprint Team

The full set of assumptions used in the model will be included in an Appendix for the final report to the CEC.

Based on the EV Blueprint Team's primary research of the PEV Charging Equipment and Service Provider industry group, we have observed that the charging station EVSPs are increasingly focusing on DC fast charging hardware in their ownership models, which target retail locations, tourist destinations, city thoroughfares, etc. The reason is self-evident given that DCFCs offer very fast charging times where a charging equipment user can carry out shorter duration activities while charging the car. In such cases the EVSP can find a host site such as a shopping mall, restaurant, etc. that offers exactly such a short duration opportunity while also addressing the PEV driver's range anxiety. Level 2 chargers, however, are more attractive for locations where the charging station user is likely to stay longer, such as workplaces, where the motivating factor is completely different. Therefore, in this scenario we assume that two-thirds of the chargers are DCFCs and one-third are Level 2 chargers.

In this ownership model, the EVSP is primarily motivated by profit/loss considerations in the decisions to install charging stations. Given this pre-condition, the EV Blueprint Team carried out a sensitivity analysis of the profitability of a charging site owned and operated by an EVSP as measured by average net income earned over the life of the equipment. This analysis was helpful to identify the key variables driving the profitability, namely (i) the current utilization of the charging equipment, and (ii) the expectations of annual growth rates for the current utilization. Given the EVSPs' affinity toward DCFC chargers, our selected sensitivity analysis results displayed in Figure 73 focus on DCFC equipment utilization and utilization growth rates.

Figure 73: EVSP Ownership Scenario Sensitivity Results



Source: EV Blueprint Team

The key inferences from the primary research and the economic analysis carried out by the EV Blueprint Team for this scenario are:

- The EVSPs currently operating in the marketplace have the technical expertise necessary for operating charging stations, the software capability such as mobile applications integrated with commonly used mapping applications, a network management framework that allows site hosts and customers to monitor the charging process and data, and easy to use payment mechanisms.
- Considering the charging station utilization rates of 10-30% observed in individual sites such as retail outlets in prime city locations, for such an EVSP owning a DC fast charging station should have no problems in recovering project-level investment costs within 2 to 3 years. However, the currently operating EVSPs are still largely not profitable just yet, primarily because they have not been able to recover their large initial investments necessary – for developing software and network capabilities, growing the brand awareness, expanding sales channels, identifying suitable sites, etc. – in the current market environment in which the current demand for public charging is still limited.
- Under our assumptions for equipment capital costs, operating costs, charging profiles, and charging fees levied by EVSPs, our model clearly indicates that the economics are very favorable for the use of DCFCs compared to Level 2 charging equipment. Specifically, by installing a single additional DCFC charging station with 2 connectors, the EVSP can expect

to earn an incremental net-income that is 10 times greater than their earnings from installing a single incremental Level 2 charger.

Public-Private Partnerships for City PEV Fleets

Fleets are accelerating the shift to eMobility, with New York City and Los Angeles as prime U.S. examples. New York City, which maintains the largest municipal transit system in the U.S., plans to convert its entire public bus fleet – more than 5,000 buses – to electric buses by 2040. Los Angeles, the nation's next largest system, has committed to replacing its entire fleet of 2,300 buses with zero-emissions vehicles (ZEVs) by 2030.

In the MUD and DAC scenarios previously discussed, the host owns the charging stations, while they outsource the operations, maintenance, billing, and customer support services to EVSPs. When capital is needed for the charging stations, the host provides it – the Property Manager and The City respectively. In our discussions with the lending institutions, we have observed that the commercial and equipment lending institutions are risk averse and have stayed away from the charging equipment financing given the uncertainty of future growth in utilization which in turn makes the future cash flows from the infrastructure uncertain. This has also limited the widespread growth of Public-Private Partnerships (P3) models in which a private entity owns and operates the stations on public land primarily because the private entity is unable to raise debt financing for such projects to limit tying up its own capital from its balance sheet or through equity infusions. However, fleet operations offer a perfect opportunity for P3 models using debt financing, as the fleet operator represents a steady demand for charging. This leads to cash flow certainty from a credit worthy off taker which is an economically sound proposition for lending institutions, who may be more willing to lend under such a business model.

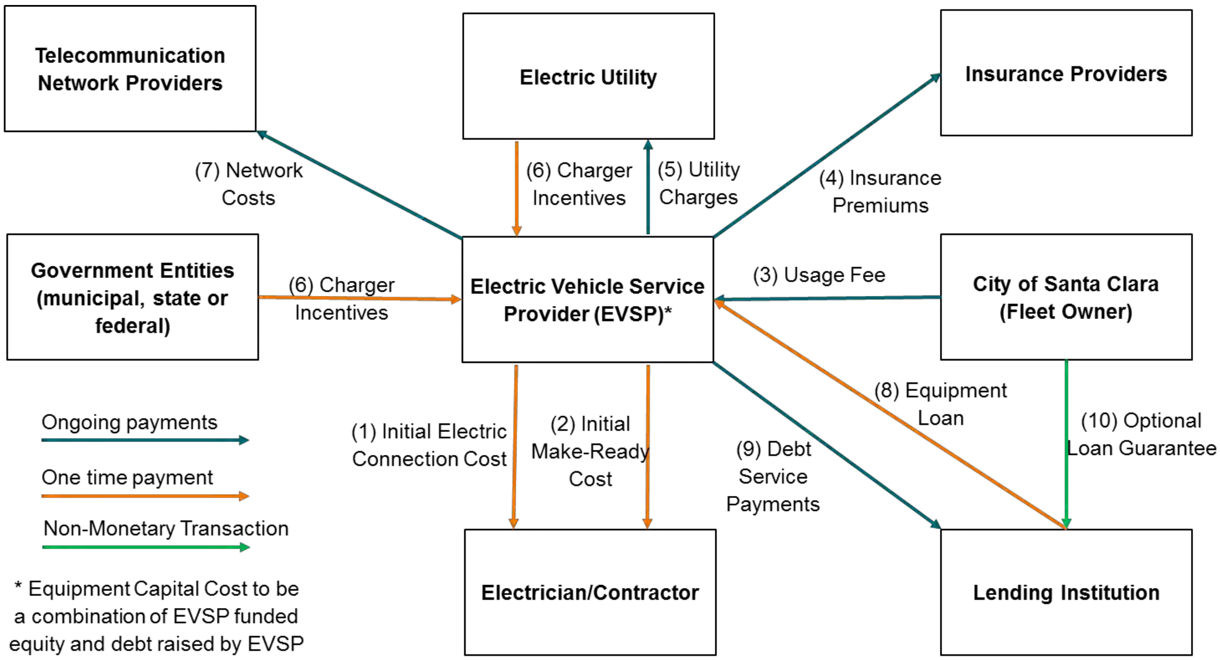
Transaction Framework for The City Fleet Charging P3 Scenario

The key parties involved in the PEV charging station business model for The City Fleet Charging P3 Scenario are listed below:

- Electric Vehicle Service Provider (EVSP)
- City of Santa Clara (fleet owner)
- Electrician or Contractor
- Electric Utility
- Insurance Providers
- Government Entities
- Telecommunication Network Providers
- Lending Institution

The economic transaction framework is fully described in Figure 74.

Figure 74: Economic Transactions for The City Fleet Charging P3 Scenario



Source: EV Blueprint Team

In the case of Santa Clara, the public transport network is owned and operated by the Santa Clara Valley Transit Authority (VTA), which is an independent institution providing transport and commuter services to the entire county of Santa Clara. Since VTA is independent of the City of Santa Clara, The City's short-term fleet electrification efforts are limited to its sedan fleet; therefore, the pro forma financial model focuses only on light-duty vehicles. In the longer term, The City will include medium and heavy-duty vehicles in the electrification effort.

Under this scenario, the business model is set in motion when The City decides to install charging stations for its sedan fleet. The City issues a request for proposal (RFP) to solicit proposals from Charging Station EVSPs under a P3 operating model, which allows The City to pass the entire capital cost of equipment onto the private partner, the EVSP in this case. The City then enters into a contract with the selected EVSP that offers the least cost and best service solution. The EVSP, armed with The City contract that includes the off take agreement from The City to charge its fleet from the charging equipment provided by the EVSP only, approaches a lending institution for an equipment loan. The EVSP does so to reduce its own capital from being tied up in the project and also is able to lower the project cost of capital by introducing debt financing which typically has a lower cost compared to pure equity financing. The lender is more inclined to approve the loan as there is a public creditworthy entity (such as the city of Santa Clara as the off taker of charging services provided by the EVSP) and there is a long-term agreement to back the project. The City may also offer an optional loan guarantee to further de-risk the project for the lender, who in turn may be able to offer a lower interest rate to reflect the lower risk. The EVSP funds the balance of the capital costs through its balance sheet or equity infusion from its investors.

The EVSP works with The City and completes the installation of the charging hardware and acquires liability insurance. The EVSP is the owner and the operator of the charging equipment in this case and leases the space for the charging equipment from The City. Given that The City has a long-term off take agreement in place, The City is able to negotiate a discounted charging user fee paid to the EVSP. The EVSP is also amenable to this discount as this model significantly reduces its sales cost and guarantees a steady stream of revenue over the life of the equipment.

The EVSP pays for the electricity consumed by the charging station users directly to the electric utility. The EVSP may be able to oversize the capacity and offer charging services to the general public. The EVSP sets up payment mechanisms and mobile applications for such charging station users to locate the charging stations, to use the charging stations, and to pay for the charging services. The charging service revenue constitutes the primary revenue source for the EVSP. The EVSP also taps into all available sources of external incentives from federal, state, and municipal agencies for additional funding to lower its capital and/or its operational costs. Given the multiple options available, and the temporary nature of many of these sources, the financial model does not include such funding sources.

All the transactions described above and shown in Figure 74 are defined in Table 23.

Table 23: Description of Transactions for City Fleet Charging P3 Scenario

Payment	Frequency	From	To	Description
(1) Initial Electric Connection Cost	One time	EVSP	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the electricity connection from the main panel to the charging spot; actual cost is a function of distance of charging spot from electrical panel.
(2) Initial Make-Ready Cost	One time	EVSP	Electrician / Contractor	One-time payment to an electrician or certified contractor to install the infrastructure (e.g., panels) to serve multiple charging stations.
(3) Usage Fee	Per use	City of Santa Clara (fleet owner)	EVSP	Per-use payments for recovery of electricity, O&M, insurance, customer service costs. Given the contractual obligation of using the charging services from the fleet owner, the usage fees are likely to be negotiated down as there is reduced uncertainty and sales costs to the EVSP.
(4) Insurance Premiums	Annual	EVSP	Insurance Provider	Ongoing liability insurance premiums for the charging equipment. These insurance costs are ultimately recovered from the charging station user in the per-use fee.

Payment	Frequency	From	To	Description
(5) Utility Charges	Monthly	EVSP	Electric Utility	EVSP pays the utility charges based on the tariff applied to the charging site for the amount of electricity used by all the charging station users that month.
(6) Charger Incentives	One time	Electric Utility or Government Agencies	EVSP	Certain utilities offer rebates to help with the installation of charging stations in low-income neighborhoods. Such rebates or tax credits may also be available from government agencies at the municipal, state, or federal level.
(7) Network Costs	Ongoing	EVSP	Telecommunicati on Network Provider	Fixed network costs based on number of chargers connected to the telcom network regardless of whether the charger generates revenue.
(8) Equipment Loan	One time	Lending Institution	EVSP	EVSP armed with a contract with the fleet owner for a multi-year offtake agreement is in a better position to raise debt financing from a commercial lending institution.
(9) Debt Service Payments	Ongoing	EVSP	Lending Institution	EVSP makes debt service payments to the lender.
(10) Optional Loan Guarantee	One time	City of Santa Clara (fleet owner)	Lending Institution	The lending institution may require a loan guarantee from The City to reduce the default risk and offer a better interest rate to reflect the reduced risk.

Source: EV Blueprint Team

Economic Analysis for The City Fleet Charging P3 Scenario

The primary assumptions under the City Fleet Charging P3 Scenario modeled in the EVSE pro forma financial model are described in Figure 75; these include the size and number of charging stations per site along with the number of potential sites in The City.

Figure 75: Pro Forma Model Assumptions for the City Fleet Charging P3 Scenario

Number of Meters	Amount
Meters per site	1

Charging Stations	Amount
DC Fast Chargers	
Total number of sites, #	5
Total number of stations, #	4
Total number of chargers, #	40
Level 2 Chargers	
Total number of sites, #	5
Total number of stations, #	12
Total number of chargers, #	60

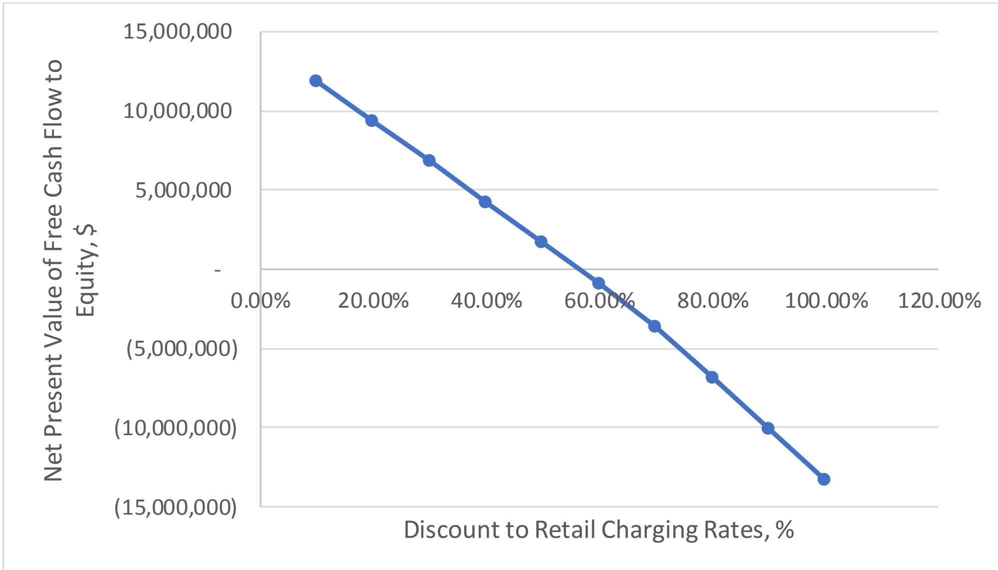
Source: EV Blueprint Team

The full set of assumptions used in the model will be included in an Appendix for the final report to the CEC.

The key inferences from our primary research of financing options available and the economic analysis using the financial pro forma model are:

- The city fleet charging scenario is the best suited scenario for raising debt financing.
- The City is able to enter into a P3 relationship with the EVSP, who in this case makes the capital investment needed to buy and install the charging equipment, and bears the expenses for operating, maintaining, and offering customer service for the equipment; in return the EVSP is paid a negotiated rate by the fleet owner.
- Given the large size of the fleet supported by the charging equipment, the size of investments necessary are big enough to attract many lending institutions to offer customized financing solutions.
- The model finds that, in the absence of any external sources of funding such as public or private grants and under the assumptions for the model, The City can negotiate a discount of up to 57% on the retail charging rates the EVSP offers to its retail customers. By offering this discount, the equity investors in the EVSP are able to earn an internal rate of return for the project that is equal to the cost of equity on a free cash flow to equity basis. The sensitivity of the NPV to this discount is provided in Figure 76.

Figure 76: City Fleet Charging P3 Scenario Sensitivity Results



Source: EV Blueprint Team

Debt Financing Options for EVSE

The EV Blueprint Team conducted primary research to identify options available to entities who may be looking for equipment loans to finance their charging infrastructure projects. In our discussions with lending institutions active in providing equipment loans to commercial and industrial borrowers, we found that lending activity to finance PEV charging stations and related infrastructure is at a very early stage. The lending activity can be described as nascent at best and there are several reasons cited by lenders to explain the current state:

- The commercial lenders believe that the equipment itself cannot effectively serve as collateral as it has limited residual value in an event of default.
- Currently, the businesses who are engaged in installing EVSE are doing so primarily to offer customers or employees the convenience of charging at locations they frequent, such as retail outlets, restaurants, workplaces, etc.; they are not doing so primarily to make a profit from the charging station.
- The private businesses (large and small) or public entities interested in installing the charging equipment are doing so on smaller scales, where the initial investment needed is small. Consequently, these potential borrowers are also not lining up for EVSE loans either, and in addition to the current size of installations being small, there are also several grants that are available at the federal, state, and the municipal level to subsidize a large portion of the capital investment needed.
- While there are several EVSPs operating in the market, the public charging industry is still in its infancy; there is not much data available on the economics of charging stations to make the lenders comfortable with future demand and related cash flows that a given public

charging site is likely to generate. In the absence of these data, the lenders have little reason to offer unsecured loans to the charging station developers. Consequently, the EVSPs engaged in developing, owning and operating public charging stations on a turnkey basis rely on their balance sheets, or equity investors and external government grants for funding their operations as opposed to raising debt finance.

- The lenders are likely to offer equipment loans to EVSE developers only if such a loan is guaranteed by a creditworthy parent or public partner, such as a city or utility with taxing or rate making authority.

While the commercial lending options are limited, there are several options available to a city in California to finance infrastructure including charging stations. In general, a city could obtain financing easier and cheaper than private parties, and they can do this either through the bond market or through banks. At least in the initial stages of developing brand new infrastructure, the banks may be easier to work with. Some of the options available to The City are:

- General Obligation Debt – voters within the city would have to approve issuance of debt for the project and agree to be taxed on their property tax bills for the repayment of the debt. The pro of this approach is that it is "free" money for the city. The con is that winning a general vote can be an expensive and uncertain process.
- Lease Purchase Financing (Certificates of Participation) – a city could pledge their general fund revenues for the project under a lease purchase credit facility. To facilitate the financing, the city would pledge one of its essential assets (a fire station, a city hall, a library, etc.) in a lease-lease-back financing agreement, with the general fund being the obligor for the repayment of the debt. The pro is this type of financing is easy, but an asset and general revenues of the city are encumbered by the debt.
- Municipal Equipment Lease – the equipment itself would be the asset under the lease, but the general fund revenues would still be required. Also, term may be shorter than under the lease purchase structure.
- System Revenue Financing – in case of an infrastructure enterprise that generates revenue, the revenue stream can be pledged to secure financing. The pro is that the general fund is not on the hook, but the con is that you need to have revenues in place already, which limits the potential for a new enterprise.

CHAPTER 5:
Task 4: Evaluating Blueprint Programs

This section describes the third stage of the Siemens EV-IF – the final stage for this EV Blueprint – in which the evaluation of programs was established. The process for evaluating these programs was conducted in two steps. The first step was completed through stakeholder engagement to identify a list of city programs that can be implemented to ensure the goals are met through 2030. The second step was to propose detailed plans for each program, so that each program has a clear roadmap toward implementation.

To establish the Blueprint detailed plan that enhances community readiness for the prioritized Blueprint goals, the program plans were developed with stakeholders. The evaluation approach for each program includes a mission statement, a team organization chart, a quarterly workplan, a budgeted resource requirement, a funding plan, and associated risks with mitigation plans. From this basis, the EV Blueprint Team provided the implementation roadmap for The City to use to promote PEV adoption.

The program evaluations are discussed below in fourteen sections: Program Initiatives Overview, 1.0 Program Management Organization (PMO), 2.0 Building Codes, 3.0 Public Payment Standards, 4.0 Streamline EVSE Permit Process, 5.0 Sub-Metering Rules, 6.0 Smart Charger Rules, 7.0 Curbside Regulations , 8.0 PEV-Only Tariffs, 9.0 Vehicle Grid Integration Incentives, 10.0 Charging Data Incentives, 11.0 EVSE Rebates, 12.0 City Fleet Electrification Plan, 13.0 Coordinated Public-Private Partnerships (P3s), and 14.0 City Funded/Owned Charging.

Program Initiatives Overview

The EV Blueprint Team proposes that The City adopts fourteen program initiatives, kicking off January 1st, 2020 together as the EV Blueprint, to ensure Santa Clara is an EV Ready Community through the end of 2030. Program initiatives are designed around the resource requirements from each of The City's departments. However, costs such as equipment capital, equipment operations, and incentives are not included in the program initiative budgets. Furthermore, many of these program initiatives are developing rules and regulations which may require revisiting in future years. Also, certain program initiatives may be developing a plan (i.e., City Fleet Electrification Plan), but the program initiative does not include executing the plan.

Program Initiatives Stakeholder Input

The EV Blueprint Team received input from The City's departments that are a part of each of the fourteen program initiatives. These program initiatives have been designed to address The City's prioritized drivers of the EV Blueprint, as were discussed in the previous section titled Blueprint Goal Development and Selection . The drivers prioritized as level 1 and 2 were considered for program development; these were divided into the two general categories of "increase public charging availability" and "other." Table 24 is a matrix that maps program initiatives to the EV Blueprint prioritized drivers.

Table 24: Program Initiatives to Address Prioritized Goals of the EV Blueprint

EV Blueprint Program Initiatives	Increase Public Charging Availability					Other	
	MUD & Low Inc.	DAC	City	Retail	Other	City Fleet PEV Targets	Electric Grid Modernization
Program Management Organization	x	x	x	x	x	x	x
Building Codes	x	x		x	x		
Public Payment Standards	x	x		x	x		
Streamline EVSE Permit Process	x	x		x	x		
Sub-Metering Rules	x	x		x	x		
Smart Charger Rules							x
Curbside Regulations					x		
PEV-Only Tariffs	x	x		x	x		
Vehicle Grid Integration Incentives	x	x		x	x		
Charging Data Incentives	x	x		x	x		
EVSE Rebate	x	x		x	x		
City Fleet Electrification Plan			x			x	
Coordinated Public-Private Partnerships			x				
City Funded/Owned Charging			x				

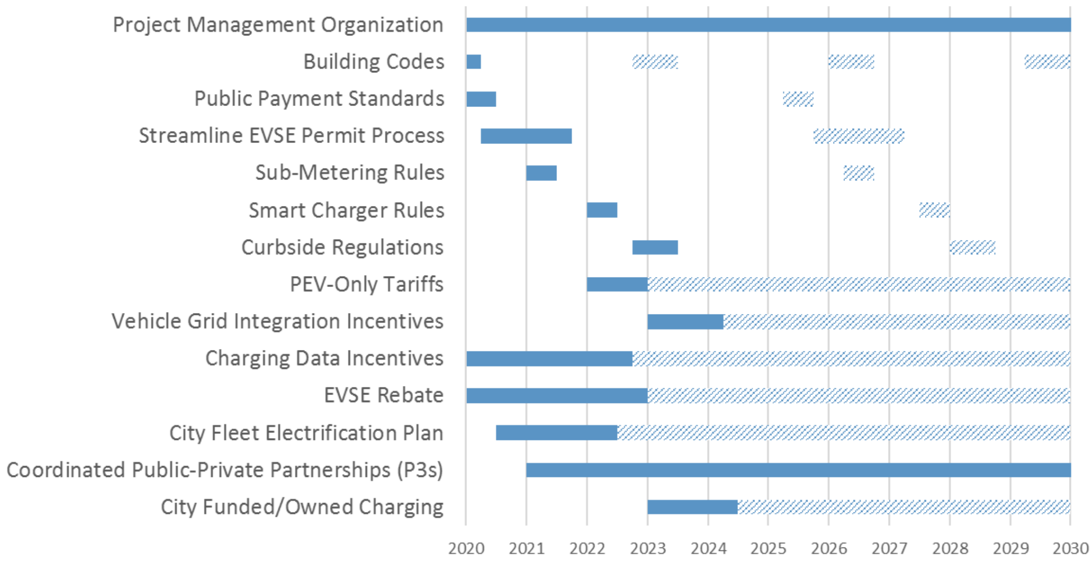
Source: EV Blueprint Team

The programs are designed in a structured order through 2030 to meet these goals.

Program Initiatives Timeline

Certain program initiatives are dependent on the outcome of other program initiatives. Meanwhile, some program initiatives must operate in parallel to guarantee success. While considering the staffing ability and City specific requirements, the EV Blueprint Team has designed the fourteen program initiatives with the timeline illustrated in Figure 77.

Figure 77: City EV Blueprint, Program Initiative Timeline



Source: EV Blueprint Team

Program detailed timelines are included in each of the specific program initiative discussions later in this section. It should be noted that the further out within the EV Blueprint timeline, the less certainty there is in revisiting or continuing the program initiative. Programs have been staffed and budgeted to accomplish the workplans within the timelines shown in solid blue bars. However, any need to revisit a program initiative or continue with the execution of a program initiative is shown in a dashed blue bar; these efforts are not included as a part of the program initiative budget.

Program Initiatives Budget

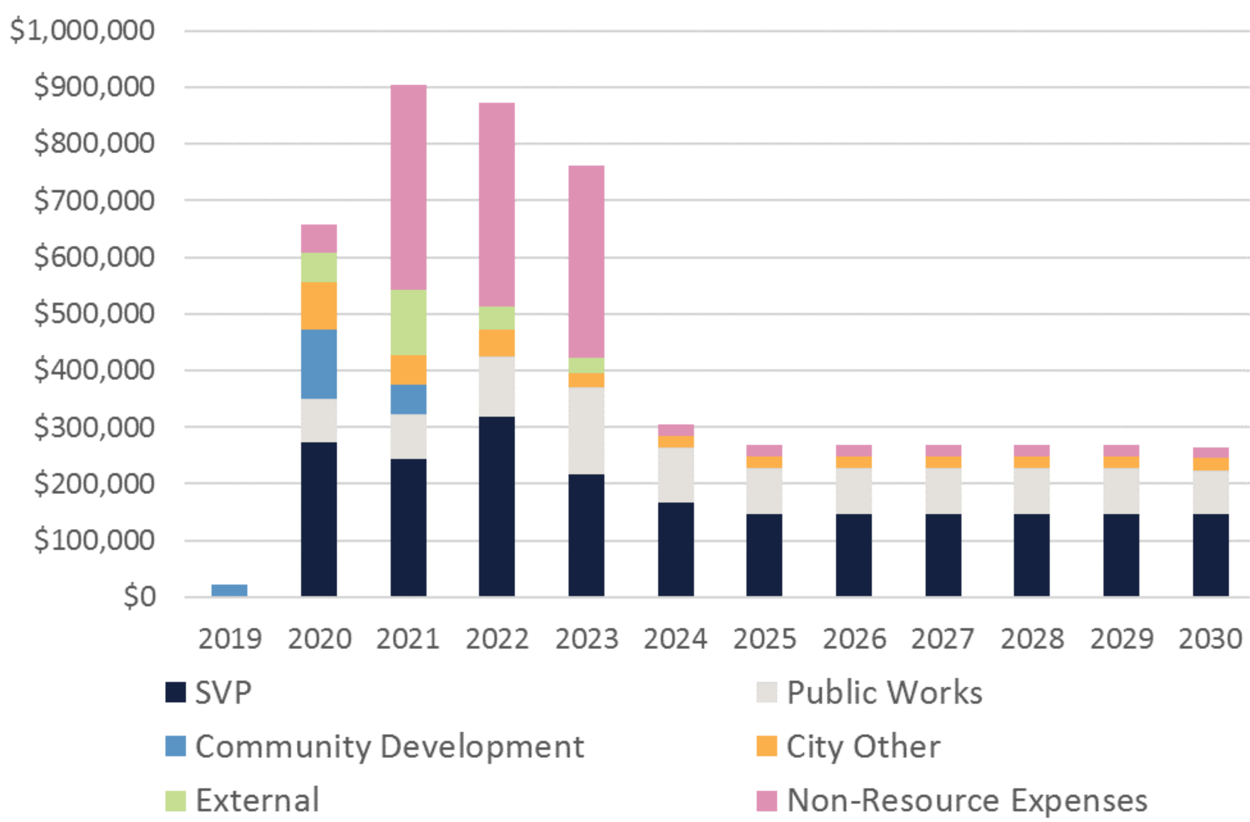
The program initiatives budget is aggregated from the estimate of resources, time, and hourly wages with fringe benefits associated with each program. Table 25 summarizes the overall program initiatives budget estimate, Figure 78 summarizes the annual program initiatives budget by expense type, and Figure 79 summarizes the overall program initiatives budget by expense type.

Table 25: Program Initiatives Total Budget Estimate, $000

Budget	$000
Near Term (2020 – 2021)	1,582
Mid Term (2022 – 2025)	2,209
Long Term (2026 – 2030)	1,343
Total	5,134

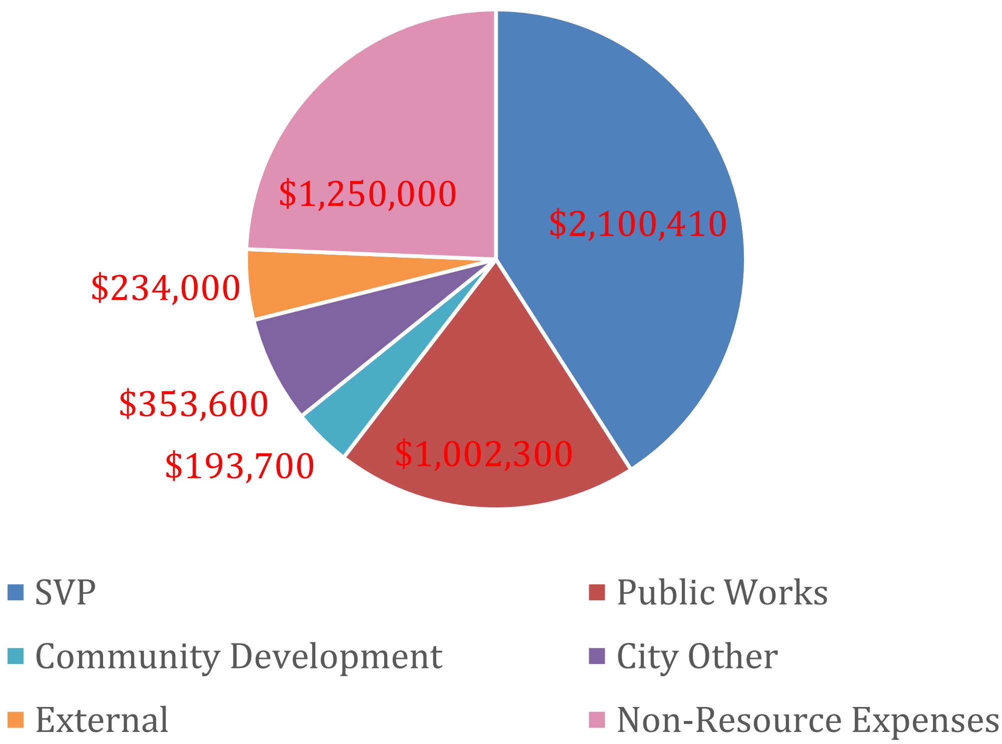
Source: EV Blueprint Team

Figure 78: Program Initiatives Annual Budget Estimate by Expense, $



Source: EV Blueprint Team

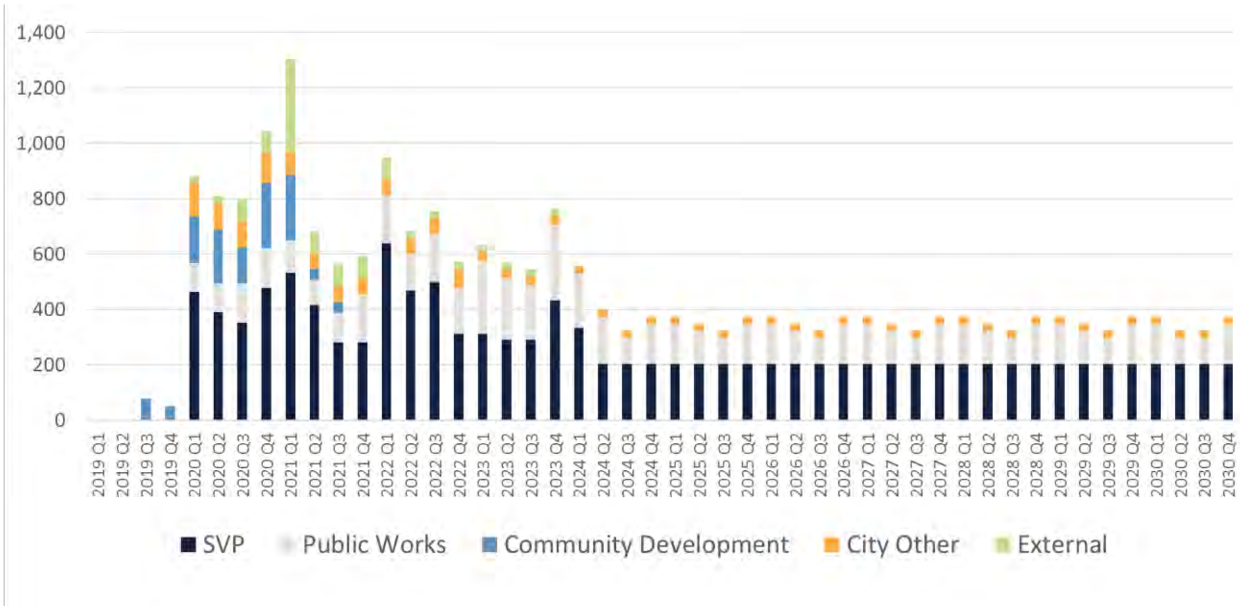
Figure 79: Program Initiatives Total Budget Estimate by Expense, $



Source: EV Blueprint Team

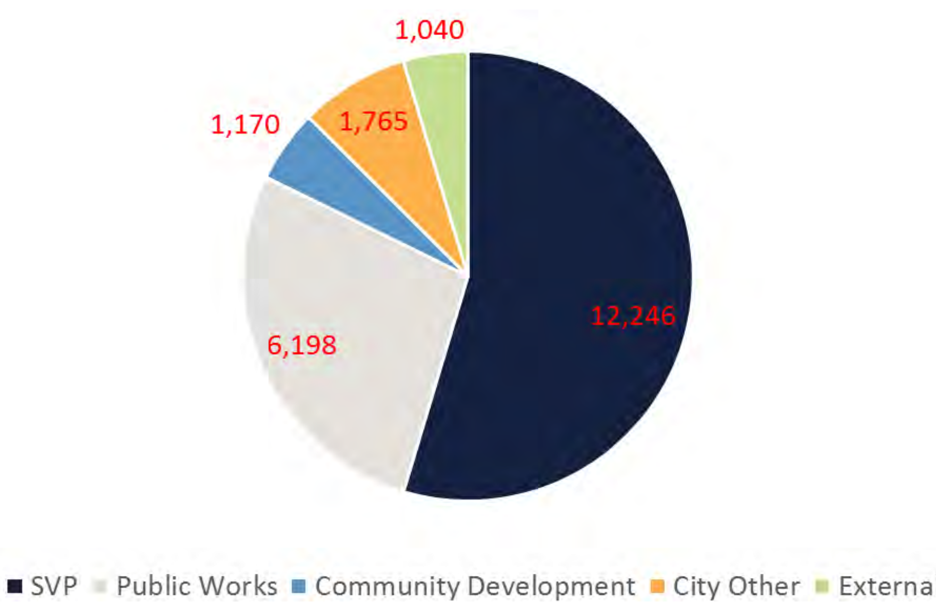
SVP, Public Works, and Community Development are the main contributors to the program initiatives. City Other aggregates city departments such as Finance and Sustainability that have roles for specific program initiatives. External resources such as consultants are required for various program initiatives due to the limited resources and schedule requirements of the program initiatives. Non-Resource Expenses such as customer incentives and capital investments are considered, depending on the specific program initiative. The City plans to use Phase II of the CEC grant funding to support program initiatives; however, funding sources for each program initiative will need to be gathered by The City. Figure 80 illustrates quarterly resource requirements estimated by organization, and Figure 81 shows the total hours estimated by organization, both through 2030.

Figure 80: Program Initiatives Quarterly Resource Requirements Estimated by Organization, # of hours



Source: EV Blueprint Team

Figure 81: Program Initiatives Total Estimated Hours by Organization, # of hours



Source: EV Blueprint Team

Each program initiative is detailed in the remaining Task 4 sections.

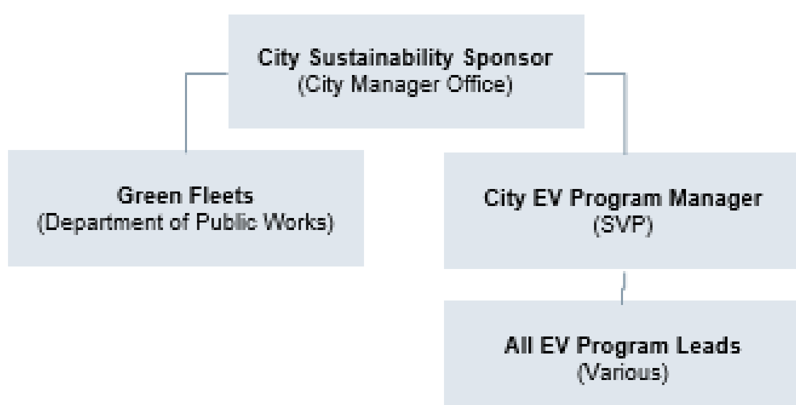
1.0 Program Management Organization (PMO)

The City of Santa Clara EV Blueprint has identified fourteen programs to implement for The City to be an EV Ready Community. Each program will consist of different targets, teams, schedules, and funding. Therefore, the Program Management Organization (PMO) is the glue that ensures the individual successes for each program are aligned with The City's overall strategy for transportation electrification. The PMO is responsible for communications with all stakeholders while mitigating and adapting to risks that arise for each program. The PMO ensures the prioritized drivers of PEV adoption within The City are met by working with each individual program lead on a regular basis.

Team Organization

The City is planning to hire an Assistant to the City Manager for Sustainability who is assumed to take on the role of City Sustainability Sponsor for the PMO. This role is expected to report updates to the city council, internal stakeholders, and external stakeholders for all the PEV Programs within the EV Blueprint. SVP will take on the role of the PMO program manager and staff, responsible for all day to day activities to govern the schedule, funding, communication, and overall success of each program initiative designed in the EV Blueprint. They must have direct communication with all program initiative leads and ensure reporting protocols are in place and met. As needed, they must support individual program teams to mitigate risks and to review findings. Lastly, the role of Green Fleets within the Department of Public Works will take on the role of program communications. The communications staff is responsible for education and marketing for all the program initiatives. This includes, but is not limited to survey distribution, town hall meetings, setting up events, social media, and oversight of all program deliverables that are made public. Figure 82 illustrates an organizational chart for the roles within the PMO.

Figure 82: Program Management Organization, Organization Chart

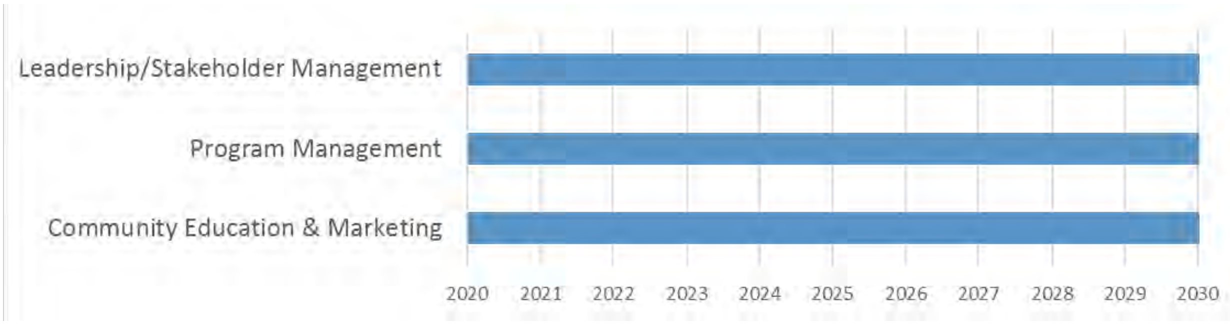


Source: EV Blueprint Team

Workplan

The PMO workplan is straightforward compared to many of the other program initiatives. All workstreams will begin January 1st, 2020 and will continue through 2030. Tasks are categorized into three workstreams: Leadership/Stakeholder Management, Program Management, and Community Education & Marketing. Figure 83 illustrates the workplan with a Gantt chart.

Figure 83: PMO Gantt Chart



Source: EV Blueprint Team

In total, five resources would be required for the PMO Initiative as shown in Table 26.

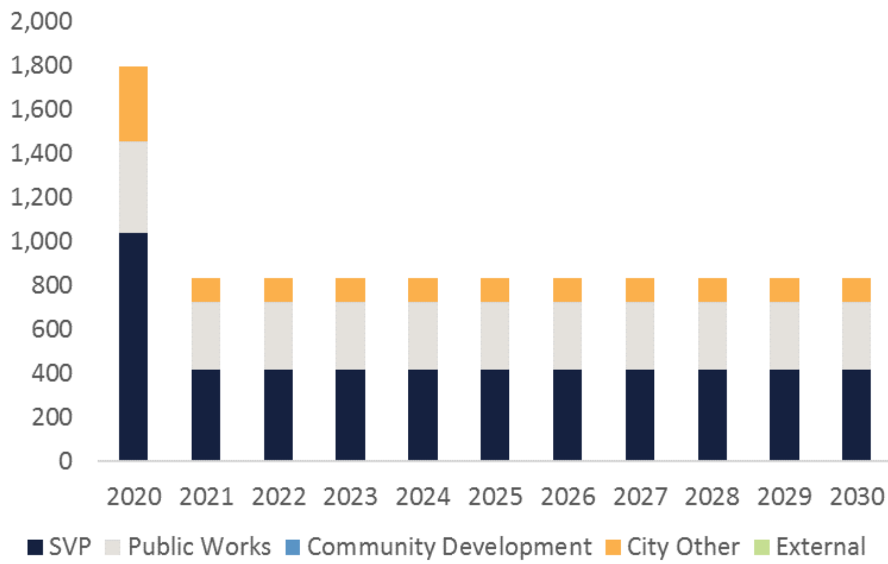
Table 26: PMO Total Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
City Manager's Office	Department Leadership	44	2.4	1,378
SVP	Department Leadership	44	2.5	1,456
SVP	Staff	44	6.5	3,744
Public Works	Staff	44	3.1	1,768
Public Works	Staff	44	3.1	1,768

Source: EV Blueprint

However, resources will be required extensively at the beginning of the program to set the foundation for the program initiatives, then demands are expected to become fairly constant with minor shifts in workload based on the other program initiative timelines. Figure 84 shows each organization's total hourly requirements on an annual basis.

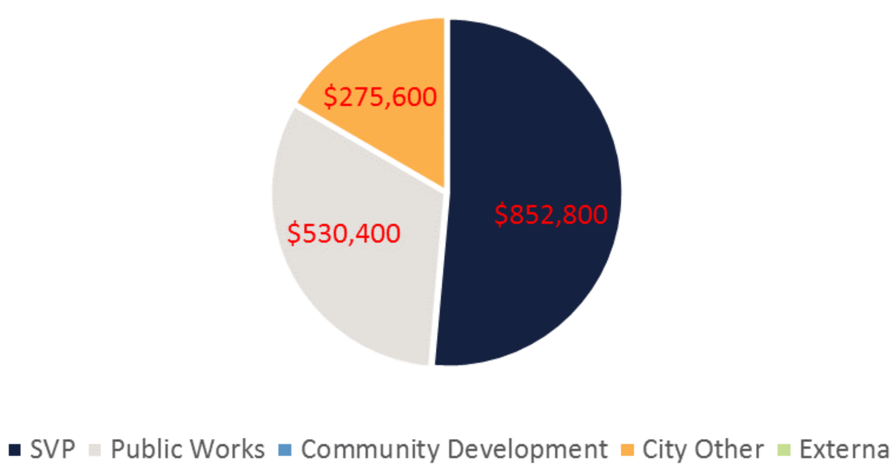
Figure 84: PMO Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the PMO Initiative budget is $1,658,000 and is illustrated by organization in Figure 85.

Figure 85: PMO Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The PMO Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 27.

Table 27: PMO Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
Long Term Funding	3	2	5	Set a months of cash limit to detect fund shortages in advance and ensure programs are staggered and prioritized	Mid
Turn Over of Resources	3	1	4	Ensure processes for PMO are standardized and organized	Low
Managing Contradicting Stakeholder Expectations	2	2	4	Ensure Sponsor is in executive position that can prioritize stakeholder demands and maintain clear communication	Low
Internal Staffing Commitment	2	1	3	Initial set up of the PMO in the near term will require large commitment of internal resources that can be outsourced to external consultants	Low

Source: EV Blueprint Team

2.0 Building Codes

The City may consider adjustments to its existing building codes above and beyond those provided by California to facilitate increased development of electric vehicle charging infrastructure. Los Angeles, Oakland, San Francisco, and Palo Alto, for example, have enacted city-specific new construction codes for one or two family dwellings, MUDs, and/or commercial development.

The intent of the Building Codes Initiative is to determine what, if any, adjustments The City might make to its existing codes to spur development of PEV charging infrastructure. To set a foundation, the program will evaluate The City's current new construction codes. Then The City will review PEV ready code adjustments made by other states and cities, which provide a useful comparison. From this review, The City will consider the pros and cons, including the potential incremental cost for developers, of various code alternatives to arrive at a recommended code refinement for new construction.

The City recognizes that adding code requirements to incentivize EVSE development is easier for new construction than for existing construction, and that since there are far more existing facilities than new ones, finding means to add EVSE code requirements to existing facilities would have a greater impact on EVSE development. Thus, this program will also consider means to add EVSE code requirements to current facilities seeking to update.

This Building Codes Initiative team will compile its recommendations for new and current construction and provide these to leadership to review through the current building code adjustment process. It is anticipated that any local modifications to the building code will be implemented through The City's update process every three years.

Team Organization

The City Community Development Department will have full ownership of the Building Codes Initiative. The program lead is expected to guide the review of EVSE related codes. The lead will provide staff guidance, report progress to the PMO and City Leadership as needed, and ensure appropriate stakeholders are engaged. The building code staff will follow the detailed work plan provided, determining what recommendations should be made to change the EVSE related building codes. The staff will consider means to bring existing facilities into EVSE code compliance. The staff will contact one or more EVSE developers to understand how current codes and any adjustments might impact asset development. Figure 86 illustrates an organizational chart for the roles within the Building Codes Initiative.

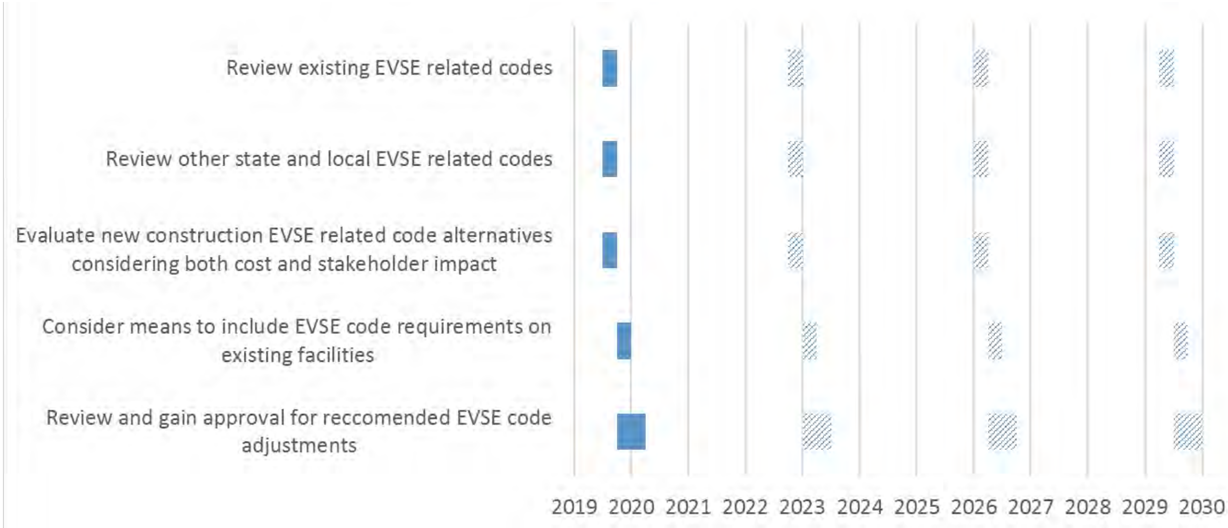
Figure 86: Building Codes, Organization Chart

Source: EV Blueprint Team

Workplan

Due to the schedule of building code updates within California and The City, the Building Codes Initiative must start before the EV Blueprint assumed start date of January 1st, 2020. The City must finalize building code revisions in early 2020; therefore, this initiative needs to begin in July 2019. California building codes are updated every three years, thus there are opportunities every three years to revisit this program initiative as needed. There are five main tasks associated with this initiative, as illustrated in Figure 87 with a Gantt chart.

Figure 87: Building Codes Gantt Chart



Source: EV Blueprint Team

In total, two resources would be required for the Building Codes Initiative as shown in Table 28.

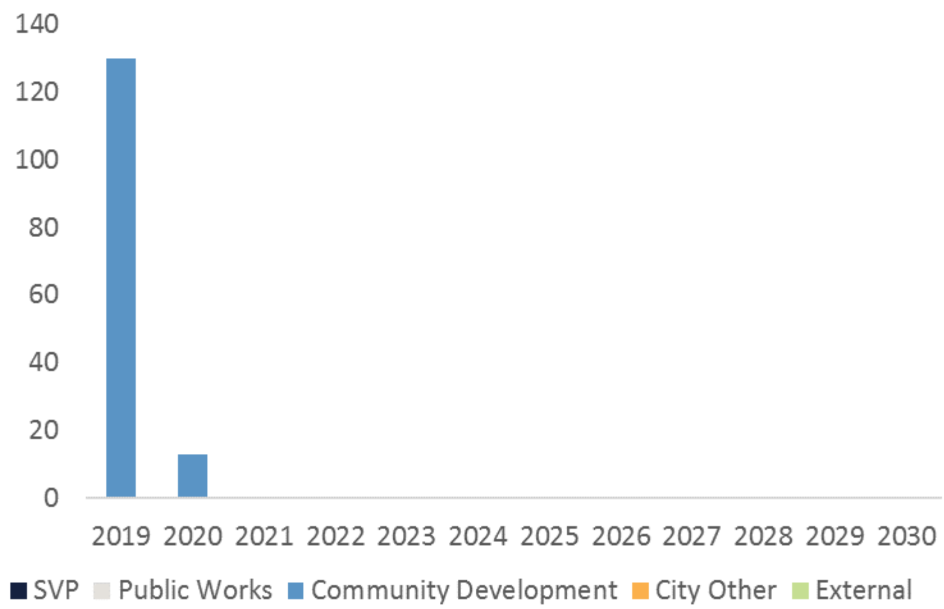
Table 28: Building Codes Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Community Development	Department Leadership	3	1 to 2	39
Community Development	Staff	2	2 to 5	91

Source: EV Blueprint

Figure 88 shows each organization's total hourly requirements on an annual basis.

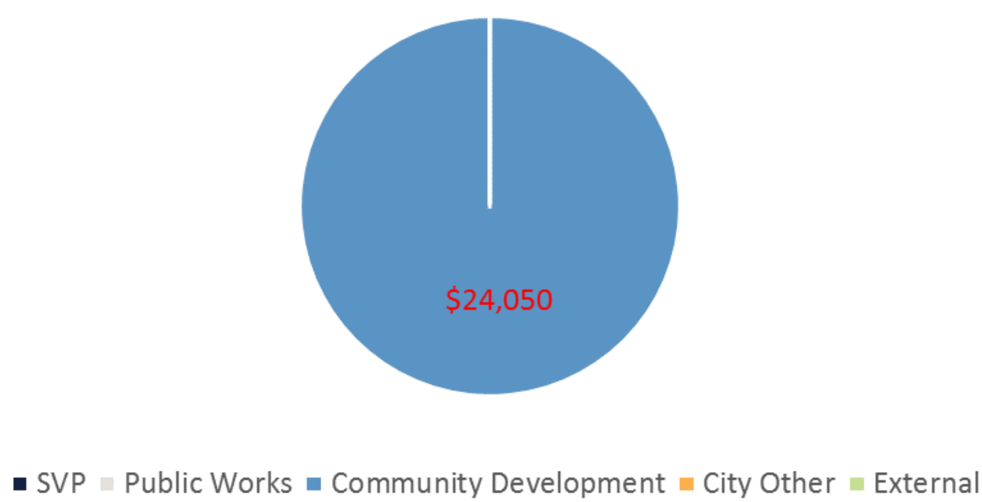
Figure 88: Building Codes Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Building Codes Initiative budget is $24,050 and is illustrated by organization in Figure 89. Note that The City may require an additional $24,050 every three years when the building code requirements are revisited.

Figure 89: Building Codes Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The Building Codes Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 29.

Table 29: Building Codes Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
Resistance from owners of existing facilities to code changes	3	2	5	Develop gradual transition plan to minimize impact/cost to owners.	Low
Time for City Leadership to reach decisions	3	1	4	Identify and map positions of key stakeholders and influencers. Let them know what decision will need to be made, its potential import, and when it will need to be made.	Mid

Source: EV Blueprint Team

3.0 Public Payment Standards

Of the many drivers which can impact the pace of electric vehicle adoption, access to public PEV chargers is one of the most important – and accessibility to such chargers is essential in promoting PEV adoption. Accessibility includes the ability to plug in using standard charging cords as well as the ability to easily pay for charging sessions.

Today's proprietary payment systems require the use of a smart phone and enrollment in the charger operator's database ("membership" is not required, but customers must enter their personal and payment information). Many Californians – particularly those in Disadvantaged Communities – do not own smart phones (only 77% of state residents own one), and cell phone coverage is an issue in many locations (even in urban areas). Also, many people do not want to provide their confidential personal information to a 3rd party. Instead, consumers want to be able to pay using the method of their own choice.

The intent of this program element is to determine whether to adopt the suggested best practice of having a credit/debit card reader available at public charging locations. Over 93% of Californians have credit or debit cards and, therefore, immediate access when such readers are available. For those who rely on cash, they can buy prepaid Visa cards at supermarkets and other locations, making payment access via card readers available to 100% of Californians. Some in the industry contend that contactless payment is the wave of the future and, therefore, should be the basis for PEV charging fees. Below is the analysis by the credit reporting firm, Credit Karma:

> *"Although the technology is widely available, contactless payments are used for only a fraction of U.S. card transactions. The majority of U.S. retailers don't accept contactless*

payments, and the majority of U.S. consumers don't use the technology... The typical consumer making contactless payments is someone comfortable in the digital world, Cohan says. If people are digitally active and use online banking and financial alerts, "they're more likely to use a product like this," he adds.

"Overall, the numbers suggest that digital wallets and contactless payment technologies still have a long way to go before they catch up with other types of payment — at least in the eyes of consumers.

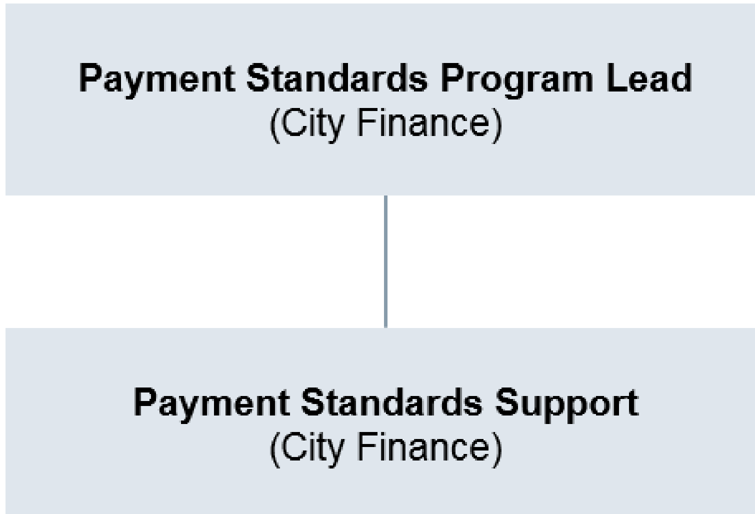
"Only 16 percent of U.S. consumers have used a digital wallet, according to a 2017 survey conducted by Forrester Consulting and commissioned by JPMorgan Chase. According to the report, 46 percent of those surveyed prefer paying with credit cards, while only 15 percent of consumers prefer mobile wallets to other forms of payment."
(Source: Credit Karma)

The intent of this program initiative is to adopt standards to make payment at public charging stations as open and universal as possible. In this initiative, the Public Payments Standards Initiative team will review the availability, costs and benefits, and effectiveness and efficiency of adopting credit/debit card readers for publicly available PEV chargers.

Team Organization

The City Finance Department will lead the Public Payment Standards Initiative. The program lead is expected to guide the review of payment approaches used at publicly available PEV charging stations. This review will include the current market status, potentially applicable State regulations (such as those of the California State Air Resources Board), evolving payment approaches, and access by members of Disadvantaged Communities. The support staff will report progress to the PMO, follow the detailed work plan provided conducting the review, identifying and evaluating improvement alternatives, implementing the agreed solution, and communicating the adopted standards to the public at large as well as local EVSE developers. Figure 90 illustrates an organizational chart for the roles within the Public Payment Standards Initiative.

Figure 90: Public Payment Standards, Organization Chart



Source: EV Blueprint Team

Workplan

A decision on universal public payments standards needs to be made soon so that as The City installs public chargers, they can meet whatever standard is determined. This initiative starts at the beginning of the EV Blueprint timeline in January 2020, and the initiative is expected to be completed by July 2020. This public payment standards decision may be revisited five years after completion to determine if an update is required. There are seven main tasks associated with this initiative as illustrated in Figure 91 with a Gantt chart.

Figure 91: Public Payment Standards Gantt Chart

Source: EV Blueprint Team

In total, two resources would be required for the Public Payment Standards Initiative as shown in Table 30.

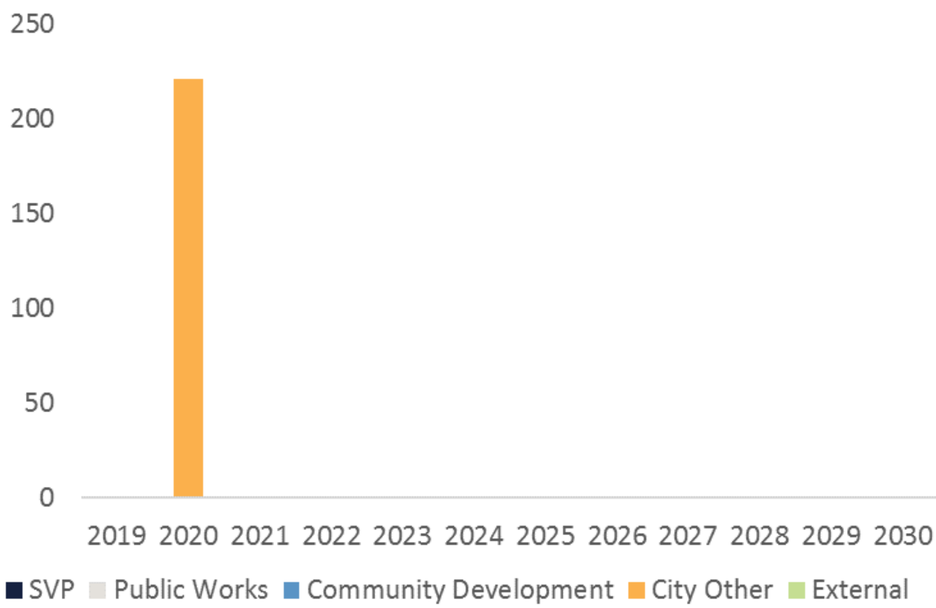
Table 30: Public Payment Standards Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
City Finance	Department Leadership	2	2 to 4	78
City Finance	Staff	2	3 to 8	143

Source: EV Blueprint

Figure 92 shows each organization's total hourly requirements on an annual basis.

Figure 92: Public Payment Standards Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Public Payment Standards Initiative budget is $37,050 and is illustrated by organization in Figure 93. Note that The City may require an additional $37,050 if The City decides to revisit the initiative in 2025.

Figure 93: Public Payment Standards Budget by Organization, $

Source: EV Blueprint Team

Risks/Mitigations

The Public Payment Standards Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 31.

Table 31: Public Payments Standards Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
New payment methods may be introduced in the market that need to be evaluated	1	1	2	The Staff should consult with external experts regarding new payment methods. This can be done by reaching out to EVSE manufacturers.	Low
New Federal or State regulations could be introduced during the evaluation that could complicate the analysis	3	1	4	The Staff should consult with external regulatory experts and contact the relevant Federal or State agency for clarification.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	The City may need an external consultant to lead the effort and reduce the workload required of City Staff. The Staff would still be required to provide expertise.	Low

Source: EV Blueprint Team

4.0 Streamline EVSE Permit Process

Of the many drivers which can impact the pace of electric vehicle adoption, the availability of electric vehicle chargers (EVSE) is key and one which The City can impact. One important way The City can speed the development of EVSE, while lowering the cost and business risk, is to refine its EVSE permitting process.

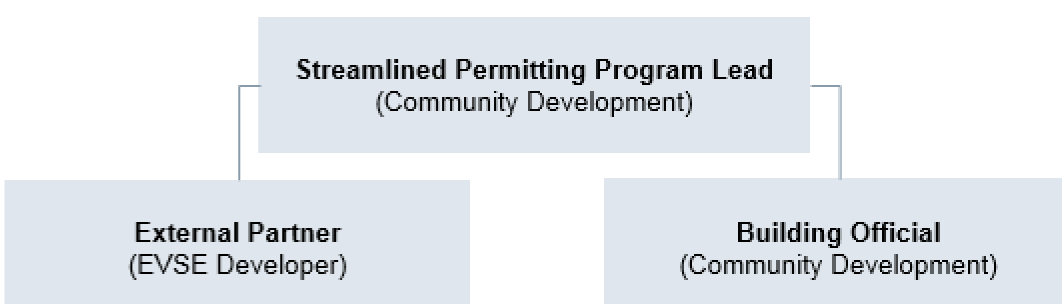
The intent of this program is to shorten the time required to gain an EVSE permit and to clarify the roles and responsibilities of The City and the EVSE developer. A revised process should inform the EVSE developer what documents must be filed, the information required in order to file for a permit, and the approximate time The City requires to evaluate the application. Reducing uncertainty for the EVSE developer reduces the perceived development risk and EVSE cost.

In this program the Streamline EVSE Permit Process Initiative team will review the existing EVSE permitting process effectiveness and efficiency, evaluate similar processes employed by other municipalities, agree to process and documentation improvements, and proactively provide these to local EVSE developers.

Team Organization

The City Community Development Department will have full ownership of the Streamline EVSE Permit Process Initiative. The program lead is expected to guide the review and improvement of the EVSE permitting process. The lead will provide staff guidance, report progress to the PMO and City Leadership as needed, ensure appropriate stakeholders are engaged in the process review and refinement, and ensure the revised process and documents are posted for public use and directly provided to known local EVSE developers to ensure awareness of any changes. The building official staff will follow the detailed work plan provided conducting the review, identifying and evaluating improvement alternatives, recommending changes to Leadership, implementing any agreed process and/or documentation improvements, and communicating the revised process to the public at large as well as local EVSE developers. Figure 94 illustrates an organizational chart for the roles within the Streamline EVSE Permit Process Initiative.

Figure 94: Streamline EVSE Permit Process, Organization Chart



Source: EV Blueprint Team

Workplan

With limited resource, the Community Development Department will kick off the Streamline EVSE Permit Process Initiative, beginning in quarter two of 2020, after completion of the Building Codes Initiative. The initiative is expected to be completed in one and a half years. This streamlined permitting process may be revisited five years after completion to determine if an update is required. There are six main tasks associated with this initiative as illustrated in Figure 95 with a Gantt chart.

Figure 95: Streamline EVSE Permit Process Gantt Chart

Source: EV Blueprint Team

In total, three resources would be required for the Streamline EVSE Permit Process Initiative as shown in Table 32.

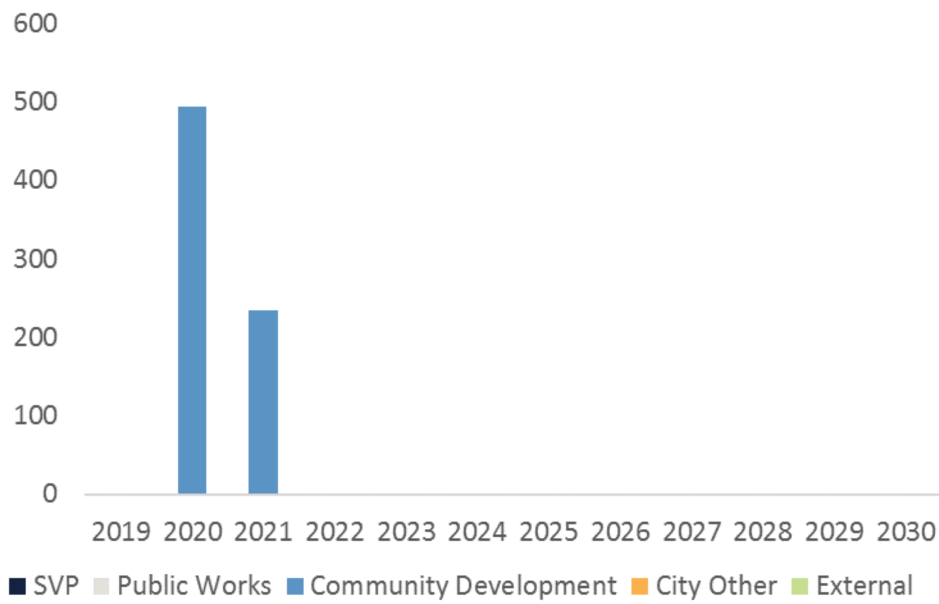
Table 32: Streamline EVSE Permit Process Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Community Development	Department Leadership	6	1 to 6	234
Community Development	Staff	6	6 to 8	286
Community Development	Staff	6	6 to 8	286

Source: EV Blueprint

Figure 96 shows each organization's total hourly requirements on an annual basis.

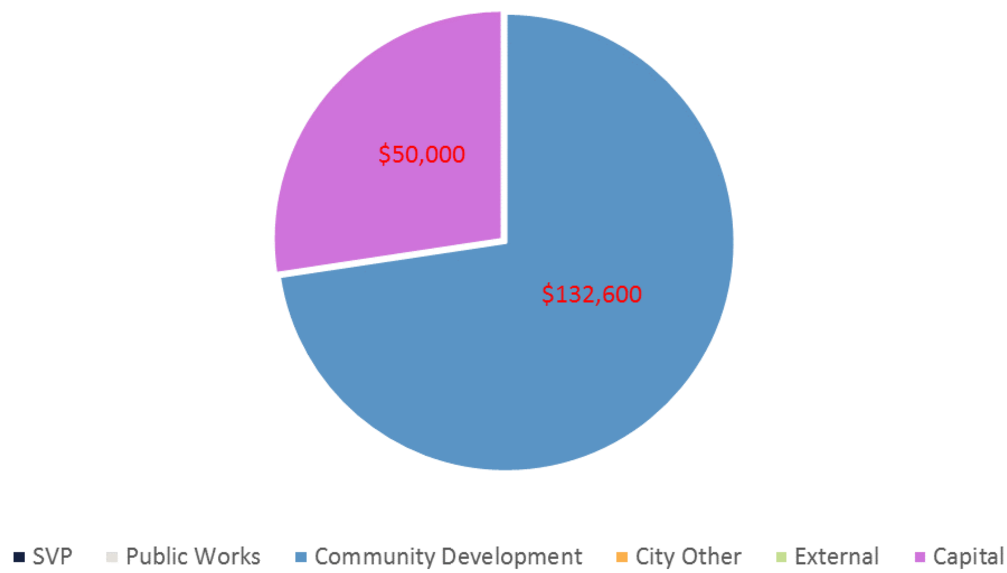
Figure 96: Streamline EVSE Permit Process Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Streamline EVSE Permit Process Initiative budget is $182,600 and is illustrated by organization in Figure 97. Within this budget is an assumed $50,000 of capital investment for website and software architecture upgrades that are required for the streamlined permitting. Note that The City may require an additional $182,600 if The City decides to revisit the initiative in 2025.

Figure 97: Streamline EVSE Permit Process Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The Streamline EVSE Permit Process Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 33.

Table 33: Streamline EVSE Permit Process Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
There may be several EVSE permitting processes to review, each for different applications which could take more time/cost to assess	2	1	3	The number of processes and the degree to which they may differ (at a high level) should be assessed before the project starts so that timing and effort can be adjusted if needed.	Low
City Staff may not be able to dedicate the time needed for this project given the current workload	2	1	3	The City may need an external consultant to lead the effort and reduce the workload required of City Staff. The Staff would still be required to provide expertise.	Low
At present, the number and impact of internal stakeholders that might be influenced by a process change are believed to be minimal. However, if the permit process impacts a large number of stakeholders, more time/effort may be required to gather their requirements and assess any change impact.	2	1	3	The number of internal stakeholders and their impact on/from the process and any change should be assessed early in the project sot that timing and effort can be adjusted is needed.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	The City may need an external consultant to lead the effort and reduce the workload required of City Staff. The Staff would still be required to provide expertise.	Low

Source: EV Blueprint Team

5.0 Sub-Metering Rules

Use of sub-meters in EVSE for billing of tariffs, for informational purposes only, or both can be a powerful driver for PEV benefits and PEV adoption. In this work effort, SVP will evaluate sub-metering in EVSE and recommend whether or not to mandate sub-metering for either SVP charger purchases, or rebate programs for customers, or both. In the event sub-metering is mandated, this effort will also identify the needed features and applicable standards.

Most PEV chargers sit behind utility meters that measure consumption for the entire premise, whether commercial or residential. In contrast, metering consumption of only the PEV charger achieves three key benefits:

- *Customers can charge PEVs at low off-peak prices on time-varying rates without exposing the home or business to price volatility*

- *PEV drivers know exactly how much they are paying to charge their vehicles, because the bill is separate from the premise bill*
- *PEV owners can earn dollars and help the grid by participating in demand response programs*

Without using a sub-meter, separate metering is required to achieve these benefits. Separate metering with a standard meter requires installation of a separate service, meter socket, and meter, typically costing $500 to $1,500 or more. This negates the business case.

Sub-metering solves this problem. Most PEV chargers come equipped with a sub-meter that measures PEV charging consumption. This sub-meter can be used for billing or calculating demand response payments, providing the charger has communications to send the data back to the utility (either directly or through a 3rd party EVSP). Also, the sub-meter must be certified for accuracy. Such certification is typically done according to rules established by utilities, though regulatory approval is required in some states.

San Diego Gas & Electric and Xcel Energy in Minnesota are operating successful programs and billing PEV tariffs using sub-meter data. This includes having detailed accuracy certification and testing programs that charger vendors have had to pass. Challenges have included integration with the utility billing system and delivering data from 3rd parties in the proper format at the correct times. An available open standard for transferring the consumption data between parties is the Green Button data format adopted by the North American Energy Standards Board.

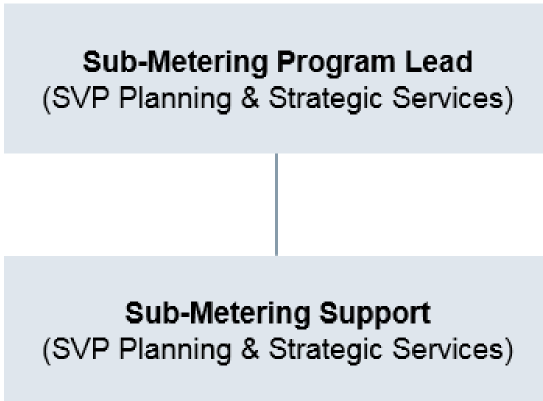
Two areas of standards may apply to sub-meters. While these standards exist, there is no federal mandate to use them; it is up to utilities or regulators to adopt them for use in billing within specific geographies. Utilities use American National Standards Institute (ANSI) standards as the basis for revenue meter accuracy, specifically ANSI C12.20 for electronic meters, including "smart" meters. This standard calls for +/- 0.5 percent accuracy for residential and most commercial meters. Non-utility building and property owners use sub-meters widely for multi-tenant situations such as apartment buildings and mobile-home parks, typically meeting the accuracy requirement of ANSI C12.1, which is +/- 1.0 percent. Regarding PEV chargers specifically, the National Institute of Standards and Technology (NIST) has developed a standard that, like the ANSI standards, may be voluntarily adopted.

The intent of this program element is to evaluate sub-metering with respect to billing of tariffs, informational purposes, or both. The Sub-Metering Rules Initiative team will recommend whether or not to mandate sub-metering for either SVP charger purchases, or rebate programs for customers, or both.

Team Organization

SVP will have full ownership of the Sub-Metering Rules Initiative. The program lead is expected to guide the analysis of sub-metering and the consideration of business and customer needs that could be met through the adoption of sub-metering, specifically whether sub-meters should be considered for tariff billing, demand response payment calculation, information only, or some combination of these. The program lead will also provide principles for use by staff in conducting the evaluation and report progress to the PMO. SVP planning staff will follow the detailed work plan provided conducting the review, identifying and evaluating alternatives, implementing the agreed solution, and communicating the result to the SVP Operations and Procurement staff as well as local EVSE developers. Figure 98 illustrates an organizational chart for the roles within the Sub-Metering Rules Initiative.

Figure 98: Sub-Metering Rules, Organization Chart

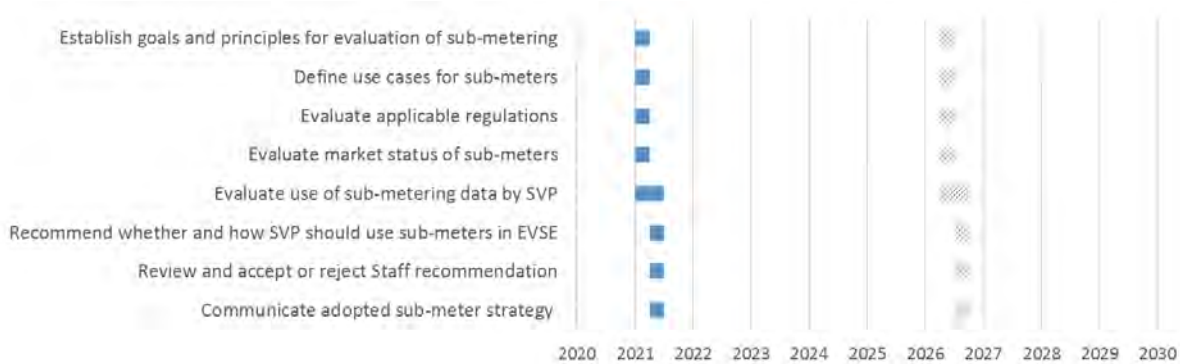


Source: EV Blueprint Team

Workplan

The Sub-Metering Rules Initiative is planned to begin January 2021 and be completed by July 2021. The sub-metering rules recommendations may be revisited five years after completion to determine if an update is required. There are eight main tasks associated with this initiative as illustrated in Figure 99 with a Gantt chart.

Figure 99: Sub-Metering Rules Gantt Chart



Source: EV Blueprint Team

In total, three resources would be required for the Sub-Metering Rules Initiative as shown in Table 34.

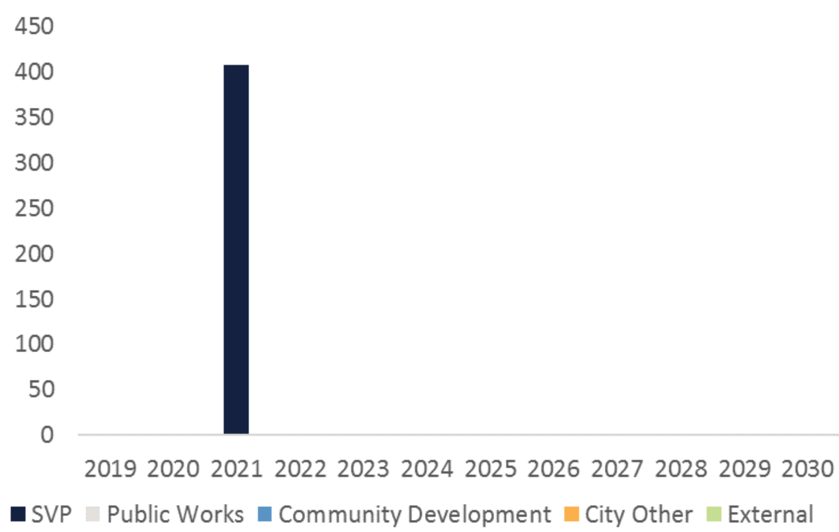
Table 34: Sub-Metering Rules Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Silicon Valley Power	Department Leadership	2	3	70
Silicon Valley Power	Staff	2	3 to 8	119
Silicon Valley Power	Staff	2	3 to 8	119

Source: EV Blueprint

Figure 100 shows each organization's total hourly requirements on an annual basis.

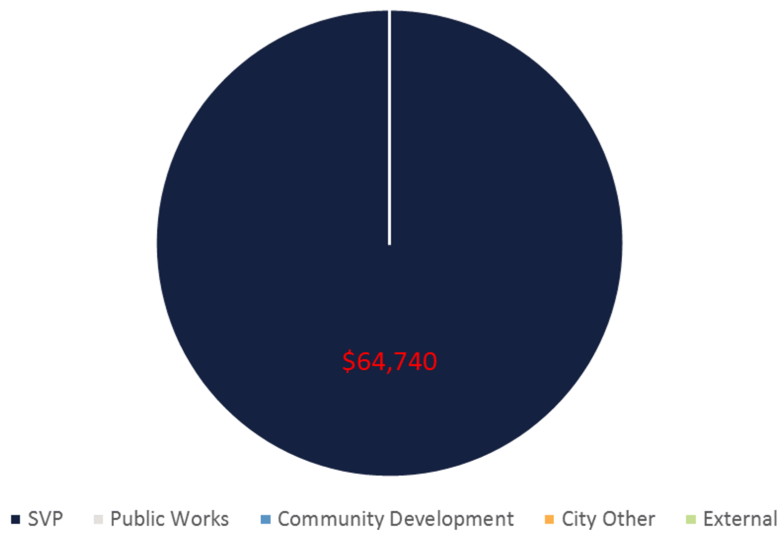
Figure 100: Sub-Metering Rules Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Sub-Metering Rules Initiative budget is $64,740 and is illustrated by organization in Figure 101. Note that The City may require an additional $64,740 if The City decides to revisit the initiative in 2026.

Figure 101: Sub-Metering Rules Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The Sub-Metering Rules Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 35.

Table 35: Sub-Metering Rules Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
New sub-meter solutions may be introduced in the market that need to be evaluated	1	1	2	The Staff should consult with external experts regarding new sub-meter solutions. This can be done by reaching out to EVSE manufacturers.	Low
New Federal or State regulations could be introduced during the evaluation that could complicate the analysis	3	1	4	The Staff should consult with external regulatory experts and contact the relevant Federal or State agency for clarification.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	SVP may need an external consultant to lead the effort and reduce the workload required of SVP Staff. The Staff would still be required to provide expertise.	Low
New data protocols or communication standards could be adopted by EVSE manufacturers	3	1	4	SVP may need an external consultant to analyze the new standards and determine whether they should be considered for use. The Staff would still be required to provide expertise.	Low

Source: EV Blueprint Team

6.0 Smart Charger Rules

The City's goals for transportation electrification include stimulating the market and putting adoption of PEVs on a self-sustaining path. One such policy toward achieving these goals is that chargers should be smart, that is, sub-metered and networked – capable of measuring charging consumption and of communications with a charging management platform, a customer app, and utility grid management software. This is especially true for the residential and workplace sectors where drivers can derive "fuel benefits" by charging during hours when there is surplus energy in the market making the "fuel" especially cheap. Such smart infrastructure in the future may also support the grid by feeding back spare capacity through vehicle to grid (V2G) power flows.

Managed charging enabled by smart chargers can become a key part of SVPs demand response portfolio and strategies for integrating additional intermittent renewable resources to the grid. When the timing and intensity of charging vehicles are effectively managed, the benefits include:

- *Transmission and distribution grid services that can reduce congestion, defer infrastructure upgrades and provide resiliency to grid operators*
- *Wholesale system services to supply capacity as well as ancillary services such as frequency response and imbalance energy*

- *Emissions reduction benefits by aligning charging with surplus renewable generation, and minimizing the need for peaking generation*
- *Economic returns to PEV owners through access to lower-cost dynamic, off-peak rates and potential payments for the supply of wholesale system services*
- *Economic benefits to all utility customers through the grid efficiencies captured by managed charging, specifically the greater throughput of electricity through the transmission and distribution networks – as long as it occurs off peak and, therefore, does not require network upgrades*

Passive managed charging (also known as behavioral load shifting) relies on customer behavior to affect charging patterns. For example, PEV time-of-use rates provide predetermined price signals to customers to incentivize them to charge off-peak.

Active managed charging (also known as direct load control) relies on communication (i.e., "dispatch") signals originating from a utility or aggregator to be sent to a vehicle or charger to control charging in a predetermined specific way. The communications signals used in managed charging can adjust the time and/or rate of charge (both load curtailment and load increase), relative to a baseline. In this way, active managed charging is a form of demand response. Further, these controls can be leveraged by utilities, load balancing authorities via aggregators, or other 3rd parties to provide grid services, such as capacity, emergency load reduction, regulation, or to absorb excess generation from renewable energy resources, like solar and wind.

Some managed charging is currently, and will continue to be, achieved through a passive approach, generally relying upon customer behavior as a means of changing charging patterns. Customer behavior is generally influenced by time-of-use rates or other incentives for the vehicle owner to use an on-board vehicle computer to set charging at times that align with utility grid management goals. Over time active managed charging is expected to grow.

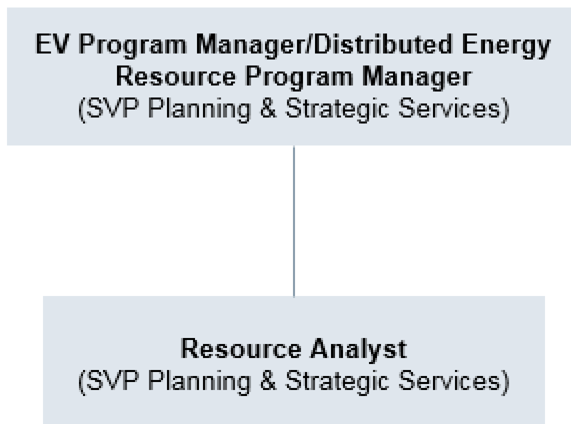
Managed charging relies upon a reliable two-way flow of information through a variety of communications technologies (such as Wi-Fi, cellular and AMI) from the charger to the utility or aggregator. A critical strategy is the need to use open protocols for the communications in order to avoid obsolescence, enable interoperability between technologies sourced from different vendors, and preventing vendor lock-in with a proprietary solution. There are open protocols for the transport of the information as well as open protocols for the messaging (the instructions for the required actions). For managed charging to work, different devices and systems, whether in the vehicle or within the charging infrastructure, must be able to communicate freely, unhindered by closed or proprietary protocols.

This initiative within The City's overall program identifies the goals and requirements of smart charging so that The City and SVP can incentivize and promote smart charging, whether through their own purchases of EVSE or providing rebates for EVSE purchases by customers or 3rd parties.

Team Organization

SVP will have complete ownership of the Smart Charger Rules Initiative. The program lead, SVP's Distributed Energy Resource Program Manager, will guide the analysis of smart charging and the consideration of business and customer needs that could be met through the adoption of smart charging, specifically whether smart charging should be promoted or incentivized. The program lead will provide principles for use by the resource analysts in conducting the evaluation and report progress to the PMO. SVP resource analysts will follow the detailed work plan provided conducting the review, identifying and evaluating alternatives, implementing the agreed solution, and communicating the result to the SVP Operations and Procurement staff as well as local EVSE developers. Figure 102 illustrates an organizational chart for the roles within the Smart Charger Rules Initiative.

Figure 102: Smart Charger Rules, Organization Chart

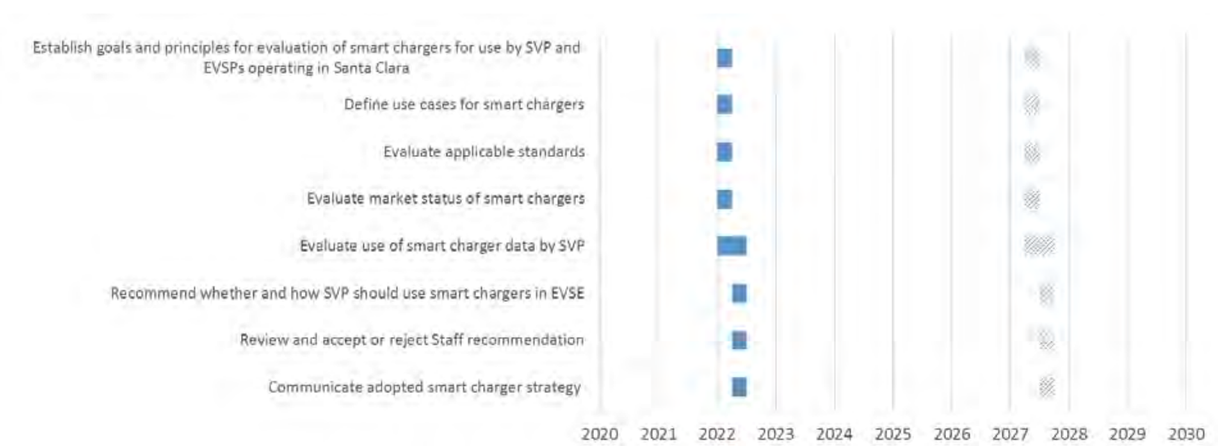


Source: EV Blueprint Team

Workplan

The Smart Charger Rules Initiative is planned to begin in January of 2022 and take place over a six month period. The smart charger rules may be revisited five years after completion to determine if an update is required. There are eight main tasks associated with this initiative as illustrated in Figure 103 with a Gantt chart.

Figure 103: Smart Charger Rules Gantt Chart



Source: EV Blueprint Team

In total, three resources would be required for the Smart Charger Rules Initiative as shown in Table 36.

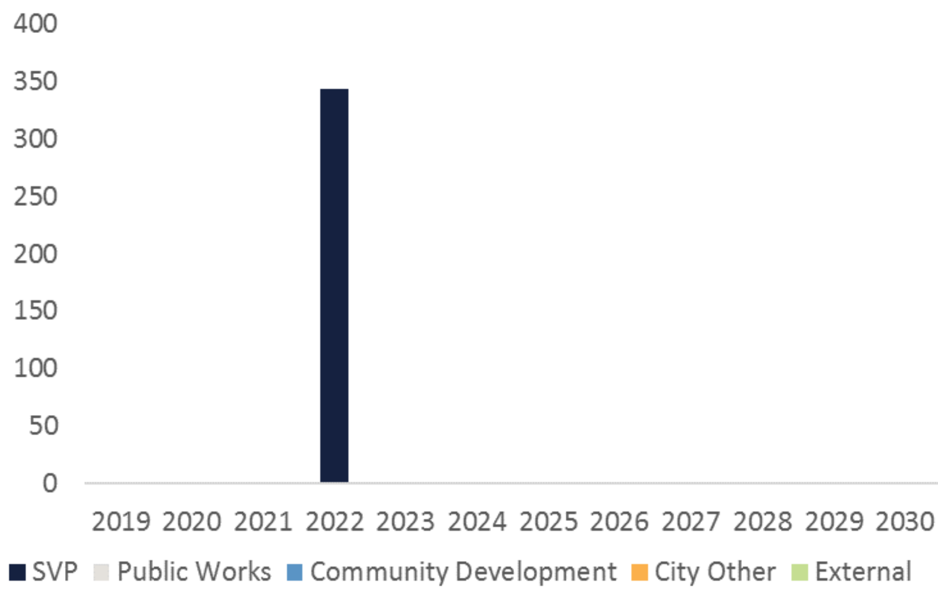
Table 36: Smart Charger Rules Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Silicon Valley Power	Department Leadership	2	2 to 3	73
Silicon Valley Power	Staff	3	3 to 6	151
Silicon Valley Power	Staff	3	3 to 6	151

Source: EV Blueprint

Figure 104 shows each organization's total hourly requirements on an annual basis.

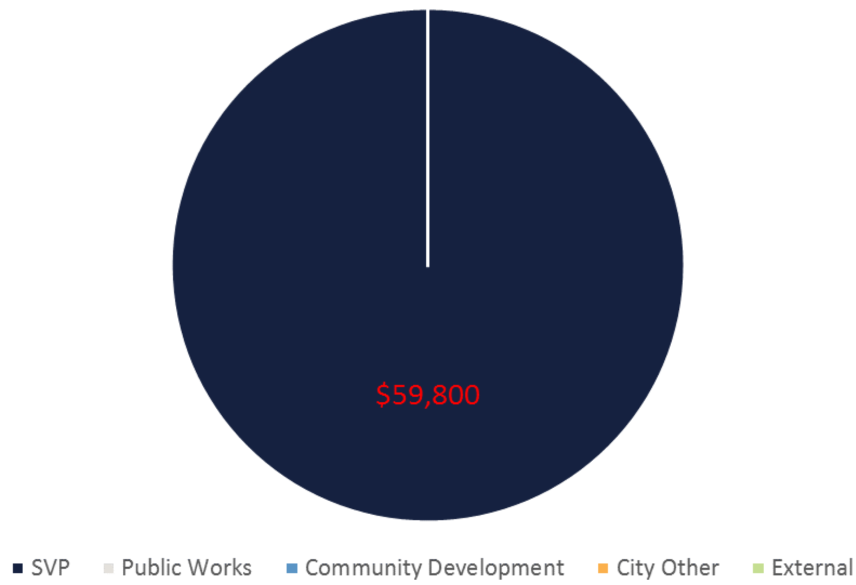
Figure 104: Smart Charger Rules Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Smart Charger Rules Initiative budget is $59,800 and is illustrated by organization in Figure 105. Note that The City may require an additional $59,800 if The City decides to revisit the initiative in 2027.

Figure 105: Smart Charger Rules Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The Smart Charger Rules Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 37.

Table 37: Smart Charger Rules Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
New smart charger solutions may be introduced in the market that need to be evaluated	1	2	3	The Staff should consult with external experts regarding new smart charger solutions. This can be done by reaching out to EVSE manufacturers.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	SVP may need an external consultant to lead the effort and reduce the workload required of SVP Staff. The Staff would still be required to provide expertise.	Low
New data protocols or communication standards could be adopted by EVSE manufacturers	3	1	4	SVP may need an external consultant to analyze the new standards and determine whether they should be considered for use. The Staff would still be required to provide expertise.	Low
New smart charger solutions may be introduced in the market that need to be evaluated	1	1	2	The Staff should monitor industry announcements and developments through following industry sources such as Utility Dive.	Low

Source: EV Blueprint Team

7.0 Curbside Regulations

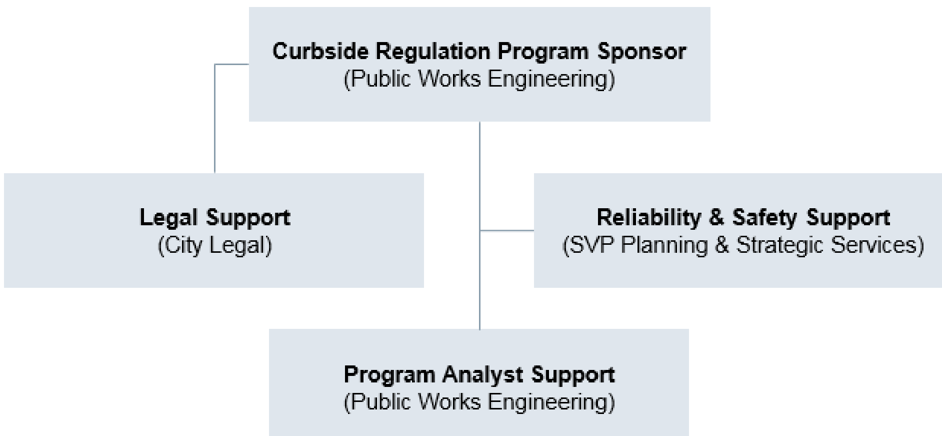
Of the many drivers which can impact the pace of electric vehicle adoption, availability of public PEV chargers is one of the most important. Today, chargers are available at homes, some workplaces, some public facilities such as libraries, some parking garages, and similar locations. A major area of potential opportunity is curbside charging, both in commercial districts where parking is normally metered, as well as in residential areas where a homeowner may desire charging capability.

The intent of this program initiative is to determine what regulations The City should adopt for the installation of EVSE at curbside locations, including whether private parties should be able to install curbside chargers. The Curbside Regulations Initiative team will include a review of what other cities are doing and which of their regulations, if any, should be adopted by The City.

Team Organization

The Public Works Department will lead the Curbside Regulations Initiative with support from SVP and The City Legal Department. The program lead is expected to guide the review of curbside regulations for charging, including specifying goals such as safety and aesthetics of appearance, and report progress to the PMO. The program analyst support will follow the detailed work plan provided, conducting the review, identifying and evaluating alternatives, recommending the agreed regulation, and communicating the adopted regulation to the public at large as well as local EVSE developers. The reliability and safety support staff will participate in the evaluation from the perspective of ensuring electrical safety and reliability. Since regulatory recommendations may be implemented, The City Legal Department will review the proposed curbside charger regulation prior to adoption by the Public Works Engineering Department. Figure 106 illustrates an organizational chart for the roles within the Curbside Regulation Initiative.

Figure 106: Curbside Regulations, Organization Chart

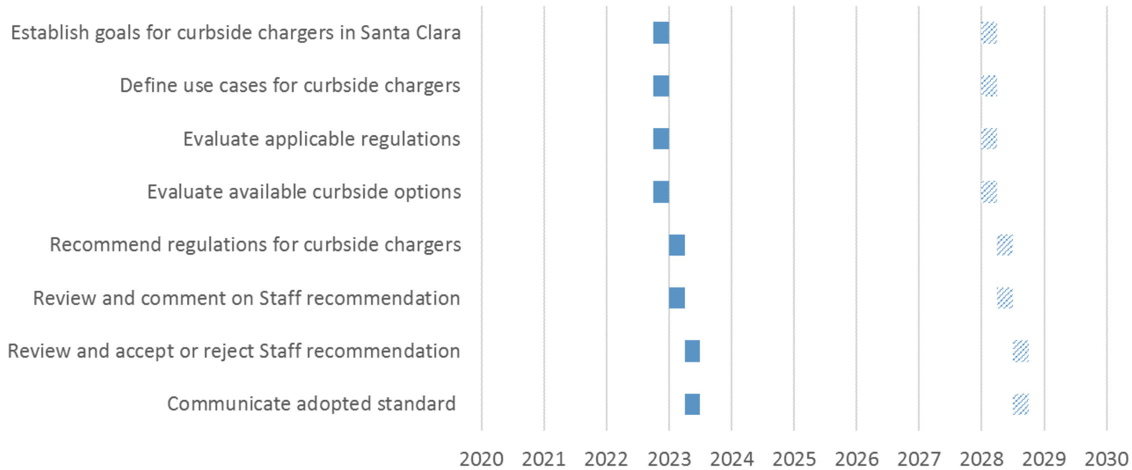


Source: EV Blueprint Team

Workplan

The Curbside Regulation Initiative is planned to begin in the last quarter of 2022 and be completed within nine months midway through 2023. The curbside regulations may be revisited five years after completion to determine if an update is required. There are eight main tasks associated with this initiative as illustrated in Figure 107 with a Gantt chart.

Figure 107: Curbside Regulations Gantt Chart



Source: EV Blueprint Team

In total, four resources would be required for the Curbside Regulation Initiative as shown in Table 38.

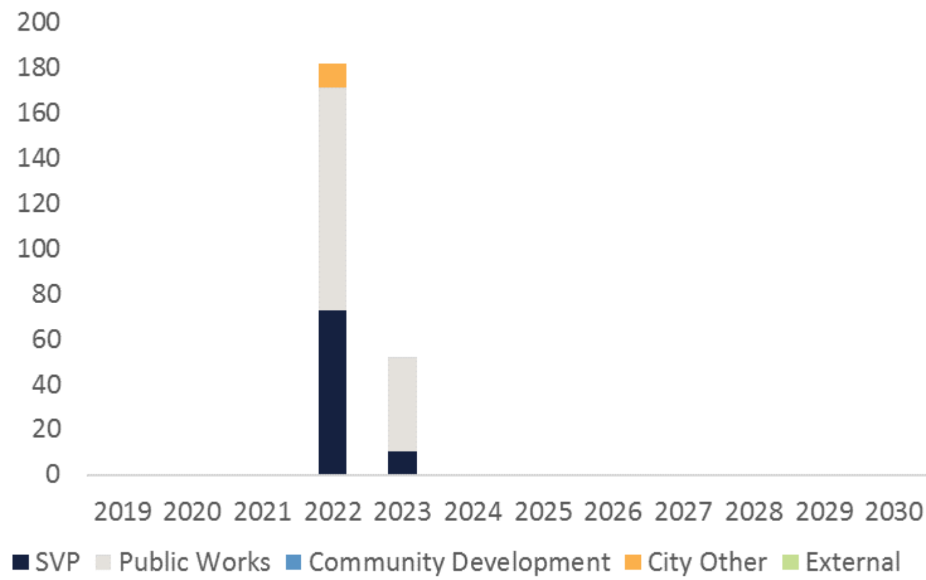
Table 38: Curbside Regulations Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Public Works	Department Leadership	2	2 to 3	57
Public Works	Staff	3	2 to 4	84
Silicon Valley Power	Staff	3	2 to 4	84
City Other	Legal	1	1	10

Source: EV Blueprint

Figure 108 shows each organization's total hourly requirements on an annual basis.

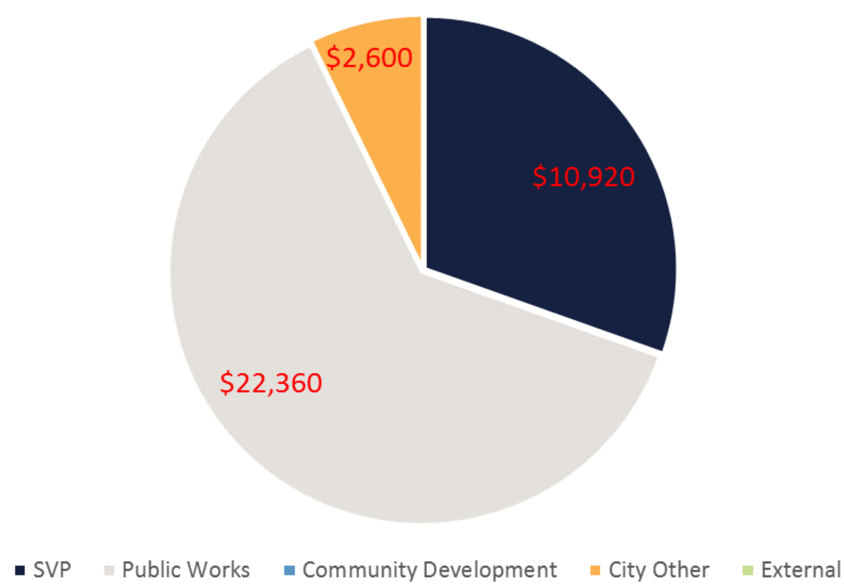
Figure 108: Curbside Regulations Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Curbside Regulations Initiative budget is $35,800 and is illustrated by organization in Figure 109. Note that The City may require an additional $35,800 if The City decides to revisit the initiative in 2028.

Figure 109: Curbside Regulations Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The Curbside Regulations Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 39.

Table 39: Curbside Regulations Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
New curbside charging methods may be introduced in the market that need to be evaluated	2	1	3	The Staff should consult with external experts regarding new payment methods. This can be done by reaching out to EVSE manufacturers.	Low
New Federal or State regulations could be introduced during the evaluation that could complicate the analysis	3	1	4	The Staff should consult with external regulatory experts and contact the relevant Federal or State agency for clarification.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	The City may need an external consultant to lead the effort and reduce the workload required of City Staff. The Staff would still be required to provide expertise.	Low

Source: EV Blueprint Team

8.0 PEV-Only Tariffs

The recent increase in the popularity of PEVs has prompted concerns that the current electric distribution grid may not be able to handle the spikes in household electricity consumption associated with PEVs. This spiked demand could necessitate costly upgrades to electric distribution infrastructure, and possibly even expensive increases in generation and transmission capacity.

The City wants to promote PEV adoption and the benefits it brings in consumer savings and reduced air emissions without incurring unnecessary grid upgrades. The industry literature provides strong evidence that PEV owners, on TOU rates, charge in ways that minimize harmful impacts on the electric grid. Rate structures generally include an expensive "on-peak" period centered around weekday afternoons and a cheap off-peak period that mainly covers night and early-morning hours. Some include in-between "mid-peak" period or a "super off-peak" period during the mid-morning in spring and fall when solar and wind are especially abundant and system loads are low.

Some rates are offered on a "whole house (or business)" basis, while others are "PEV-only." Customers on whole house rates have their entire household electricity consumption recorded by a single meter, so that all of their electricity usage is affected by the TOU rate structure. PEV-only rates, in contrast, require a separate meter or use of a sub-meter in the charger, and apply only to a customer's PEV charging. These rates enable customers to have TOU rates for their vehicle but not for their home or business.

PEV drivers consistently respond to TOU rates, whether they are whole house or PEV-only. However, pilot programs have shown that the response to PEV-only tariffs are significantly stronger than for whole house tariffs. In Pacific Gas & Electric's program, whole house customers used 22% of energy on peak, while PEV-only customers used only 7% on peak. Nevertheless, both rate options proved successful and will be considered by The City in this program initiative.

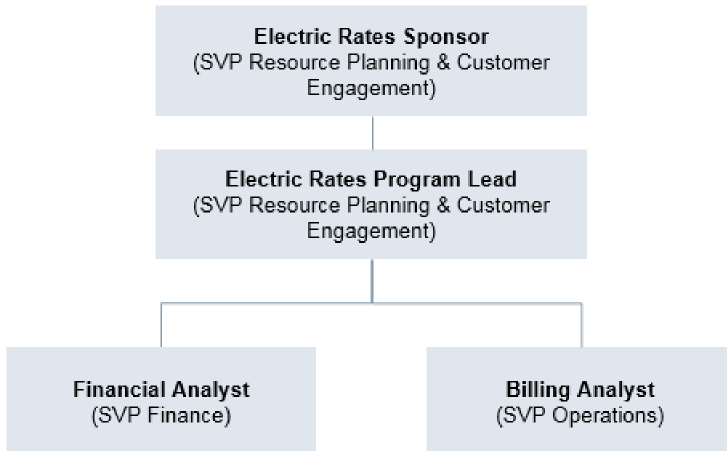
Another factor is the current design of TOU rates. SVP's residential TOU rate has a peak period from 6 am to 10 pm, and the peak to off-peak ratio is about 1.3:1. This makes it extremely unattractive for whole house rates. One reason for the long peak period is that SVP has a very high load factor, roughly 75%, which compares to load factors averaging around 57% for the electricity industry as a whole. PEV drivers could respond to, and save money on, the current TOU rate, if it were available as a PEV-only option. The other consideration is to focus on the collection of capacity costs to the hours in which they are most concentrated, which would shorten the peak period and increase the price ratio. SVP is currently evaluating this option, beyond the context of PEV charging itself.

This element of The City's overall program considers how TOU and/or PEV-only tariffs could promote PEV adoption while fairly reflecting costs and sending price signals to minimize any adverse effects on the electricity grid. It includes the design of new TOU tariffs and PEV-only tariffs and plans for implementing the billing and metering of such tariffs. It does not include actual implementation, which will require review and approval by SVP senior management once the implementation requirements and costs are determined.

Team Organization

SVP will have complete ownership of the PEV-Only Tariffs Initiative. The Electric Rates Sponsor will guide the analysis and the consideration of business and customer needs that could be met through revised TOU rates and PEV-only tariffs, specifically whether new TOU periods and PEV-only tariffs should be designed and proposed for approval. This leadership role will provide principles for use by the program lead and support in conducting the evaluation. SVP planning will lead the initiative and follow the detailed work plan provided conducting the review, identifying and evaluating alternatives, and delivering the recommended solutions to SVP Financial Management, Planning & Strategic Services, and Operations Department Staffs for implementation of their respective responsibilities (e.g., tariffs, customer education and marketing, billing, and metering). Further, the lead will report progress to the PMO. SVP Finance Staff will design rates in accordance with the recommendations resulting from the SVP Planning and Strategic Services Department's evaluation of alternatives. SVP Operations Staff will determine billing and metering requirements for revised TOU tariffs and PEV-only tariffs and recommend alternatives for implementation. Figure 110 illustrates an organizational chart for the roles within the PEV-Only Tariffs Initiative.

Figure 110: PEV-Only Tariffs, Organization Chart

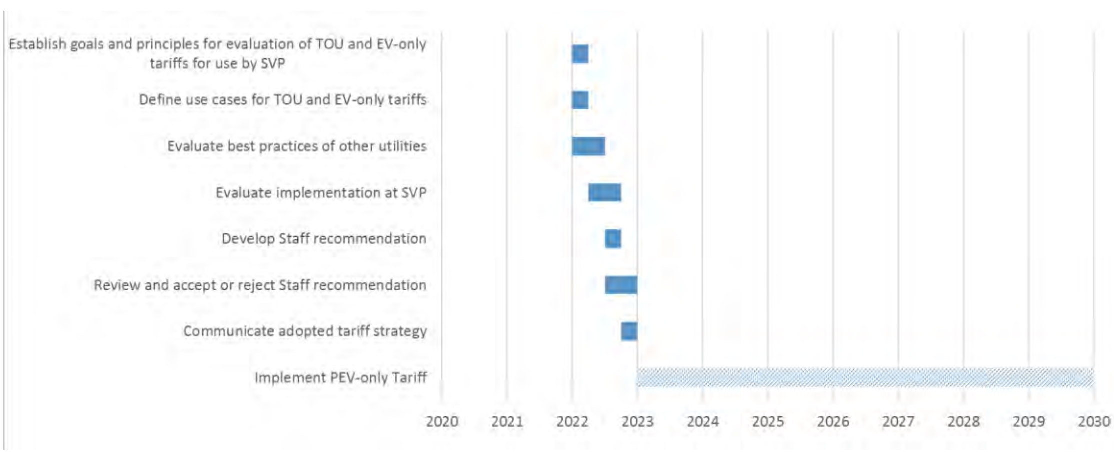


Source: EV Blueprint Team

Workplan

The PEV-Only Tariffs Initiative is planned to begin in January of 2022 and continue for one year. The PEV-only tariff decisions may be revisited five years after completion to determine if an update is required. There are eight main tasks associated with this initiative as illustrated in Figure 111 with a Gantt chart.

Figure 111: PEV-Only Tariffs Gantt Chart



Source: EV Blueprint Team

In total, four resources would be required for the PEV-Only Tariffs Initiative as shown in Table 40.

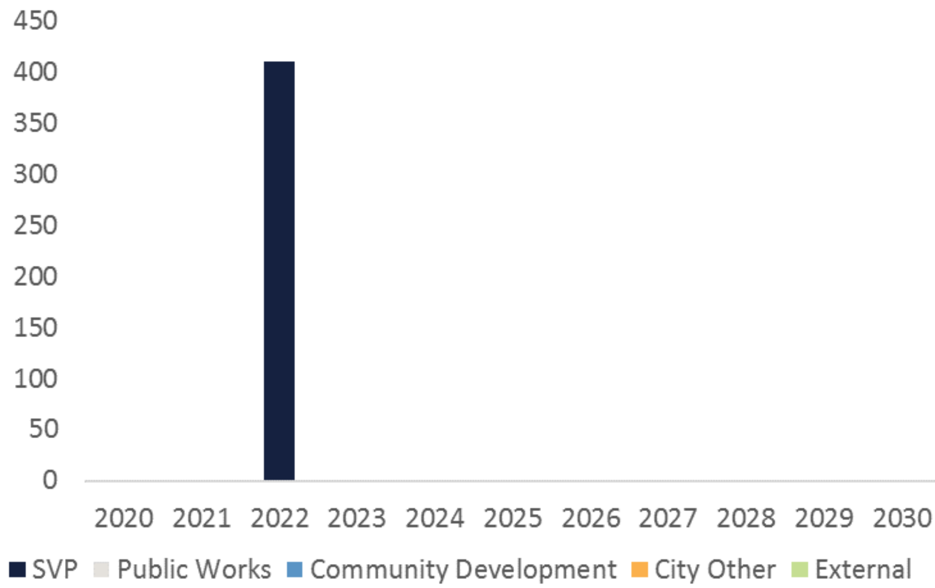
Table 40: PEV-Only Tariffs Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Silicon Valley Power	Department Leadership	2	2 to 3	68
Silicon Valley Power	Department Leadership	4	3 to 4	187
Silicon Valley Power	Staff	2	2 to 4	78
Silicon Valley Power	Staff	2	2 to 4	78

Source: EV Blueprint

Figure 112 shows each organization's total hourly requirements on an annual basis.

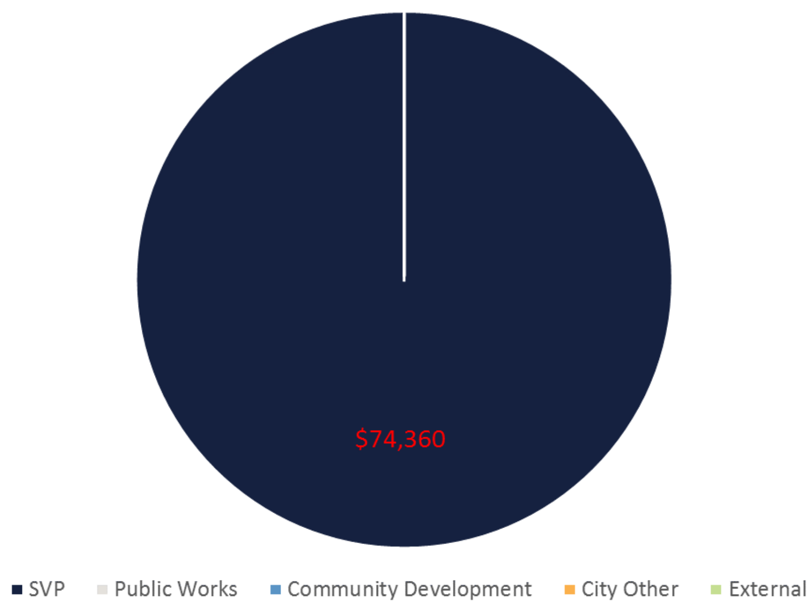
Figure 112: PEV-Only Tariffs Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the PEV-Only Tariffs Initiative budget is $74,460 and is illustrated by organization in Figure 113.

Figure 113: PEV-Only Tariffs Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The PEV-Only Tariffs Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 41.

Table 41: PEV-Only Tariffs Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
New TOU or EV-only tariffs may be introduced in the market that need to be evaluated	1	2	3	The Staff should consult with external experts regarding new TOU or EV-only tariffs. This can be done by reaching out to external consultants or other regulatory experts.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	SVP may need an external consultant to lead the effort and reduce the workload required of SVP Staff. The Staff would still be required to provide expertise.	Low
SVP Operations may make changes in its billing and metering systems	3	1	4	The Staff will need to review the changes working closely with SVP Operations Staff to determine the effect in light of the TOU and EV-only tariff strategy.	Low

Source: EV Blueprint Team

9.0 Vehicle Grid Integration Incentives

Of the many drivers which can impact the pace of PEV adoption, the creation of incentives to enable demand response and time of use charging for electric vehicles is a key component which The City can impact. One important way The City can accelerate the adoption of PEVs, while directly lowering the fuel cost for participating members, is to provide “smart charging incentives” for PEV owners and to accelerate vehicle to grid integration (VGI).

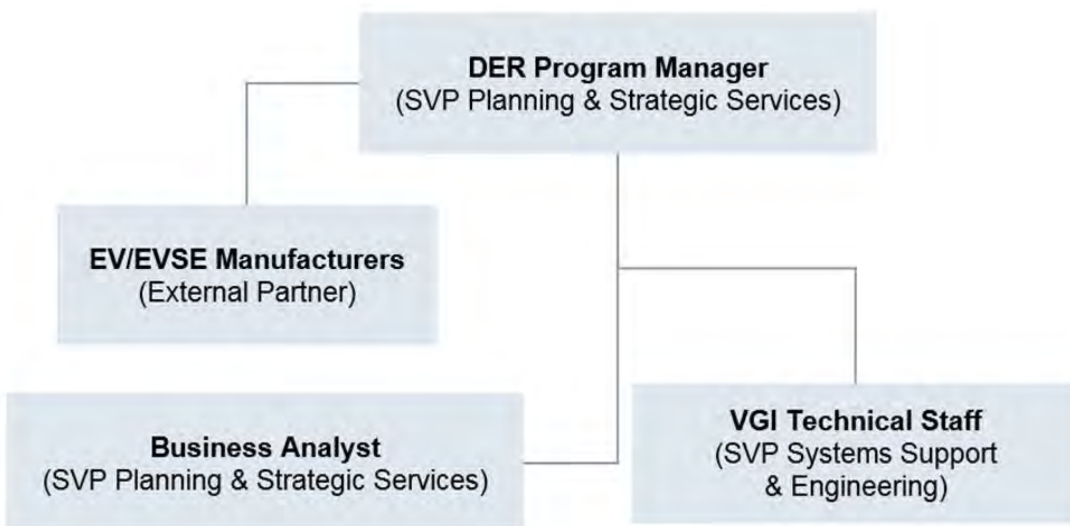
Vehicle electrification presents a great number of opportunities for utilities to enable charging strategies that can collectively contribute to a more reliable management of the power grid. VGI is enabled through smart charger technology that provides vehicle charging benefits to PEV owners while reducing risks and potentially saving costs for grid operators. This technology can include inverters, controls and chargers, or programs and products, such as time of use tariffs or bundled charging packages (i.e., TOU charging for standard outlet PEV chargers in a residential setting). Furthermore, the incentive requirements may include standards that support VGI aggregation, communication, and control requirements.

Within VGI, V1G – managed charging – refers to the capability for the power grid operator to modulate electricity charging of the vehicle through various mechanisms as discussed in the Smart Charger Rules initiative. Generally, the tools deployed are charging delay, throttling to draw more or less electricity and/or switching load completely on or off. A less tested application, V2G, refers to the bidirectional flow of energy. V2G is not planned in this initiative. In the initiative program, The City will provide a demand response program (V1G) option for electric vehicle owners.

Team Organization

SVP will have complete ownership of the Vehicle Grid Integration Incentives Initiative. The program lead, SVP's Distributed Energy Resource Program Manager, will guide the analysis of V1G incentives, having already led the Smart Charger Rules Initiative, and report progress to the PMO. The team involved includes support staff from SVP Operations, as well as individuals from the Engineering Department in order to define the value and impact of V1G on SVP's service territory. The support roles are expected to lead the impact study analysis with feedback from external partners. The DER program manager is expected to bring together a team of strategy leaders and engineers in order to guide the review of the system impact of V1G, assess SVP's ability to monetize and implement these features, and determine what the potential market signals and pricing would be. Figure 114 illustrates an organizational chart for the roles within the Vehicle Grid Integration Incentives Initiative.

Figure 114: Vehicle Grid Integration Incentives, Organization Chart

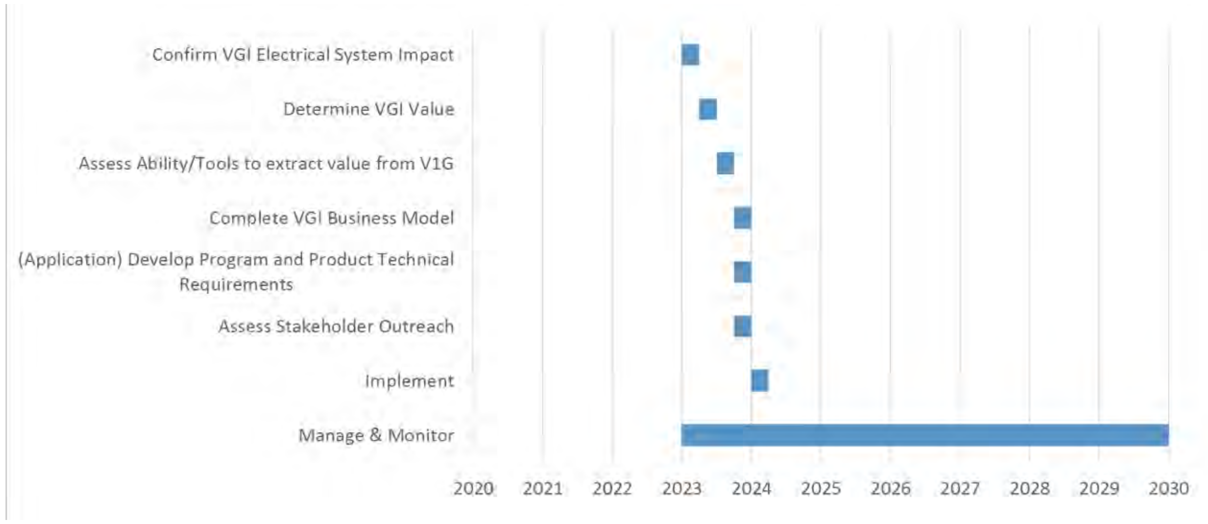


Source: EV Blueprint Team

Workplan

The Vehicle Grid Integration Incentives Initiative is planned to begin in January of 2023 and begin implementation of the incentive program one year later. The incentive is planned to be managed through 2030. There are eight main tasks associated with this initiative as illustrated in Figure 115 with a Gantt chart.

Figure 115: Vehicle Grid Integration Incentives Gantt Chart



Source: EV Blueprint Team

In total, five resources would be required for the Vehicle Grid Integration Incentives Initiative as shown in Table 42.

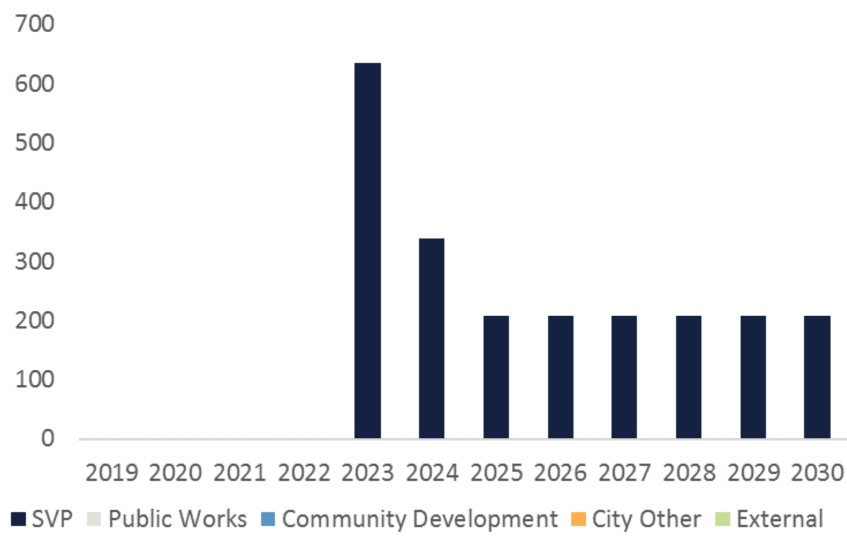
Table 42: Vehicle Grid Integration Incentives Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Silicon Valley Power	Department Leadership	32	3 to 4	1,596
Silicon Valley Power	Staff	5	4 to 8	156
Silicon Valley Power	Staff	5	4 to 8	156
Silicon Valley Power	Staff	5	4 to 8	156
Silicon Valley Power	Staff	5	4 to 8	156

Source: EV Blueprint

Figure 116 shows each organization's total hourly requirements on an annual basis.

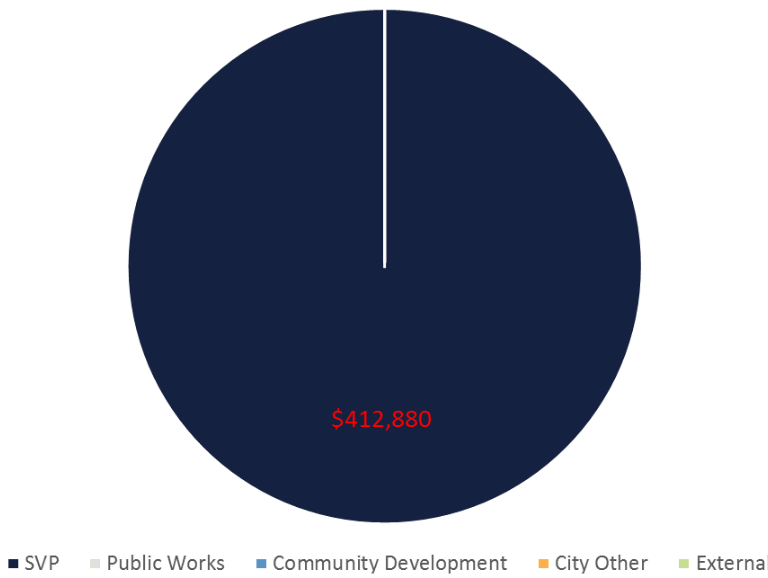
Figure 116: Vehicle Grid Integration Incentives Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Vehicle Grid Integration Incentives Initiative budget is $412,880 and is illustrated by organization in Figure 117. Note that The City has accounted for the resource requirements in this budget but not for the costs of the actual incentives since these will be determined in the initiative.

Figure 117: Vehicle Grid Integration Incentives Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The Vehicle Grid Integration Incentives Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 43.

Table 43: Vehicle Grid Integration Incentives Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
City Staff may not be able to dedicate the time needed for this project given the current workload	2	1	3	The City may need an external consultant to lead the effort and reduce the workload required of City Staff. The Staff would still be required to provide expertise.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	The City may need an external consultant to lead the effort and reduce the workload required of City Staff. The Staff would still be required to provide expertise.	Low
Long Term Funding	3	2	5	Set a months of cash limit to detect fund shortages in advance and ensure programs are staggered and prioritized.	Mid
Managing Contradicting Stakeholder Expectations	2	2	4	Ensure Sponsor is in executive position that can prioritize stakeholder demands and maintain clear communication.	Low

Source: EV Blueprint Team

10.0 Charging Data Incentives

Tracking charging consumption data throughout The City can help provide a recurring funding source for SVP to use on other program initiatives. Specifically, SVP receives LCFS credits by filing quarterly reports that comply with the California Air Resources Board (CARB) program. These credits are sold in an exchange, and these funds are to be used to comply with Title 17 of the California Code of Regulations Section 95483(e) (1) (A-D).

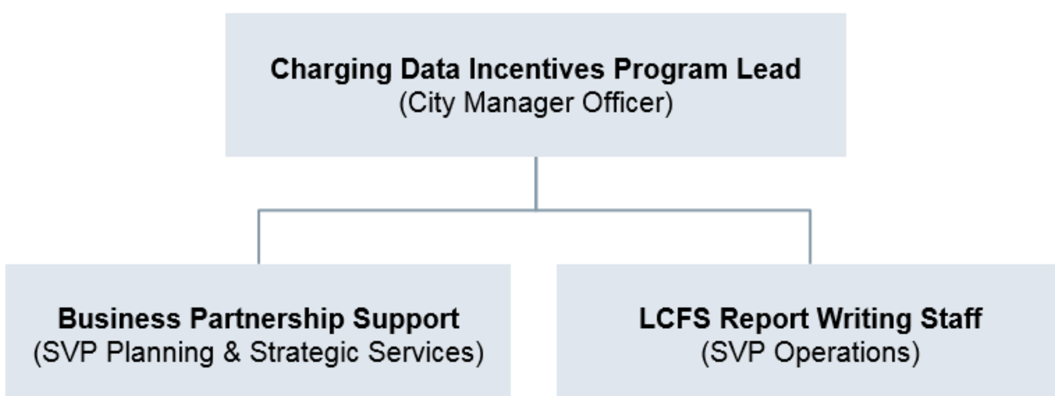
The objective of this Charging Data Incentives Initiative is to increase the number of LCFS credits that SVP can exchange for funding on other PEV Programs. Currently, SVP has first right to file charging consumption data from any chargers that The City owns or for charging from residential customers. The charge point operator or EVSP has first rights to the LCFS credits for their chargers. However, the quarterly data collection and reporting to the CARB to receive LCFS credits for their charging activity is so strenuous, that most local businesses do not bother collecting the LCFS credits: The value of the credits is less than the time required to report to CARB. In these cases, SVP can work out win-win solutions with local businesses through marketing by recognizing them as "businesses for advancement of electrification." Currently, SVP collects on average 15 LCFS credits quarterly from the 60 charge connectors owned by The City at ~$200 per credit. The time SVP puts into reporting for these credits is not cost effective. However, if the initiative can obtain the right to LCFS credits from more chargers from businesses in their city, then this method of funding would greatly support future city PEV programs. To put this into perspective, SVP also receives ~1,000 LCFS credits quarterly based on the PEVs registered within The City which is currently the main source of PEV program funding.

SVP also has first rights to any residential vehicle charging; however, SVP's smart meters do not have the ability to collect residential charging information. SVP would need to incentivize residential customers to share their data quarterly or to let SVP install devices on their chargers to submit data directly to SVP – both of which are not easy to accomplish, and the resulting credit value may not be worth the cost of the program. One major risk to this program is the ability for CARB to update and change rules to the LCFS program, as the LCFS program rules are constantly evolving. This program will require involvement of the City's Public Works Department as The City has just recently decided that owning and operating chargers will fall under the Public Works responsibility. SVP will still be responsible for collecting/providing data, and for recommending technology that maintains a reliable grid.

Team Organization

The City Manager's Office will lead this Charging Data Incentives Initiative as it will support funding of other blueprint program initiatives. SVP will have multiple roles within the initiative to support. The program lead will follow the detailed work plan conducting the review, identifying and evaluating improvement alternatives, establishing process linkages to data reporting technologies and procedures from various stakeholders - aligning customer facing programs. Further, the lead will report progress to the PMO. They are also responsible for implementing any agreed process and/or documentation improvements and communicating the revised process to other relevant stakeholders at large. The LCFS report writing staff will support the defining of process related interfaces and will focus on the efficiency of collecting consumption data from numerous customers. They will also have to evaluate customers for business model development and a market rollout strategy. The business partnership support will be defining, implementing, and communicating with customers to sign up for the win-win program. Figure 118 illustrates an organizational chart for the roles within the Charging Data Incentives Initiative.

Figure 118: Charging Data Incentives, Organization Chart

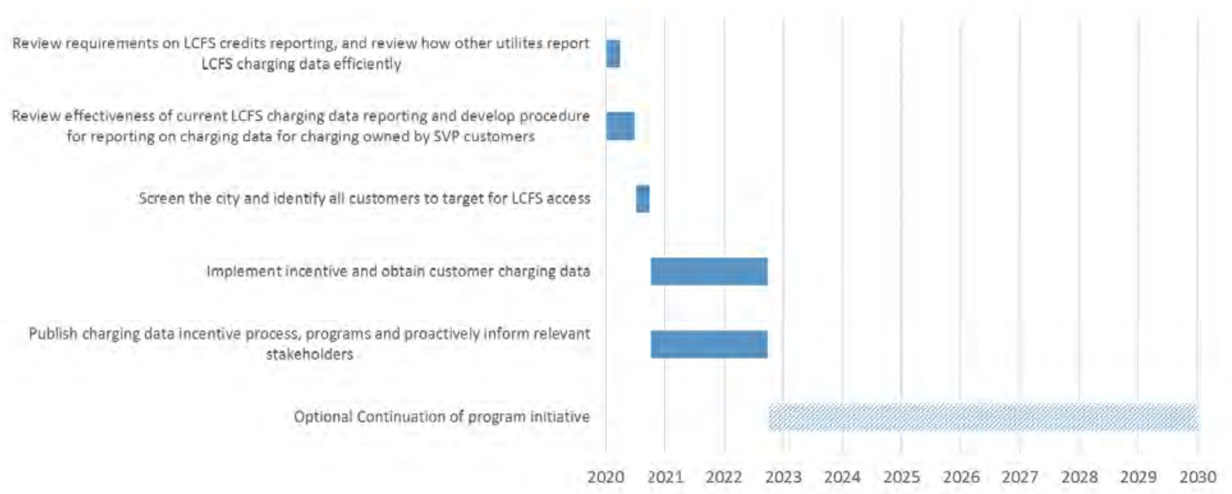


Source: EV Blueprint Team

Workplan

The Charging Data Incentives Initiative is planned to begin January 2020 and be ready to be implemented by October 2020. Two years of implementation and acquiring customers to partner with will take place through October 2020. Then, The City can decide whether to continue with the program incentive through 2030. There are six main tasks associated with this initiative as illustrated in Figure 119 with a Gantt chart.

Figure 119: Charging Data Incentives Gantt Chart



Source: EV Blueprint Team

In total, four resources would be required for the Charging Data Incentives Initiative as shown in Table 44.

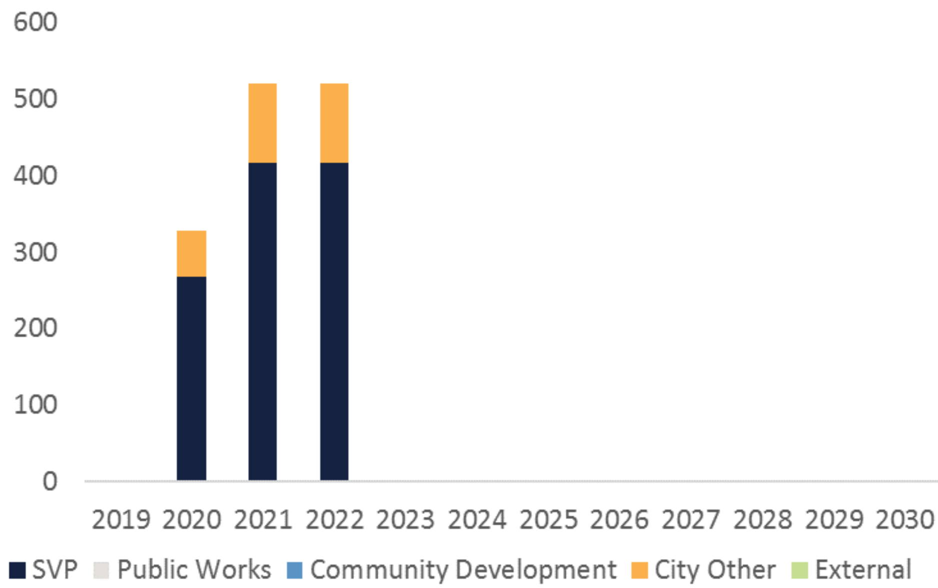
Table 44: Charging Data Incentives Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
City Manager's Office	Department Leadership	12	3	268
Silicon Valley Power	Staff	12	2 to 4	297
Silicon Valley Power	Staff	12	2 to 4	296
Silicon Valley Power	Staff	10	4	507

Source: EV Blueprint

Figure 120 shows each organization's total hourly requirements on an annual basis.

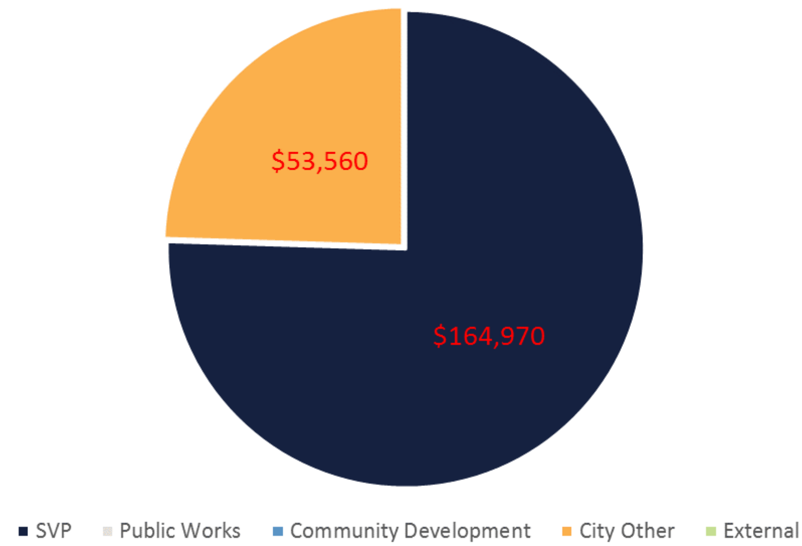
Figure 120: Charging Data Incentives Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Charging Data Incentives Initiative budget is $218,530 and is illustrated by organization in Figure 121. Note that The City will require additional funding to continue the initiative beyond 2022.

Figure 121: Charging Data Incentives Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The Charging Data Incentives Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 45.

Table 45: Charging Data Incentives Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
The California Air Resource Board (CARB) could stop the program or incentivizing the reporting of LCFS credits	3	1	4	Besides alignment and clear communication to relevant regulatory bodies only minimal influence is possible.	Mid
Establishing the processes, communication procedures, metering technologies and gathering of required data, including their adaption and education of stakeholders could require more time/effort than the anticipated value	2	1	3	Specific measures should be defined to track effort and value in order to ensure overall feasibility of the program/process changes. Remedial actions throughout the execution could be triggers if required.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	The utility may need an external consultant to lead the effort, provide subject matter expertise, and reduce the workload required of internal Staff. The Staff would still be required to provide business insights.	Low

Source: EV Blueprint Team

11.0 EVSE Rebates

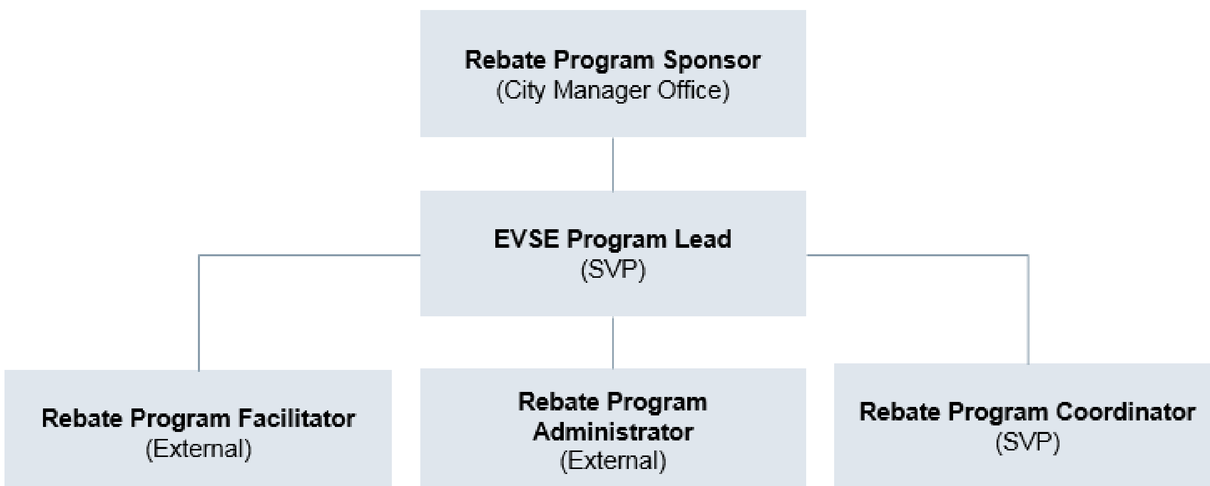
Of the many drivers which can impact the pace of PEV adoption, the availability of Level 2 (L2) electric vehicle chargers is key and one which The City can directly impact. While the PEV industry has continued to expand across the U.S., widespread adoption of PEVs has been slowed by the lack of EVSE. Easy access to chargers is necessary to help provide comfort to consumers considering an PEV. Providing rebates to commercial facilities willing to host EVSE on site is one important way The City can accelerate the development of chargers, while lowering the cost and business risk placed on a site host. A rebate program for L2 chargers will help expedite the deployment of charging infrastructure, and thus the adoption of electric vehicles. It is important to note that this rebate program is different from the existing rebate currently offered by SVP, as it goes beyond targeting homes, multi-family housing, schools, and non-profit facilities to target commercial facilities with greater public access.

In this EVSE Rebates Initiative, The City will review implementing a program aimed at L2 chargers at commercial facilities. The intent is to provide a rebate option for host sites looking to procure chargers and increase the adoption of PEVs in The City.

Team Organization

The team involved in defining, managing and implementing the EVSE Rebates Initiative in The City will include SVP resources and external parties. The program is designed around four core roles: an EVSE Program Lead and Rebate Program Coordinator (both from the SVP Planning & Strategic Services group), a Rebate Program Facilitator, and a Rebate Program Administrator. The team also includes an Rebate Program Sponsor, who will be the internal champion at SVP and who will dedicate the resources to complete this program. The EVSE Program Lead and Rebate Program Coordinator are expected to guide the review and design of the rebate program, and report progress to the PMO. The Rebate Program Coordinator will support all reporting and communications to stakeholders involved, while supporting the EVSE Program Lead in evaluating the performance of existing rebate programs, reviewing existing rebate programs implemented by other municipalities, and contributing to the design and documentation of the new program. The external resources brought on will be used to manage the rebate payments and platform for SVP, and to help in managing the program through implementation. At present, a company such as the Center for Sustainable Energy, seems like a viable option to manage the supporting rebate system. Figure 122 illustrates an organizational chart for the roles within the EVSE Rebates Initiative.

Figure 122: EVSE Rebates, Organization Chart

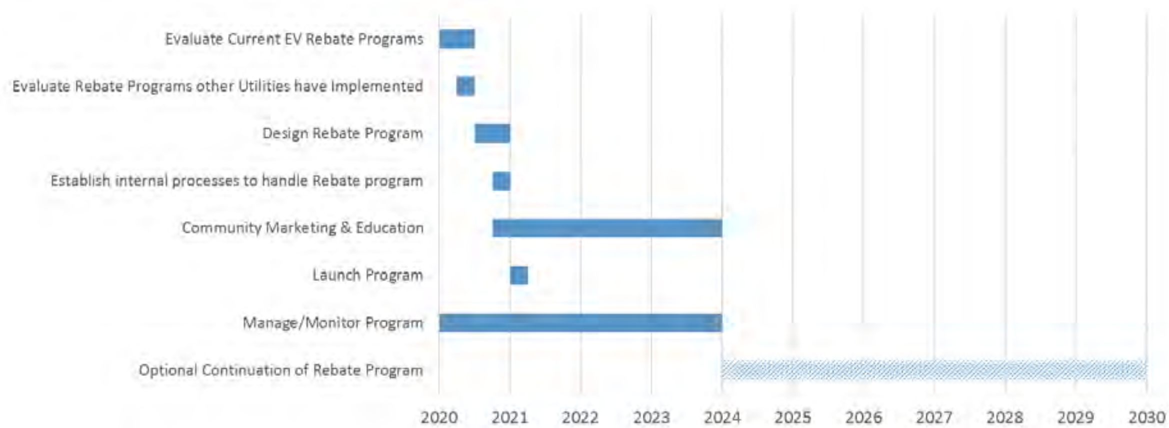


Source: EV Blueprint Team

Workplan

The EVSE Rebates Initiative workplan consists of evaluating the current rebate program aimed at residential customers and existing rebate programs across the U.S. in order to develop SVP's approach for the expanded rebate program. All workstreams are set to begin at the start of 2020, with much of the program design being completed by 2021, which is expected to coincide with the launch of the rebate program. It is currently assumed that the program will provide $1,000,000 in total incentives over the life of the rebate program. However, this incentives budget is subject to approval. Furthermore, Figure 123 depicts that The City will reevaluate the continuation of this initiative past 2023 through 2030. The workplan is only budgeted through 2023. There are seven main tasks associated with this initiative as illustrated in Figure 123 with a Gantt chart.

Figure 123: EVSE Rebates Gantt Chart



Source: EV Blueprint Team

In total, five resources would be required for the EVSE Rebates Initiative as shown in Table 46.

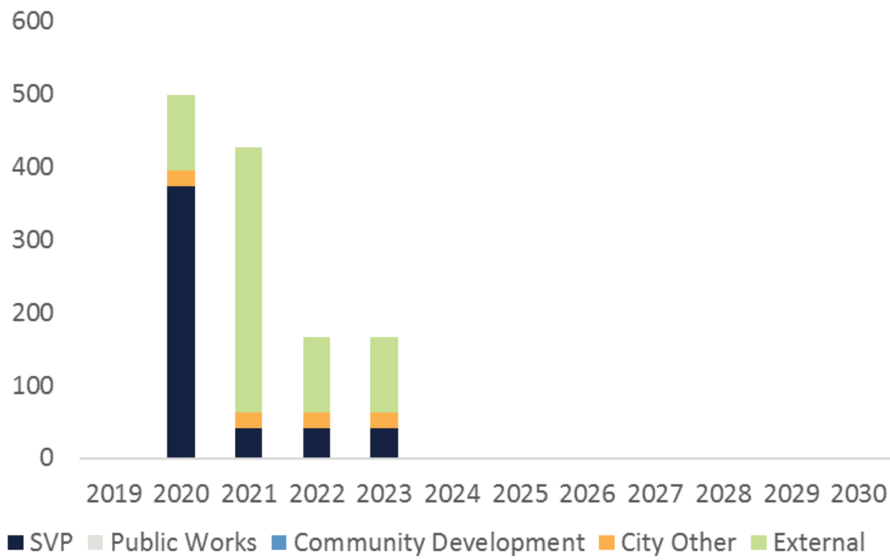
Table 46: EVSE Rebates Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
City Manager's Office	Department Leadership	16	0.5	83
Silicon Valley Power	Staff	4	2 to 6	182
Silicon Valley Power	Staff	13	2 to 4	317
External Party	Consultant	16	2	416
External Party	Partner	1	20	260

Source: EV Blueprint

Figure 124 shows each organization's total hourly requirements on an annual basis.

Figure 124: EVSE Rebates Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the EVSE Rebates Initiative budget is $1,211,900 and is illustrated by organization in Figure 125. This is broken into $211,900 in resource requirements and $1,000,000 in incentives. Note that The City will require additional funding to continue the initiative beyond 2023.

Figure 125: EVSE Rebates Budget by Organization, $

Source: EV Blueprint Team

Risks/Mitigations

The EVSE Rebates Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 47.

Table 47: EVSE Rebates Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
City Staff may not be able to dedicate the time needed for this project given the current workload	2	1	3	The City may need an external consultant to lead the effort and reduce the workload required of City Staff. The Staff would still be required to provide expertise.	Low
The project duration needs to be shortened to provide quicker results	2	1	3	The City may need an external consultant to lead the effort and reduce the workload required of City Staff. The Staff would still be required to provide expertise.	Low
Long Term Funding	3	2	5	Set a months of cash limit to detect fund shortages in advance and ensure programs are staggered and prioritized.	Mid
Managing Contradicting Stakeholder Expectations	2	2	4	Ensure Sponsor is in executive position that can prioritize stakeholder demands and maintain clear communication.	Low

Source: EV Blueprint Team

12.0 City Fleet Electrification Plan

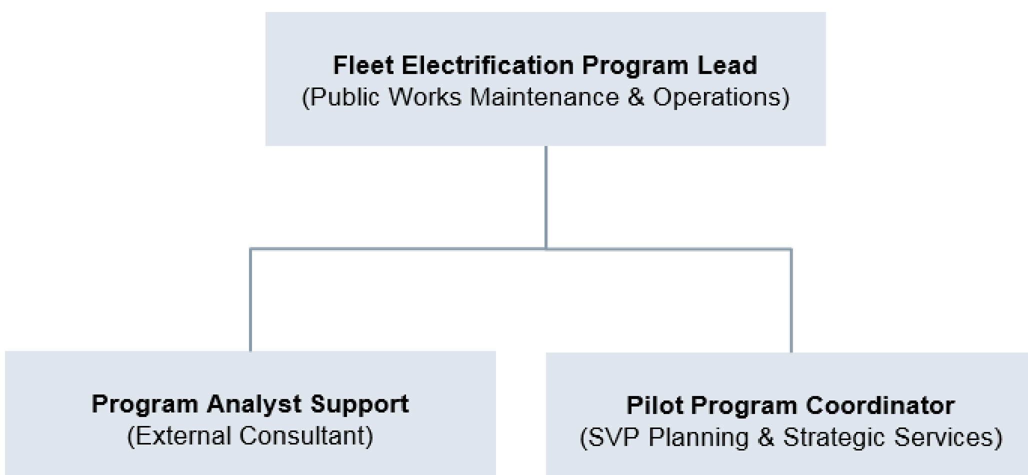
Of the 90 sedans The City currently owns, six are PEV sedans. Overall, The City owns slightly less than 500 vehicles that could be electric fuel-based by 2030. The City has a responsibility to lead the electrification of its vehicles to help set an example for the community to meet the Climate Action Plan targets. In addition, a City owned electric vehicle fleet will promote charging infrastructure development and lay the foundation for pilot programs such as vehicle grid integration and public-private partnerships.

The City Fleet Electrification Plan Initiative will identify when current vehicles are deemed ready for replacement based on age and mileage. With a replacement plan, The City can determine where charging infrastructure is needed to support new PEVs in the fleet. For vehicle types that do not have competitive PEV models in the market, key identifiers need to be determined to decide when PEV vehicle classes would be considered in the replacement process. In addition, if costs are a barrier to replacement with a PEV, incentive/funding programs need to be considered to ensure PEV adoption goals are met. Pilot programs will be considered with The City's electric vehicle fleet that can be used to help other program initiatives.

Team Organization

The Public Works Department will lead the City Fleet Electrification Plan Initiative with support from SVP. Due to the limited resource capabilities within Public Works, an external consulted is planned to be involved in the initiative as program analyst support. The program lead is expected to follow the detailed work plan overseeing the day to day operations, coordinating with the PMO, and identifying and evaluating improvement alternatives. The program lead will be responsible for reviewing all recommendations and ultimately delivering the city vehicle electrification plan that will be publicized. Additional tasks include establishing process linkages to data reporting technologies and procedures from various stakeholders and developing and aligning customer facing programs together with the team. The program analysts will be responsible for the data collection, analysis, and for providing recommendations to support The City Fleet Electrification Plan. Since there is not staffing available to support the program lead in Public Works, an external consultant will support as a subject matter expert; this consultant will also provide expertise and knowledge, and recommendations from other fleet electrification plans to help program analysts conduct analysis and program review. Lastly, SVP will have a role as the Pilot Program Coordinator. A major advantage to the city fleet electrification will be pilot testing that will provide the city with guidance on PEV readiness rules, technology, and partnerships. This role is responsible for understanding the needed pilots for The City and identifying how and when city vehicle electrification can be used for pilot programs that may involve 3rd party partners, SVP customers, and other city agencies. Figure 126 illustrates an organizational chart for the roles within the City Fleet Electrification Plan Initiative.

Figure 126: City Fleet Electrification Plan, Organization Chart

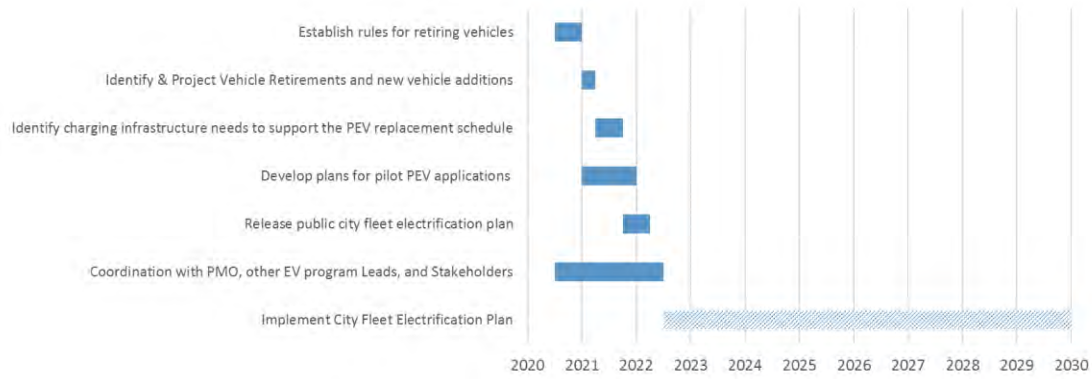


Source: EV Blueprint Team

Workplan

The City Fleet Electrification Plan Initiative is planned to begin midway through 2020 and be completed in 2022. The City Fleet Electrification Plan Initiative does not include the time or budget involved to implement the plan and procure the new fleet vehicles. It is assumed the implementation will go through 2030. There are seven main tasks associated with this initiative as illustrated in Figure 127 with a Gantt chart.

Figure 127: City Fleet Electrification Plan Gantt Chart



Source: EV Blueprint Team

In total, four resources would be required for the City Fleet Electrification Plan Initiative as shown in Figure 128. Due to resource constraints, the average hours per week has been limited; this led to an increase in time required to complete this initiative.

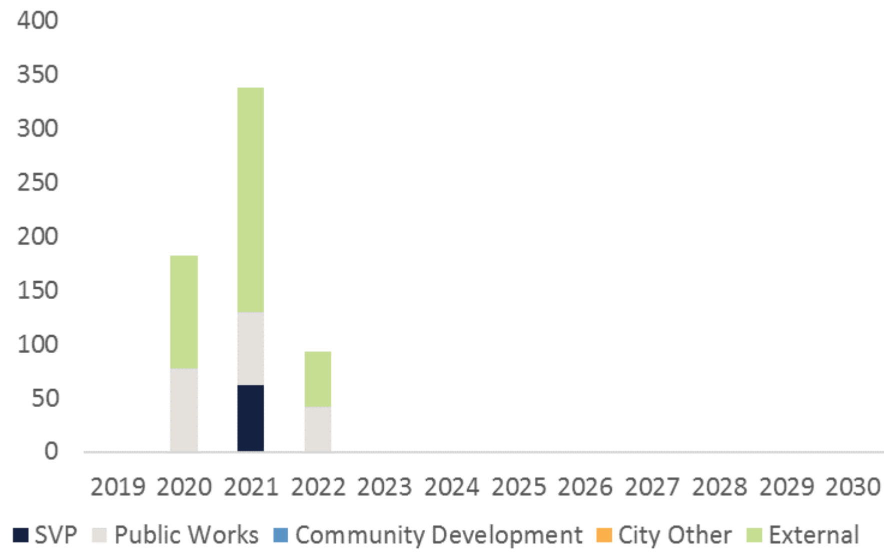
Figure 128: City Fleet Electrification Plan Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Public Works	Department Leadership	8	3	187
External Party	Consultant	8	2	182
External Party	Consultant	8	2	182
Silicon Valley Power	Staff	4	1	62

Source: EV Blueprint

Figure 129 shows each organization's total hourly requirements on an annual basis.

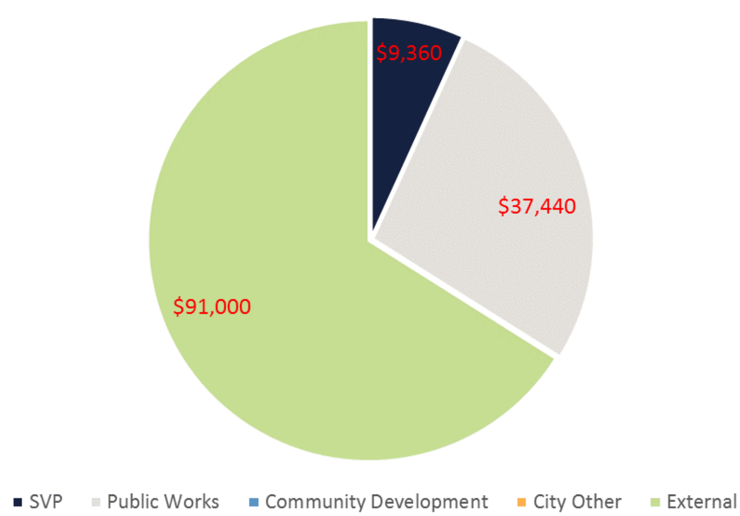
Figure 129: City Fleet Electrification Plan Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the City Fleet Electrification Plan Initiative budget is $137,800 and is illustrated by organization in Figure 130. Note that The City will require additional funding to implement the City Fleet Electrification Plan.

Figure 130: City Fleet Electrification Plan Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The City Fleet Electrification Plan Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 48.

Table 48: City Fleet Electrification Plan Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
PEV models not available to replace ICE vehicles when they are ready to be replaced	3	2	5	Forecast PEV model availability by class to incorporate this risk into the City Vehicle adoption plan. Potentially slow down the replacement of vehicle classes if there will not be a competitive PEV model available by time of replacement.	Mid
Adoption of city PEVs occurs sporadically throughout the city which will make infrastructure support difficult	3	2	5	Tag each vehicle with locations so the program analyst can identify vehicle replacements by specific locations.	Mid
PEVs may come at a price premium to ICE options at the time of replacement	2	2	4	Forecasting how PEV types will meet specified requirements over time to help determine in advance if additional funding is required to support PEV adoption at premiums. Evaluate the costs for Total Cost of Ownership rather than capital investment.	Low
City vehicles may be parked in areas that the public does not have access to	2	1	3	If infrastructure needs revenue streams for support, additional utilization from public may benefit. Identify locations that can have public access if needed in the future.	Low
City vehicles may be parked in places with public access which increases risk of unavailable charging	1	2	3	Charging demand may be too high from public which does not allow the city fleets to operate efficiently. Have a plan that can systematically give city control of charging without being in a location that prohibits public charging if this changes in the future.	Low

Source: EV Blueprint Team

13.0 Coordinated Public-Private Partnerships (P3s)

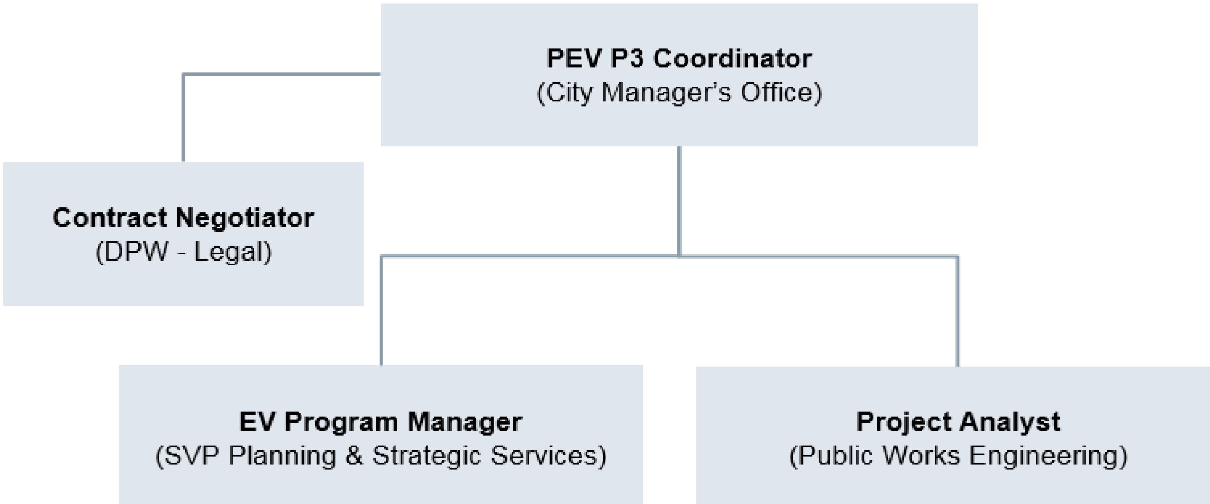
Charging infrastructure typically involves three or more stakeholders such as developers, business owners, utilities, and charge point operators as discussed in detail in the business model considerations. Charging infrastructure in many areas, especially MUD and DAC areas, do not meet commercial standards for all stakeholders involved. In fact, much of the development today is dependent upon capital incentives or programs such as the Low Carbon Fuel Standards. Meanwhile, new charging technologies are being designed and implemented in cities that may not meet the communication standards necessary to align with a city's or utility's needs. There are a wide range of charging applications that could hurt or help a city, depending on the city's ability to plan ahead.

This is why The City must work together with private stakeholders to promote safe and reliable charging infrastructure that will help meet The City's goals addressed in the EV Blueprint. The Coordinated Public-Private Partnerships (P3) Initiative team will work with the PMO and other program leads to gather technical, economical, and societal recommendations to guide discussions with private developers that will promote PEV charging development in target areas for The City. This initiative team will work closely with The City/Funded Owned Charging Initiative team as well.

Team Organization

The City Manager's Office Sustainability Director will oversee the Coordinated Public-Private Partnerships (P3) Initiative since they will require oversight among various city departments depending on the P3 opportunity and sign off on any final contracts. SVP will lead as the P3 program manager which will be responsible for maintaining a network of potential private stakeholders to engage in specific projects. While initiating P3 opportunities and sponsoring the due diligence toward signing contracts, the P3 program manager will frequently coordinate with the PMO, thus ensuring the recommendations from other Blueprint programs will be being applied to the P3 projects, in addition to focusing on increased PEV readiness specific to the EV Blueprint prioritized partnerships. Depending on the P3 being developed, the coordinator will bring in other city organizations or resources as needed. On an opportunity basis, this initiative team will have project analyst support and legal review from the Department of Public Works. The project analyst will help support technical and financial analysis on a project by project basis for each P3 opportunity, and the legal support will be brought in only when a project is ready for commercial contract negotiations to begin. The legal support will take responsibility for the project due diligence until contract or termination is met. Figure 131 illustrates an organizational chart for the roles within the Coordinated Public-Private Partnerships (P3) Initiative.

Figure 131: Coordinated Public-Private Partnerships, Organization Chart

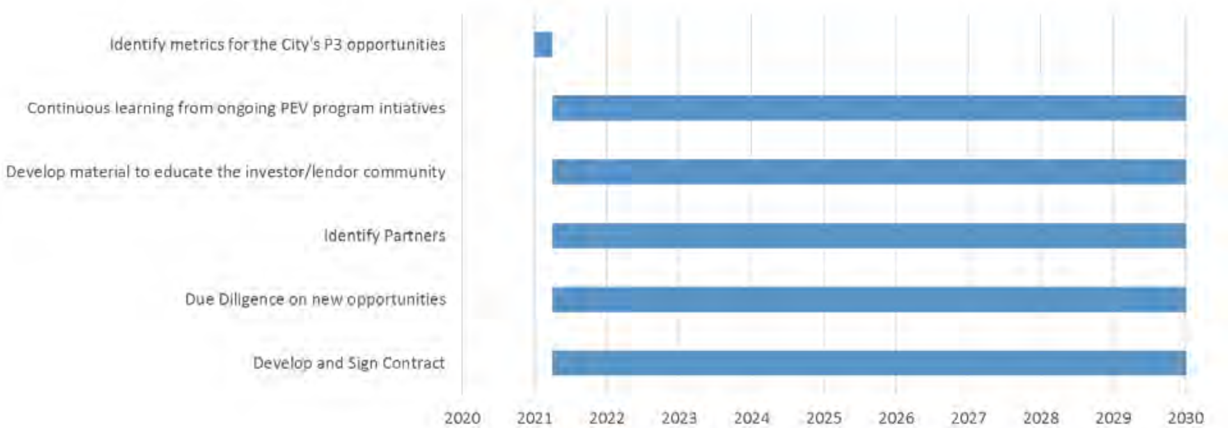


Source: EV Blueprint Team

Workplan

The Coordinated Public-Private Partnerships (P3) Initiative is planned to begin January 2021 and continue through 2030. There are six main tasks associated with this initiative as illustrated in Figure 132 with a Gantt chart.

Figure 132: Coordinated Public-Private Partnerships Gantt Chart



Source: EV Blueprint Team

In total, four resources would be required for the Coordinated Public-Private Partnerships (P3) Initiative as shown in Figure 133. Note that the project specific roles from Public Works will be sporadic as projects arise. Thus, the average hours extended through the program duration underestimate the actual weekly hours needed when there is a new opportunity.

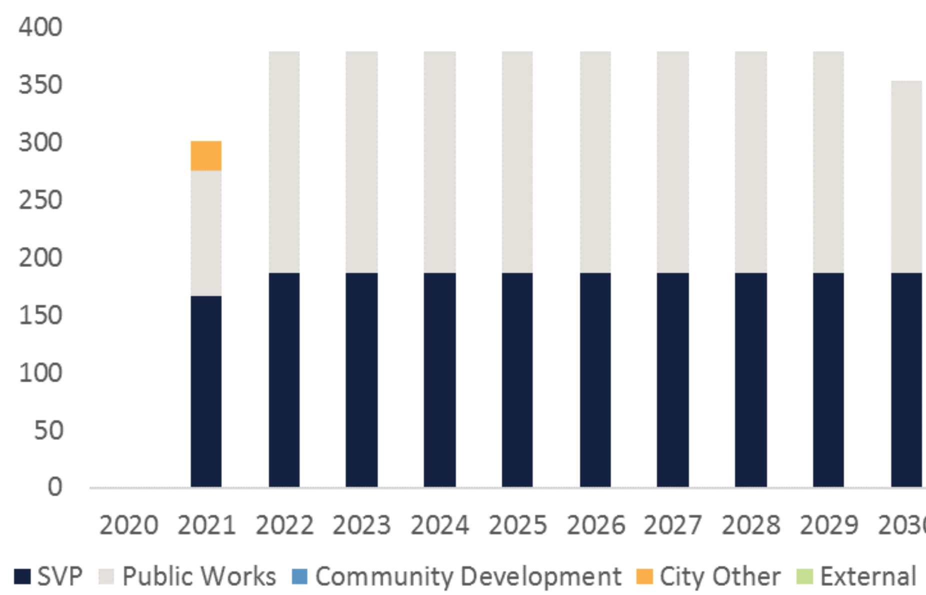
Figure 133: Coordinated Public-Private Partnerships Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
City Manager's Office	Department Leadership	1	2	26
Silicon Valley Power	Staff	40	3 to 4	1,877
Public Works	Staff	39	4	2,028
Public Works	Lawyer	39	1	608

Source: EV Blueprint

Figure 134 shows each organization's total hourly requirements on an annual basis.

Figure 134: Coordinated Public-Private Partnerships Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the Coordinated Public-Private Partnerships (P3) Initiative budget is $906,940, including $200,000 ($5,000 per quarter) budgeted for any incentives, capital, or maintenance costs associated with the partnerships. Figure 135 provides a detailed breakdown of the budget.

Figure 135: Coordinated Public-Private Partnerships Budget by Organization, $

Source: EV Blueprint Team

Risks/Mitigations

The Coordinated Public-Private Partnerships (P3) Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 49.

Table 49: Coordinated Public-Private Partnerships Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
Long Term Funding	3	2	5	Strive to focus on partnerships where the city can offer noncapital investments such as commitment to utilization from city fleets.	Mid
Coordination across all city stakeholders	3	1	4	P3 opportunities and org chart require a team spread across the City Manager's Office, Public Works, SVP, and Community Development. Approval from each resource's direct manager is required to work on the program team. This alignment helps to avoid slowdowns in negotiations which may prevent P3 from happening.	Low
Commitment of resources when a potential project arises. There will be some light constant work for the team, but for the majority of the time, lots of work will be required in short spurts as P3 opportunities arise.	2	2	4	Potentially outsource project analyst to an external consultant that can work ad hoc and meet short time demand.	Low

Source: EV Blueprint Team

14.0 City Funded/Owned Charging

The City may choose to own and operate, either on their own or in partnership, a select number of PEV chargers/connectors to support PEV adoption in Santa Clara. The purpose of the City Funded/Owned Charging Initiative is to determine if and how The City should consider adding City owned PEV chargers and how best to plan development of the stations.

The program will first work with City leadership to establish an investment thesis. The thesis will consider if charging will be public access and/or limited to City vehicles. The program will develop a pro forma investment to assess the investment and operating requirements, the risks of owning PEV charging, and the limited conditions under which The City would consider ownership. During the process, other non-financial benefits, costs, and risks will be considered. Issues such as funding access, ongoing operations and maintenance, liability, insurance coverage, etc. will be considered. The program will also consider alternative funding mechanisms in the form of grants, bonds, and loans. A key City decision will be whether or not The City is willing and able to partner on PEV charger development. An EVSE partner could fund development with The City as an anchor tenant receiving service at favorable rates, while The City and developer earn returns through public sales. The program will present its analysis and findings to the appropriate City leadership for educational and decision-making purposes.

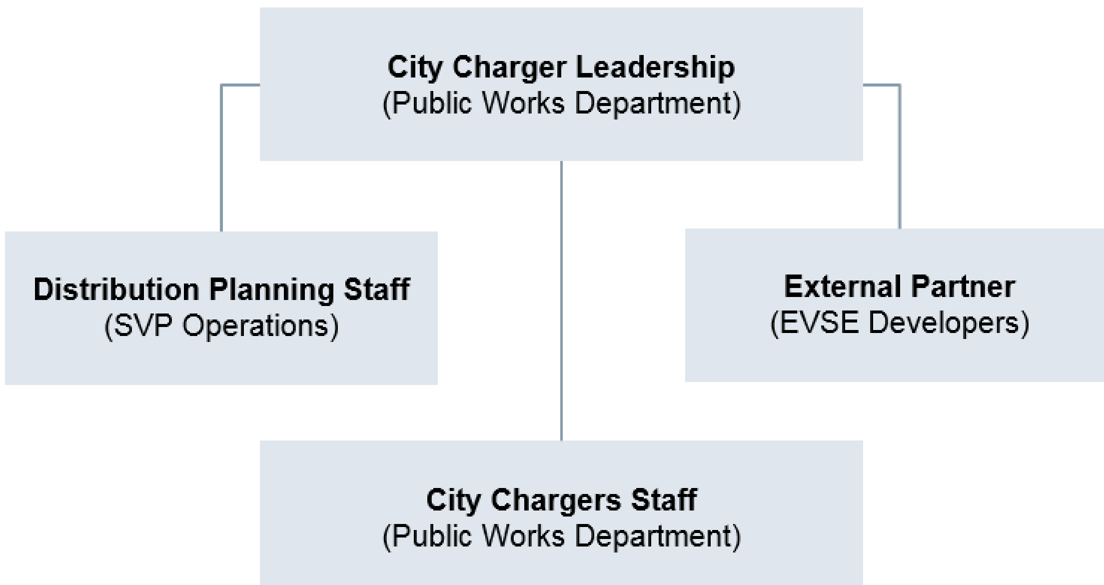
With City approval, and business structures and funding limits and interests understood, the program will craft a PEV charging development plan. The plan will address such issues as how many stations should be built, where, and when.

Team Organization

The Public Works Department will take ownership of the City Funded/Owned Charging Initiative with support from SVP. The program lead is expected to guide the consideration of City owned EVSE equipment. The City Charger Leadership will provide staff guidance, report progress to the

PMO and City Leadership as needed, and ensure appropriate stakeholders are engaged. The City Charger Staff will follow the detailed work plan provided, determining under what conditions The City might own PEV chargers. The staff will also evaluate typical station economics and key issues (i.e., liability, etc.) that The City may need to address in order to own PEV chargers. SVP's Distribution Planning Staff will review available capacity and potential interconnection issues at potential charging sites as needed. Should The City choose to consider developing EVSE in partnership with a qualified EVSE developer, a representative of one such firm should contribute development insight to the program. Figure 136 illustrates an organizational chart for the roles within the City Funded/Owned Charging Initiative.

Figure 136: City Funded/Owned Charging, Organization Chart

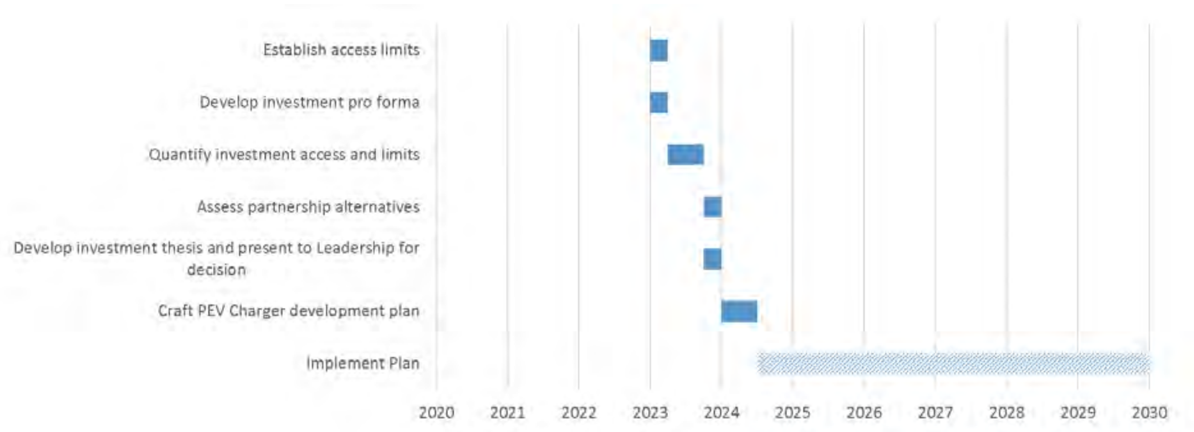


Source: EV Blueprint Team

Workplan

The City Funded/Owned Charging Initiative workplan is set to begin at the start of 2023 and end in July 2024. Note that this workplan is to plan EVSE funding/ownership. There are seven main tasks associated with this initiative as illustrated in Figure 137 with a Gantt chart.

Figure 137: City Funded/Owned Charging Gantt Chart



Source: EV Blueprint Team

In total, four resources would be required for the City Funded/Owned Charging Initiative as shown in Table 50.

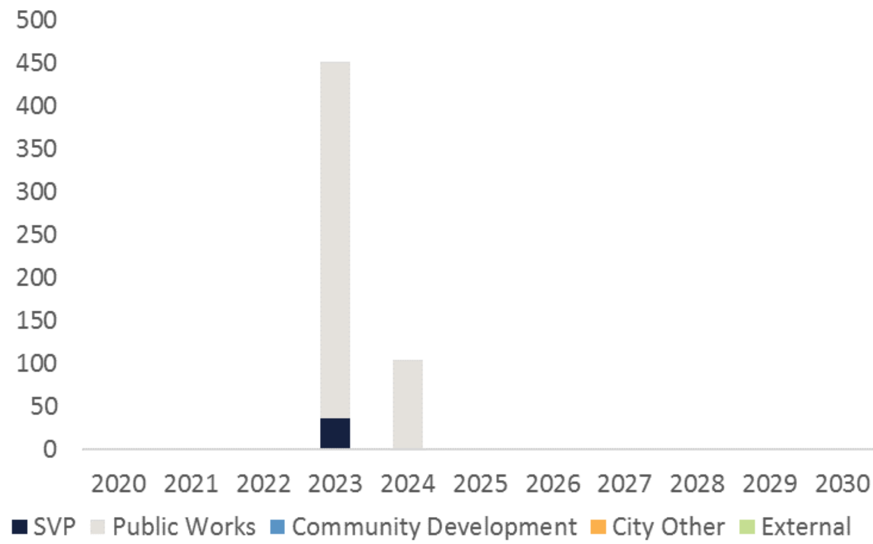
Table 50: City Funded/Owned Charging Resource Requirements

Organization	Resource Level	# of Quarters	Avg Hours per Week	Total Hours
Public Works	Department Leadership	3	2	52
Public Works	Staff	6	2 to 6	234
Public Works	Staff	6	2 to 4	234
Silicon Valley Power	Staff	2	1 to 2	36

Source: EV Blueprint

Figure 138 shows each organization's total hourly requirements on an annual basis.

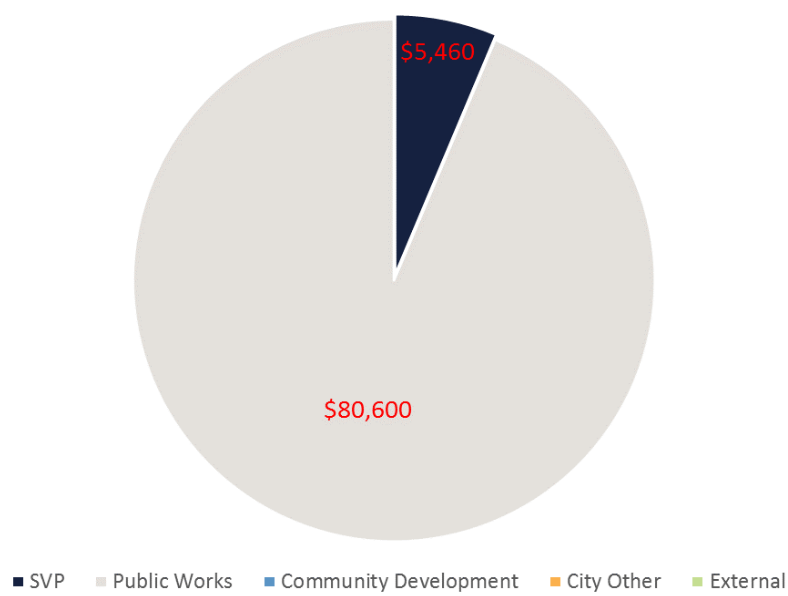
Figure 138: City Funded/Owned Charging Annual Resource Requirements, # of hours



Source: EV Blueprint Team

Overall, the City Funded/Owned Charging Initiative budget is $86,060 and is illustrated by organization in Figure 139. Note that The City will require additional funding to fund and own chargers.

Figure 139: City Funded/Owned Charging Budget by Organization, $



Source: EV Blueprint Team

Risks/Mitigations

The City Funded/Owned Charging Initiative has risks that should be considered during implementation. The EV Blueprint Team developed a risk matrix to identify the impact and frequency of each risk on a number scale: Low – 1, Mid – 2, and High – 3. Together, the sum of the impact and frequency for each risk established the risk assessment: Low – 1 to 2, Mid – 3 to 4, and High – 5 to 6. Mitigation plans are highlighted with a corresponding risk assessment in Table 51.

Table 51: City Funded/Owned Charging Risk Matrix

Risk	Impact	Frequency	Assessment Without Mitigation	Mitigation Plan	Assessment with Mitigations
Time to get City inputs to investment thesis	3	1	4	Identify key stakeholders and their concerns/ positions. Educate them on the potential impacts of City owned EV charging. Clearly define the ask and ask for as little as needed to make inputs easy.	Low
Time for City Leadership to reach decisions	3	1	4	Identify and map positions of key stakeholders and influencers. Let them know what decision will need to be made, its potential import, and when it will need to be made. Educate.	Mid

Source: EV Blueprint Team

CHAPTER 6: Conclusion

The City of Santa Clara has and will derive considerable benefit from development of the EV Blueprint. On one hand, the EV Blueprint development process united disparate City Departments, local agencies, and residents into a cohesive team focused on a common goal – reducing greenhouse gas emissions from vehicles operating in The City. While on the other hand, the EV Blueprint report and plan provided The City both direction and guidance which will enable increased access to PEV charging, thereby accelerating PEV adoption.

Siemens stakeholder guided EV-IF process combined the different perspectives of City residents, SVP, City Planning and the like with that of PEV charging developers and financiers. Customer surveys and Department workshops brought out the interests and very real concerns of a broad constituency, which proved a foundational element of the plan. Team members found common cause around The City greenhouse gas reduction goal and agreed with the structured logical approach that linked tangible program initiatives to the key drivers and barriers of PEV charging development which The City can influence. Through the process, team members learned the perspectives of other individuals and departments, and how working together, The City could develop a practical plan to combat greenhouse gas emissions.

The EV Blueprint development process also provided the team, City, and ultimately the plan itself with quantifiable research, analysis, and expertise ultimately educating all involved. In Task 2 the team develop the plan foundation through first identifying the existing PEV chargers, the expected PEV growth, and the electric system impacts of increase PEV charging and second by establishing targets and goals for EV Blueprint. In Task 3 the team conducted detailed analysis to forecast vehicle usage patterns as a means to project where and when within The City charging would be required, determined electric load impacts within City traffic zones, developed technical considerations for charger development, and quantified the potential of several PEV charging business models. Finally, in Task 4 the team developed the EV Blueprint program initiatives and total plan including goals, schedules, staff requirements, budgets, and risk/mitigation actions.

While the EV Blueprint provided significant benefit to The City and its residents, we also recognize the value Santa Clara's plan can provide other cities. The structured process and analytical learnings while customized for Santa Clara, can be employed to support development of a similar plan for other localities.